FEDERAL COURT

No. T-2030-13

BETWEEN:

NEIL ALLARD
TANYA BEEMISH
DAVID HEBERT
J.M.
SHAWN DAVEY

PLAINTIFFS

AND:

HER MAJESTY THE QUEEN IN RIGHT OF CANADA

DEFENDANTS

AFFIDAVIT OF ZACHARY WALSH

I, ZACHARY WALSH, Ph.D., R. Psych, Assistant Professor, Department of Psychology at the University of British Columbia of 3333 University Way, Kelowna, British Columbia Campus, MAKE OATH AND SAY AS FOLLOWS, THAT:

1. I am an Assistant Professor with the Department of Psychology at the University of British Columbia, Kelowna Campus, now produced and marked as Exhibit "A" to this my Affidavit is a copy of my Curriculum Vitae.

2. Now produced and marked as Exhibit "B" to this my affidavit is a copy of an article recently published in the *International Journal of Drug Policy* after a blind peer review process, entitled "Cannabis for Therapeutic Purposes: Patient Characteristics, Access and Reasons for Use" that is the culmination of research by myself and the other authors/participants.

3. Now produced and marked as Exhibit "C" to this my affidavit is another paper that I have authored with others that has also been blind peer reviewed and invited for resubmission pending minor revisions with the *International Journal of Drug Policy* and which I expect will be published soon, entitled "Cannabis for Therapeutic Purposes – Survey on Barriers to Access to Cannabis for Therapeutic Purposes in Canada" by myself and the other authors/participants mentioned accordingly.

4. Now produced and marked as Exhibit "D" to this my affidavit is a copy of a PowerPoint presentation entitled "Cannabis Access for Medical Purposes: Patient Characteristics, Patterns of Use and Barriers to Access". This study CAMPS is the largest study to date in Canada of medical cannabis (marihuana) consumers in Canada and was externally funded and reviewed by the UBC Institute for Healthy Living and Chronic Disease Prevention and was carried out between 2011 and 2012.

5. I believe the CAMPS survey is relatively self-explanatory by each slide or page illustrating the methods used, the demographics with respect to the individuals, the medical conditions for which cannabis has been authorized and for which unauthorized use continues, the medical condition systems indicated by the patients, the patterns of use by them, the various modes of access both authorized and unauthorized, obstacles to access including, physicians, affordability, availability and modes of access followed by a summary of the discussion engendered by these findings.

6. On the page dealing with 'affordability' in relation to access you will note that those in the lowest income groups had the most difficulty affording medicine with the graph indicating somewhere between 50% and 70% and also indicating that a large number of that group choose between obtaining their medicine and other necessities. The further graph on that page also demonstrates that those having the greatest difficulty affording their medicine are the most likely to choose between their medicine and other necessities are those in the poorest health.

7. In Exhibit "C" we define "barriers to access" as areas of poor fit between clients and services and used 5 dimensions to examine access to cannabis for therapeutic purposes, namely "accommodation, accessibility, availability, affordability and

acceptability". As indicated in the abstract summary and results, our findings revealed that it was difficult for Canadians to find a physician to support their application, that access from unauthorized sources were common with only 7% of the Respondents accessing cannabis for therapeutic purposes exclusively from authorized sources and accessibility to such therapy was associated with the presence of medical cannabis dispensaries, even though they were excluded from the regulatory regime. Access also varied by medical condition and general quality of health. Most significantly affordability was determined to be a significant barrier to access that we recommended should be addressed under future programs.

8. As indicated in Exhibit "C" an estimated 1,000,000 Canadians or 4% of those age 15 and older reported using cannabis to treat self-defined medical conditions in the previous 12 months. In 2001 the *Marihuana Medical Access Regulations (MMAR)* came into effect and we were advised that as of December 2012 there were 28,115 Canadians who had obtained authorizations under these Regulations to possess cannabis for therapeutic purposes and to obtain it from a legal source. We understood that while the uptake of the federal program has increased in recent years, its enrollment still only represents fewer than 5% of the estimated users of cannabis in Canada. This suggested to us that there were numerous barriers to access in existence which we undertook to analyze.

9. We determined in addition to authorized sources, there are medical cannabis dispensaries known as Compassion Clubs or Dispensaries that represent a parallel source of cannabis providing cannabis and related services apparently to over 40,000 patients in Canada according to the Canadian Association of Medical Cannabis Dispensaries in 2013. These dispensaries arose in Canada in 1997 in response to demand and predate the Regulations and are not officially recognized by them. In addition, apparently many Canadians access cannabis through friends, illicit self-production and the street market. Our analysis drew on the data from the largest survey of Canadians who use cannabis for therapeutic purposes, namely the *Cannabis Access for Medical Purposes Survey (CAMPS)* and we employed a Health Services analytical framework to define the concept of "access" and its relationship to patient satisfaction

and to examine barriers to access under the program. As mentioned above, we focused on five dimensions, which are summarized at page 5 of the paper and focusing on the question of "affordability" we set out that such reflected the relationship between the costs of services and products and the patient's willingness and ability to pay for them and we addressed this dimension by examining associations among income, costs associated with cannabis for therapeutic purposes and the ability to access cannabis.

10. We conducted a literature review on the barriers to access to cannabis therapy in Canada noting few studies touching on this issue and pointing to a 2005 study by the Canadian AIDS Society that found over 1/3 of the patients had applied to participate in the federal program, but with many of them describing significant barriers. Apparently 86% of respondents obtained their cannabis from illegal sources, including friend, dispensaries and unauthorized self-cultivation as well as street dealers. Only 8% had licences to produce their own and 4% had a designated grower with fewer than 2% purchasing from Health Canada. A more recent survey reported similar low levels of obtaining cannabis from Health Canada and high levels via dispensaries and licenced self-cultivation while the Respondents were generally highly satisfied with the overall federal program (page 6).

11. The results of the study commence at page 9 referring to the issue of accommodation (pages 9 and 10); accessibility (pages 10-11); availability (pages 12-14); affordability (pages 14-15); and acceptability (pages 15-16).

12. On the question of "availability" we determined that with regard to sources of cannabis almost 1/3 of the respondents reported self-producing of whom 50% were licenced to produce for personal use. Approximately 1/3 of those who self-produced reported difficulties in learning to produce. Among those who did not self-produce the most prominent reason for not producing was lack of space, expense or legal concerns. However, among self-producers the most important reason for self-producing was quality (39%), followed by price (36%), avoiding the black market (29%), selection of a specific strain of cannabis (24%) and safety (12%). Of those who reported that

someone else produced for them, 67% had designated producers who were licenced to produce for them.

13. On the question of affordability, while many applicants were charged a fee by their physicians for the service of having their application completed, it was determined that it was the actual cost of the cannabis that was the major barrier to access in terms of affordability. Among the participants who reported buying cannabis the median amount reportedly spent was $200 a month.However, 54% of the respondents reported that there were sometimes or never able to afford to buy sufficient quantity of cannabis to relieve their symptoms and approximately 1/3 reported that they often or always choose between cannabis and other necessities (e.g. food, rent, other medicines) because of lack of money. The proportions of respondents who reported that they were sometimes or never able to afford sufficient quantity of cannabis differed according to income such that it was most frequently report by the lower income group (72%) and least frequently by the higher income group (30%). We found that the frequency of reports of choosing between cannabis therapy and other necessities followed a similar pattern with the highest level amongst lower income people and the lowest level amongst higher income people. Approximately two thirds of those experiencing fair to poor general health were sometimes or never able to afford sufficient cannabis compared to half of those with better health. Those with poorer health were also nearly twice as likely to report choosing between cannabis and other necessities.

14. We discuss again the question of "affordability" at page 20 and indicate that we found further obstacles to optimal cannabis use with over ½ the respondents indicating that financial considerations interfered with their ability to treat symptoms with cannabis. Lower income individuals were the most vulnerable with approximately ½ the participants in the lowest income group reporting having to choose between cannabis and other necessities. Even 1/3 of the highest income group reported difficulties affording cannabis. Affordability appeared to disproportionately impact the most seriously ill patients so the group who reported fair to poor health were twice as likely as healthier patients to report having to choose between cannabis and other necessities. While the lowest income group was the most likely to obtain an Authorization to

Possess, it was not the cost of the Authorization but the cost of the cannabis that presented the primary barrier to affordability. Consequently we concluded that this financial strain across all income barriers demonstrated the need for developing approaches to mitigate financial barriers and integrate cannabis therapy within a subsidized medicine framework.

15. We concluded (page 24) that "affordability" of cannabis for therapeutic purposes remains a significant barrier for many Canadians and especially the most seriously ill. We note based on our information with respect to the new *Marihuana for Medical Purposes Regulations* that Canadians who use cannabis for therapeutic purposes will no longer have the cost effective option of producing their own cannabis or designating a producer and that the move to commercial Licenced Producers will increase the price of cannabis as indicated by the government's regulatory impact analysis statement regarding the new *MMPR* (Government of Canada 2012). The background paper in support of the Regulatory Impact Analysis Statement was completed by Delsys Research Group Inc. in December 2012 and is entitled "Cost Benefit Analysis of Regulatory Changes for Access to Marihuana for Medical Purposes". Now produced and marked as Exhibit "E" to this my affidavit is a copy of that final report of December 2012.

16. In summary, the government cost benefit analysis makes it clear that a major change under the new program is a projected significant price increase which will therefore significantly impact upon the patients to an even greater degree as indicated in the CAMPS survey and that data resulting therefrom with respect to "affordability" as the most significant barrier to access for the largest group.

17. I swear this Affidavit in support of an Application for an Order under s.24(1) of the *Canadian Charter of Rights and Freedoms* as the appropriate and just interim remedy, in the nature of

i. An interim constitutional exemption from ss.4,5 and 7 of the *Controlled Drugs and Substances Act* for all persons medically approved under the *Narcotic Control Regulations* C.R.C., c.1041 (*NCR*), the *MMAR* or the *MMPR*,

including those patients who have a caregiver 'person responsible' for them designated to produce for them, including an exemption for that caregiver 'person responsible' designated producer, pending trial of the merits of the action or such further Order of the court as may be necessary;

or, alternatively

ii. an interlocutory exemption/injunction preserving the provisions of the *MMAR* relating to personal production, possession, production location and storage, by a patient or designated caregiver 'person responsible for the patient' and related ancillary provisions, and if necessary, limiting the applicability of certain provisions of the *MMPR* to such patients or designated caregivers that are inconsistent with their s. 7 constitutional right under the *Charter* pending the decision of this Court on the merits of this action.

or alternatively, and together with

iii. an interim/interlocutory order in the nature of *mandamus* to compel the Defendant to process all applications, renewals and modifications to any licences pursuant to the *MMAR* in accordance with all of its provisions (other than those challenged as unconstitutional herein), notwithstanding ss.230, 233-234, 237-238, 240-243 of the *MMPR* relating to applications under the *MMAR* after September 30th, 2013 as reflected in the amended *MMAR* sections 41-48.

and such further and other relief as the court deems appropriate and just in all of the circumstances.

SWORN BEFORE ME at the City of Kelowna, in the Province of British Columbia, this 15 day of January, 2014

A Commissioner for Taking Affidavits in and for the Province of British Columbia

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EDUCATION

2008 Ph.D., Clinical Psychology
Rosalind Franklin University/ Chicago Medical School, North Chicago, IL.
Dissertation: *Psychopathy, ethnicity, SES and violence: A further examination.*
Supervisor: David S. Kosson, Ph.D.

2004 M.S., Psychology
Rosalind Franklin University/ Chicago Medical School, North Chicago, IL.
Thesis: *The impact of socioeconomic status, ethnicity, and psychopathy on recidivism in a county jail population.*
Supervisor: David S. Kosson, Ph.D.

2001 B.A. (Honours), Psychology
University of Winnipeg, Winnipeg, MB.
Thesis: *The effects of expectations of reminders and action-state orientation on prospective memory.*
Supervisors: Evelyn Schaefer, Ph.D. & Ross Broughton, Ph.D.

1997 B.Ed., English
University of Winnipeg, Winnipeg, MB.

POSTGRADUATE TRAINING

2008 - 2009 Postdoctoral Research Fellowship, Brown University, Warren Alpert Medical School, Department of Psychiatry & Human Behavior, Providence, RI.

2007 - 2008 Clinical Psychology Internship, Brown University, Clinical Psychology Training Consortium, Providence, RI.

PROFESSIONAL LICENSURE

2012 - College of Psychologists of British Columbia -
Registered Clinical Psychologist #2011

2008 - 2010 Psychological Association of Manitoba - C. Psych (Candidate)
Resigned 07/2010 to pursue licensure with College of Psychologists of British Columbia.

ORIGINAL PUBLICATIONS IN PEER-REVIEWED JOURNALS

Walsh, Z., Callaway, R., Belle-Isle, L., Capler, R., Kay, R., Lucas, P., & Holtzman, S. (*In press*). The Cannabis Access for Medical Purposes Study: Patient characteristics, reasons for use, and modes of access. *International Journal of Drug Policy*

Swogger, M.T., **Walsh, Z.,** Maisto, S.A., Conner, K.R. (*in press*). Reactive and proactive aggression and suicide attempts among criminal offenders. *Criminal Justice & Behavior*

Walsh, Z. (*in press).* Psychopathy and criminal violence: The moderating effect of ethnicity. *Law & Human Behavior*

Walsh, Z., Shea, M.T., Yen, S., Edelen, M.O., Hopwood, C.J.,Markowitz, J.C., Ansell, E.B., Morey, L.C., Grilo, C.M., Sanislow, C.A., Skodol, A.E., Gunderson, J.G., Zanarini, M.C.,McGlashan, T.H. (2012). Socioeconomic-status and mental health in a personality disorder sample: The importance of neighbourhood factors. *Journal of Personality Disorders, 26,* 1-12.

Swogger, M.T., **Walsh, Z.,** Kosson, D.S., Cashman-Brown, S., & Caine, E.D. (2012). Self-reported childhood physical abuse and perpetration of intimate partner violence: The moderating role of psychopathic traits. *Criminal Justice & Behavior, 39,* 910-922.

Swogger, M. T., **Walsh, Z.**, Homaifar, B. Y., Caine, E. D., & Conner, K. R. (2012). Predicting self- and other-directed violence among discharged psychiatric patients: The roles of anger and psychopathic traits. *Psychological Medicine, 42,* 371-379.

Swogger, M. T., Conner, K. R., **Walsh, Z.**, & Maisto, S. A. (2011). Childhood abuse and harmful substance use among male and female criminal offenders. *Addictive Behaviors, 36,* 1205-1212.

Chatav-Schonbrun, Y., **Walsh, Z.**, Stuart, G.L., & Strong, D. (2011). Marital status and treatment seeking for alcohol use disorders. *Addictive Disorders and Their Treatment*, 10, 111-122.

Yen, S., Shea, M. T., **Walsh, Z.**, Edelen, M. O., Hopwood, C. J., Markowitz, J. C., Ansell, E. B., Morey, L. C., Grilo, C. M., Sanislow, C. A., Skodol, A. E., Gunderson, J. G., Zanarini, M. C., McGlashan, T. H. (2011). Self-harm subscale of the Schedule of Nonadaptive and Adaptive Personality (SNAP): Predicting suicide attempts over 8 years of follow-up. *Journal of Clinical Psychiatry, 72,* 1522-1528

Walsh Z., Swogger, M.T., O' Connor, B.P., Stuart, G.L., Shea, M.T., & Chatav, Y. (2010*).* Psychopathy and subtypes of partner violent men and women. *Journal of Abnormal Psychology, 119,* 563-574.

Swogger, M.T., **Walsh, Z.**, Lejuez, C.J., & Kosson, D.S. (2010). Psychopathy and risk-taking among criminal offenders. *Criminal Justice and Behavior, 37,* 439-452.

Swogger, M.T., **Walsh, Z.**, Houston, R.J., Cashman-Brown, S., & Conner, K.R. (2010). Psychopathy and Axis I psychiatric disorders among criminal offenders: Relationships to impulsive and proactive aggression. *Aggressive Behavior, 36,* 45-53.

Walsh, Z., Swogger, M.T., & Kosson, D.S. (2009). Psychopathy and instrumental violence: Facet level relationships. *Journal of Personality Disorders, 23,* 416-424.

Stuart, G.L., O'Farrell, T.J., Leonard, K., Moore, T.M., Temple, J.R., Ramsey, S.E., Stout, R., Kahler, C., Bucossi, M., Andersen, S., Recupero, P., **Walsh, Z.**, Chatav Schonbrun, Y., Strong, D., Rothman, E., Rhatigan, D., & Monti, P. (2009). Examining the interface between substance misuse and intimate partner violence. *Substance Abuse: Research and Treatment, 3,* 25-29.

Swogger, M.T., **Walsh, Z.**, & Kosson, D.S. (2008). Psychopathy subtypes among African American county jail inmates. *Criminal Justice and Behavior, 35,* 1484-1499.

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Walsh, Z., Epstein, A.M., Munisamy, G., & King, A.C. (2008). The impact of depressive symptoms on the efficacy of naltrexone in smoking cessation. *Journal of Addictive Diseases, 27,* 65-72.

Swogger, M.T., **Walsh, Z.**, & Kosson, D.S. (2007) Domestic violence and psychopathic traits: Distinguishing the antisocial batterer from other antisocial offenders. *Aggressive Behavior, 33,* 253-260.

Walsh, Z., Allen, L.C., & Kosson, D.S. (2007) Beyond social deviance: Substance-specific relationships with PCL-R facets. *Journal of Personality Disorders, 21,* 273-288.

Walsh, Z., Swogger, M.T., Walsh, T., & Kosson, D.S. (2007). Psychopathy and violence: Increasing specificity. *Netherlands Journal of Psychology, 63,* 136-143.

Walsh, Z., & Kosson, D.S. (2007) Psychopathy and violence: A prospective study of the influence of socioeconomic status and ethnicity. *Law and Human Behavior, 31,* 209 -229.

Walsh, Z., & Walsh, T. (2006) The evidentiary introduction of PCL-R assessed psychopathy in U.S. courts: Extent and appropriateness. *Law and Human Behavior, 30,* 493-507.

Walsh, Z., Swogger, M.T., & Kosson, D.S. (2004) Psychopathy, IQ and violence in European American and African American county jail inmates. *Journal of Consulting and Clinical Psychology, 72,* 1165-1169.

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(underline indicates supervised student authorship)

Hare, R.D., Black, P.J., **& Walsh, Z.** (*in press*). The PCL-R: Forensic applications and limitations In R. P. Archer (Ed.). *Forensic use of clinical assessment instruments.* Mahwah, NJ: Lawrence Erlbaum.

Baker, A., Black, P.J., **& Walsh, Z** (*in press*). Deception. In Arrigo, B.A. & Golson, G. (Eds.). *Encyclopedia of Criminal Justice Ethics*. Thousand Oaks, CA: Sage Publications.

Black, P.J., **& Walsh, Z** (*in press*). Police profiling. In Arrigo, B.A. & Golson, G. (Eds.). *Encyclopedia of Criminal Justice Ethics*. Thousand Oaks, CA: Sage Publications.

Crosby, K., Hiles, M., & **Walsh, Z.** (*in press*). The war on drugs. In Arrigo, B.A. & Golson, G. (Eds.). *Encyclopedia of Criminal Justice Ethics*. Thousand Oaks, CA: Sage Publications.

Langille, J.I., Peters, L. & **Walsh, Z.** (*in press*). Violence against women and girls. In Arrigo, B.A. & Golson, G. (Eds.). *Encyclopedia of Criminal Justice Ethics*. Thousand Oaks, CA: Sage Publications.

Peters, L. & **Walsh, Z.** (*in press*). Drug courts. In Arrigo, B.A. & Golson, G. (Eds.). *Encyclopedia of Criminal Justice Ethics*. Thousand Oaks, CA: Sage Publications.

Stuart, G.L., Chatav Schonbrun, Y., & **Walsh, Z.** (2009). Treatment for substance abuse reduces intimate partner violence. DATA: *The Brown University Digest of Addiction Theory and Application, 28,* 8.

Walsh, Z., & Stuart, G.L. (2009). Antisocial Personality Disorder as a co-occurring disorder with Substance Use Disorder. In G.L. Fisher & N. A.Roget (Eds.). *Encyclopedia of Substance Abuse Prevention, Treatment, and Recovery* (92-95). Thousand Oaks, CA: Sage Publications.

Walsh, Z., & Stuart, G.L. (2009). Experimental substance use. In G.L. Fisher & N.A. Roget (Eds.), *Encyclopedia of Substance Abuse Prevention, Treatment, and Recovery* (pp. 389-391). Thousand Oaks, CA: Sage.

Walsh, Z., & Stuart, G.L. (2009). Moderation in use. In G.L. Fisher & N.A. Roget (Eds.), *Encyclopedia of Substance Abuse Prevention, Treatment, and Recovery* (pp. 554-555). Thousand Oaks, CA: Sage.

Walsh, T., **Walsh, Z.**, & Stuart, G.L. (2009). Decriminalization. In G.L. Fisher & N.A. Roget (Eds.), *Encyclopedia of Substance Abuse Prevention, Treatment, and Recovery* (pp. 263-266). Thousand Oaks, CA: Sage.

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ABSTRACTS & PRESENTATIONS (underline indicates supervised student authorship)

Walsh, Z., Swogger, M.T., & Crosby, K. (2013). *Cannabis use motives across contexts: Differences and similarities between college and correctional samples.* Poster presented at the annual Addiction Health Services Research meeting, Portland, OR.

Swogger, M.T.,Hart, E., Priddy, B., Murray, T., Erowid, F., Erowid, E. & **Walsh, Z.** (2013). *Experiences of kratom users: A qualitative analysis.* Poster presented at the annual Addiction Health Services Research meeting, Portland, OR.

Walsh, Z., Callaway, R., Belle-Isle, L., Capler, R., Kay, B., Lucas, P. & Holtzman, S. (2013). *Cannabis Access for Medical Purposes Survey: Patient Characteristics, Reasonfor Use and Modes of Access* Talk presented at Symposium of the International Cannabinoid Research Society, Vancouver, BC.

Lucas, P., Crosby, K., Hiles, M., Swogger, M. T., & **Walsh, Z.** (2013). Substance use among medical cannabis users: Substituting cannabis for alcohol and other substances. Poster presented at the 75th Annual Scientific Meeting of the College on Problems of Drug Dependence

Hiles, M., Crosby, K., Swogger, M. T., & **Walsh, Z.** (2013). Cannabis use motives and frequency of use: Combined and distinct associations with cannabis use problems. Poster presented at the 75th Annual Scientific Meeting of the College on Problems of Drug Dependence (CPDD). San Diego, CA.

Walsh, Z., Belle-Isle, L., Callaway, R., Capler, R., Kay, B., Lucas, P., Holtzman, S., Crosby, K. & Atkinson, B. (2013). *Use of Cannabis to Treat Symptoms of Anxiety and Depression: Results from a Survey of Medical Cannabis Users.* Poster presented at meeting of Multidisciplinary Association for Psychedelic Studies, Oakland, CA.

Wafler, J. M., **Walsh, Z.**, Woodworth, M., & Porter, S. (2013). *The Okanagan General Remorse Exam (OGRE): Preliminary validation.* Poster presented at the meeting of the American Psychology-Law Society, Portland, OR.

Peters, L. R., Langille, J. I., Blanco Carranza, A., Okano, M., & **Walsh, Z.** (2013). *Bidirectional Versus Unidirectional Violence: The Roles of Psychopathy and Personality.* Poster presented at the meeting of American Psychology-Law Society, Portland, OR.

Belle-Isle, L., **Walsh, Z.**, Callaway, R., Lucas, P., Capler, R., Kay, B., Stratton, T., & Holtzman, S. (2013). *Cannabis Access for Medical Purposes Survey: Preliminary Findings on Barriers to Access.* Invited talk presented at BC Ministry of Health - Health Services and Health Policy Research Priorities Meeting, Victoria, BC.

Walsh, Z., Callaway, R., Belle- Isle, L., Capler, R., Kay, R., Lucas, P., Stratton, T., Swogger, M.T. (2012). *Medical cannabis: Incentives and barriers among a Canadian sample*. Poster presented at Addiction Health Services Research Conference, New York, NY.

Walsh, Z. (2012). *One Size Does Not Fit All: Psychopathy and Subtypes of Partner Violence Perpetrators.* Invited keynote lecture at the Intimate Partner Violence: Innovations in the Field Conference, Department of Psychiatry, University of Rochester, Rochester, NY.

Erickson, K., Langille, J.I. & **Walsh, Z.** (2012). *Who's to Blame? Gender Roles and Victim Blaming in Intimate Partner Violence.* Poster presented at the meeting of Canadian Psychological Association, Halifax, NS.

Roemer, A., Crosby, K. & **Walsh, Z.** (2012). *Psychopathic Traits, Alcohol Use and Female Perpetration of Intimate Partner Violence.* Poster presented at the meeting of American Psychological Society, Chicago, IL.

Roemer, A. & **Walsh, Z.** (2012). *Where You Live Matters: The Role of Living Arrangement on Self-esteem and Hazardous Drinking Behaviors.* Poster presented the meeting of the Research Society on Alcoholism, San Francisco, CA.

Walsh, Z. & Callaway, R. (2012). *Medicine out of joint: Barriers to accessing cannabis among individuals with chronic illness*. Invited talk at UBC Institute for Healthy Living and Chronic Disease Prevention/ Interior Health Authority Partnership in Research Seminar, Kelowna, BC.

Carranza, A.B., **Walsh, Z.** & Swogger. M.T. (2012). *Self-directed Violence and IPV Perpetration: The Roles of Psychopathy and Emotion Dysregulation.* Poster presented at the Intimate Partner Violence: Innovations in the Field Conference, Department of Psychiatry, University of Rochester, Rochester, NY.

Walsh, Z. & Capler, R. (2012). *Medical Cannabis: Standards Engagement, Evaluation and Dissemination (SEED).* Invited talk at the Peter Wall Solutions Initiative Grantee Celebration, Peter Wall Institute of Advanced Studies, University of British Columbia, Vancouver, BC.

Swogger, M.T., **Walsh, Z,** Maisto, S.A. & Connor, K.R. (2011). *Harmful alcohol use moderates the link between proactive aggression and suicide attempts among criminal offenders*. Poster presented at Addiction Health Services Research Conference, Fairfax, VA.

Walsh, Z. (2011). *Psychopathy socio-economic status and criminal violence: Evidence consistent with social push.* Poster presented at the North American Correctional and Criminal Justice Psychology Conference, Toronto, ON.

Urch, G., **Walsh, Z.**, & Roemer, A., (2011). *Individual differences among perpetrators of violence against children: Negative affect and subcomponents of the psychopathic personality.* Poster presented at the conference of the Canadian Psychological Association, Toronto, ON.

Roemer, A., **Walsh, Z.**, Urch, G., & Wallace, G. (2011). *Pathways to college drinking: Gender differences in the association between parental bonds and hazardous alcohol use.* Poster presented at the conference of the Canadian Psychological Association, Toronto, ON.

Edalati, H., & **Walsh, Z.** (2011). *Psychopathy and emotional dot probe: Selective attention to happy faces.* Poster presented at the conference of the Society for the Scientific Study of Psychopathy, Montreal, PQ.

Walsh, Z., & Swogger, M. T. (2011). *Predicting self-directed and other directed violence: The roles of psychopathic traits.* Poster presented at the conference of the Society for the Scientific Study of Psychopathy, Montreal, PQ.

Langille, J. I., & **Walsh, Z.** (2011). *Psychopathy predicts intimate partner violence perpetration across gender.* Poster presented at the conference of the Society for the Scientific Study of Psychopathy, Montreal, PQ.

Urch, G., & **Walsh, Z.** (2010). *Psychopathy and violence against children: Factor level relationships.* Poster presented at the conference of the International Society for Justice Research, Banff, AB.

Walsh, Z. (2010). *Psychopathy and criminal violence – The moderating effects of ethnicity.* Talk presented at the meeting of the American Psychology and Law Society, Vancouver, BC.

Swogger, M.T., & **Walsh, Z.** (2010). *Childhood abuse and substance use consequences among male and female criminal offenders.* Poster presented at the meeting of the American Psychology and Law Society, Vancouver, BC.

Manning, J., **Walsh, Z.,** & Cioe, J. (2010). *Psychopathy, substance use and stress.* Poster presented at the meeting of the American Psychology and Law Society, Vancouver, BC.

Swogger, M. T., Conner, K. R., **Walsh, Z.**, & Caine, E. D. (2010). *Testing traits of personality disorders as moderators of treatment efficacy among criminal offenders.* Abstract published in *Clinical and Translational Science, 3,* A-077.

Swogger, M. T., **Walsh, Z.**, Cashman-Brown, S., Houston, R. J., & Conner, K. R. (2009). *Psychopathy, Axis I Disorders, and Subtypes of Aggression among Criminal Offenders.* Poster presented at the meeting of the American Psychological Association, Toronto, ON.

Walsh, Z. (2009). *The influence of ethnicity and neighborhood factors on the predictive power of psychopathy for violence: Social push or social potentiation?* Talk presented at the meeting of the Society for the Scientific Study of Psychopathy, New Orleans, LA.

Swogger, M. T., **Walsh, Z.**, & Conner, K. R. (2009). *Predicting self-directed versus other-directed violence: The roles of anger and psychopathic traits.* Poster presented at the meeting of the Society for the Scientific Study of Psychopathy, New Orleans, LA.

Walsh, Z., Swogger, M. T., Chatav, Y., & Stuart, G. L. (2009). *Alcohol use and interpersonal violence: The importance of perpetrator subtypes.* Talk presented at the meeting of the Research Society on Alcoholism, San Diego, CA.

Walsh, Z., Swogger, M.T., Chatav, Y., & Stuart, G.L. (2008). *Psychopathy and subtypes of partner violent men and women.* Poster presented at the meeting of the Association for Behavioral and Cognitive Therapy, Orlando, FL.

D'Amore, C., Cashman-Brown, S., **Walsh, Z.**, & Swogger, M. T. (2008). *Anger and psychopathic traits among inpatients at risk for suicide and violence.* Poster presented at the Collier Research Day, University of Rochester Medical Center, Rochester, NY.

King, A. C., **Walsh, Z.**, Munisamy, G., & Epstein, A. M. (2007). *The impact of depressive symptoms on the efficacy of naltrexone in smoking cessation.* Talk presented at the meeting of the American Psychosomatic Society, Budapest, Hungary.

Kosson, D. S., Allen, L., McBride, C. K., **Walsh, Z.**, Tercek, R., & Greco, J. (2007). *Preliminary evidence for negative affectivity and maladaptive emotion regulation strategies in youth with psychopathic traits.* Talk presented at the meeting of the Society for the Scientific Study of Psychopathy, St. Petersburg, FL.

Walsh, Z., & Kosson, D. S. (2007). *Psychopathy and terror management: Impact on perceptions of blue-collar and white-collar criminality.* Talk presented at the meeting of the Society for the Scientific Study of Psychopathy, St. Petersburg, FL.

Kosson, D. S., **Walsh, Z.**, & Swogger, M. T. (2007). *Psychopathy, crime, & violence: What we know and what we don't know.* Invited talk presented to the Department of Criminal Sciences, Pontificia Universidade Catolica do Rio Grande do Sul, Brazil.

Walsh, Z., Stuart, G., & Shea, M. T. (2007). *Psychopathy and intimate partner violence: The moderating effect of substance use treatment.* Poster presented at the meeting of the Association for Behavioral and Cognitive Therapy, Philadelphia, PA.

Walsh, Z., & Kosson, D. S. (2006). *Psychopathy and violence: Two factors are still better than one.* Talk presented at the meeting of the American Psychology and Law Society, St. Petersburg, FL.

Swogger, M., **Walsh, Z.**, & Kosson, D. S. (2006). *Domestic violence and psychopathic traits: Distinguishing the antisocial batterer from other antisocial offenders.* Talk presented at the meeting of American Psychology and Law Society, St. Petersburg, FL.

Walsh, Z., Allen, L. C., & Kosson, D.S. (2005). *Beyond social deviance: Substance-specific relationships with PCL-R facets.* Talk presented at the meeting of the American Psychology and the Law Society, San Diego, CA.

Walsh, Z., & Kosson, D. S. (2005). *Schematic processing in psychopathic and antisocial criminals: Mistrust, grandiosity and criminality.* Talk presented at the meeting of the Society for the Scientific Study of Psychopathy, Vancouver, BC.

Walsh, Z., Brook, M., & Kosson, D. S. (2005). *Psychopathy and violence: Two factors are still better than one.* Poster presented at the meeting of the Society for the Scientific Study of Psychopathy, Vancouver, BC.

Munisamy, G., Epstein, A. M., **Walsh, Z.**, & King, A. C. (2005). *Higher sensation seeking predicts smoking relapse.* Poster presented at the meeting of the Society of Behavioral Medicine, Boston, MA.

Walsh, Z., Swogger, M. T., & Kosson, D. S. (2004). *Psychopathy, depression and violence: The moderating role of rumination.* Poster presented at the meeting of the Society for Research in Psychopathology. St. Louis, MO.

Walsh, Z., Allen, L. C., Sullivan, E. A., & Kosson, D. S. (2004). *Beyond general social deviance: Substance-specific relationships with Psychopathy Checklist-Revised (PCL-R) facets.* Poster presented at the meeting of American Psychological Society, Chicago, IL.

Walsh, Z., & Kosson, D. S. (2004). *Psychopathy and recidivism in a county jail: The impact of ethnicity and socioeconomic status.* Poster presented at the meeting of the American Psychology and the Law Society, Scottsdale, AZ.

Swogger, M., **Walsh, Z.**, & Kosson, D. S. (2004). *Psychopathy and domestic battery: Relationship to the four-facet model.* Poster presented at the meeting of the American Psychology and Law Society, St. Petersburg, FL.

Walsh, Z., Swogger, M. T., & Kosson, D. S. (2003). *Instrumental and reactive violence in psychopathic and nonpsychopathic violent offenders*. Poster presented at the meeting of the Society for Research in Psychopathology, Toronto, ON.

Walsh, Z., Swogger, M. T., & Kosson, D. S. (2003). *Psychopathy, head injury and child abuse: Predicting violent crime.* Poster presented at the meeting of Developmental and Neurosciences Perspectives on Psychopathy, Madison, WI.

Walsh, Z., Kosson, D. S., & Sullivan, E.A. (2002). *Psychopathy, I.Q., and violence.* Poster presented at the meeting of the Society for Research in Psychopathology, San Francisco, CA.

GRANTS

Ongoing:

2013 - **Principal investigator** - *Institute for Healthy Living and Chronic Disease Prevention* (BC Interior Health Authority / University of British Columbia). Research Interest Group Grant "Medical Cannabis and Arthritis - Barriers and Pathways" $10,000. Co-Investigators: Kam Shojania, M.D., Susan Holtzman, Ph.D., Cheryl Koehn.

2013 - **Supervisor** - *Social Sciences and Humanities Research Council.* Joseph-Armand Bombardier Master's Scholarship "Examining Linguistic Cues Regarding Intimate Relationships in Psychopathic Versus Non-Psychopathic Offenders"- $17,500. Co-Supervisor Steven Porter, Student awardee: Lacy Peters.

2012 - **Principal investigator** - *Peter Wall Endowment*
Peter Wall Solutions Initiative "Medical Cannabis – Standards, Engagement, Evaluation & Dissemination (SEED)" - 3-years - $90,000 Co-Investigators: Rielle Capler, MA., Philippe Lucas, MA.

2011 - **Principal investigator** - *Social Sciences and Humanities Research Council.* Standard Operating Grant "One Size Does Not Fit All: A Prospective Multimethod Examination of Subtypes of Women and Men Involved in Intimate Partner Violence" -3-years - $117,150

Supervisor - *Social Sciences and Humanities Research Council.* Doctoral Fellowship Award "Social support needs of women involved in intimate partner violence. -3-years - $60,000. Student awardee: Jennifer I. Langille, MA

2010 - **Co-principal investigator** - *Canadian Foundation for Innovation.* Leaders Opportunity Fund "Centre for the Study of Psychology and Law" $413,285 Co-Principal Investigators: Stephen Porter, Ph.D. & Michael Woodworth, Ph.D.

Completed:

2011 - 2013 **Principal investigator** - *Institute for Healthy Living and Chronic Disease Prevention (BC Interior Health Authority / University of British Columbia).* Research Interest Group Grant "Barriers to Accessing Medical Cannabis Among Individuals with Chronic Illness" $10,000. Co-Investigators: Michael Woodworth, Ph.D., Susan Holtzman, Ph.D., Robert Calloway, Jamie Marshall.

2012 - 2013 **Co-investigator** - *Canadian Institutes of Health Research.* Planning grant "Cannabis for Therapeutic Purposes in Provincial Health Systems: A Priority Setting Workshop" $24,471. Principal investigator: Lynda G Balneaves, Ph.D.

2012 - 2012 **Principal investigator** - *Health Canada.* Drugs and Tobacco Initiatives "Targeted Prevention for Cannabis Use Among Canadian Youth - Environmental Scan and Literature Review" $7,813

2010 - 2012 **Supervisor** - *Social Sciences and Humanities Research Council.* Joseph-Armand Bombardier Master's Scholarship "Subtypes of Male and Female Partner Violence Perpetrators"- $17,500. Student awardee: Alissa Fezatte

2010-2012 **Co-investigator** - *Canadian Institutes of Health Research.* Catalyst grant "Alternative intervention for marijuana use (AIM): Addressing individual risk factors for transitions to initiation and escalation of marijuana use in early adolescence." $87,001. Principal investigator: Marvin Krank, Ph.D.

Co-investigator - *Institute for Healthy Living and Chronic Disease Prevention (BC Interior Health Authority / University of British Columbia).* Research Interest Group grant "Improving the Health and Well-Being of Men Who Have Sex With Men in the Interior of British Columbia" $10,000. Principal investigator: Susan Holtzman, Ph.D.

2008 - 2009 **Principal investigator** - *Canadian Institutes of Health Research.* Fellowship Award in Clinical Research: "Personality disorder as a moderator of treatment outcome for male and female perpetrators of partner violence." $60,00/$120,000 (Declined 2010). Supervisors: Gregory L. Stuart, Ph.D. & M. Tracie Shea, Ph.D.

HONOURS & AWARDS

2008 Internship Research Grant, Brown University

2007 Student Travel Award, Rosalind Franklin University

2006 Dissertation Award, American Academy of Forensic Psychiatry

2006 Dissertation Award, American Psychological Association

2005 Grant-in-Aid for Student Research, American Psychology and Law Society

2004 Award for Research Excellence, Rosalind Franklin University

2001 - 2004 Academic Fellowship, Rosalind Franklin University

2000 - 2001 Millennium Scholarship for Academic Excellence, Government of Canada

ACADEMIC APPOINTMENTS

2009 - Assistant professor, University of British Columbia - Okanagan, Kelowna, BC.

2008 Adjunct professor, Rhode Island College, Providence, RI.

2006 Graduate teaching assistant, Rosalind Franklin University, North Chicago, IL.

2004 - 2005 Group dynamics consultant and trainer - Tavistock Study Group, Northwestern University, Evanston, IL.

2001 Undergraduate teaching assistant, University of Winnipeg, Winnipeg, MB

Courses taught:
Drugs and Behaviour
Introduction to Psychology – Basic Processes
Introduction to Educational Psychology
Research Methods and Statistics

CLINICAL APPOINTMENTS

2008 - 2009 Research therapist - Brief Motivational Intervention for addictions and family violence, Butler Hospital, Providence, RI.

2008 - 2009 Research therapist - Cognitive Behavioral Therapy for anger and trauma, Providence Veterans Affairs Hospital, Providence, RI.

2007 - 2008 Graduate therapy intern - Cognitive Behavioral Therapy and Motivational Enhancement Therapy for addictions, Butler Hospital, Providence, RI.

2007 - 2008 Graduate therapy intern - Dialectical Behavior Therapy for women with emotion regulation difficulties, Butler Hospital, Providence, RI.

2007 - 2008 Graduate therapy intern - Pediatrics psychology, Hasbro Children's Hospital, Providence, RI.

2006 - 2007 Graduate therapy extern - Cognitive Behavioural Therapy for anxiety disorders, Clinics at Rosalind Franklin University, North Chicago, IL.

2005 - 2006 Graduate psychometrics extern - Forensic neuropsychological assessment, Isaac Ray Center, Chicago, IL.

2004 - 2005 Graduate therapy extern - Cognitive Behavioral Therapy and Motivational Enhancement for addictions, University of Chicago Hospital, Chicago, IL.

2004 - 2005 Graduate therapy extern - Dialectical Behavior Therapy for women with emotion regulation difficulties, University of Chicago Hospital, Chicago, IL / Emotion Management Program, Tinley Park, IL.

2003 - 2004 Graduate psychometrics extern - Neuropsychology, University of Chicago Hospital, Chicago, IL.

2002 - 2003 Graduate therapy extern - Mood disorders, North Chicago Veterans Affairs Hospital, North Chicago, IL.

OTHER APPOINTMENTS

2013 - Reviewer – German-Israeli Foundation for Scientific Research and Development, Young Scientist's Program Grant

2012 - Reviewer - Social Sciences and Humanities Research Council of Canada, Insight Grant Program

2012 - Member - Editorial Board, Legal and Criminological Psychology

2012 - Member - Advisory Board, Multidisciplinary Association for Psychedelic Studies (MAPS) Canada

2011 - Director - UBC Centre for the Advancement of Psychological Science and Law

2010 - Member - Board of Directors, John Howard Society of the Central and South Okanagan

2008 - 2010 Psychiatry faculty - Personality and Impulse Disorders Section, Faculty of 1000 Medicine.

2008 - 2009 Project manager - National Institute on Alcohol Abuse and Alcoholism funded R01: *Brief intervention to reduce drinking among batterers,* PI: Gregory L. Stuart, Butler Hospital, Providence, RI.

2008 - 2009 Project manager - National Institute on Alcohol Abuse and Alcoholism funded R01: *Brief alcohol intervention for violent women,* PI: Gregory L. Stuart, Butler Hospital, Providence, RI.

2007 - 2008 Graduate research intern - National Institute of Mental Health funded R01: *Collaborative longitudinal study of personality disorders,* site PI: M. Tracie Shea, Brown University, Providence, RI.

1997 - 2001 High school teacher - Manitoba School Divisions 1 & 6, Winnipeg, MB.

Ad hoc reviewer: *Addictive Behavior; Biological Psychology; Criminal Justice and Behavior*; *Current Drug Abuse Reviews; International Journal of Law and Psychiatry*; *Journal of Abnormal Child Psychology*; *Journal of Interpersonal Violence*; *Personality and Mental Health*; *Personality Disorders: Treatment, Theory and Research*; *Psychology of Addictive Behavior; Social Science and Medicine*; *Substance Abuse Treatment, Prevention and Policy; Suicide and Life Threatening Behavior; Violence Against Women*

UNIVERSITY COMMITTEES

2011 - Member, UBC IK Barber Undergraduate Research Award Selection Committee

2010 - Member, UBC Travel Award Selection Committee

2010 - Member, UBC Task Force Committee on Student Alcohol Use

2010 - Member, UBC Sessional Selection Committees

2009 - Member, UBC Clinical Psychology Graduate Committee

2009 - Member, UBC Forensic Students Research Group

2009 - Member, UBC Forensic Psychology Honours Program Selection Committee

2007 - 2008 Member, Brown University Psychology Internship Admissions Committee

2001 - 2007 Member, Rosalind Franklin University Graduate Students Association

MEMBERSHIPS IN SOCIETIES & ORGANIZATIONS

Canadian Psychological Association

Canadian Consortium for the Investigation of Cannabinoids

Physicians for Human Rights

Society for the Scientific Study of Psychopathy

Stop the Violence BC

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Research paper

Cannabis for therapeutic purposes: Patient characteristics, access, and reasons for use

This is Exhibit "B" referred to in the Affidavit of Zachary Walsh sworn before me at Kelowna, BC this 15th day of Jan 2014

A Commissioner for taking Affidavits for British Columbia

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ABSTRACT

Background: The authorized and unauthorized use of cannabis for therapeutic purposes (CTP) has increased dramatically in recent years, and physicians have called for further research to better clarify the parameters of effective and appropriate use. We report findings from a large cross-sectional study of the use of CTP in Canada and compare use across medical conditions and across authorized and unauthorized users.

Methods: We examined cannabis use history, medical conditions and symptoms, patterns of current use of CTP, modes of access and perceived effectiveness among 628 self-selected Canadians consumers of CTP. Participants were recruited from medical cannabis dispensaries and from organizations that assist users of CTP.

Results: Patients reported using cannabis to treat multiple symptoms, with sleep, pain, and anxiety being the most common. Cannabis was perceived to provide effective symptoms relief across medical conditions. Patterns of use were also consistent across medical conditions. Notable differences were observed with regard to modes of access.

Conclusion: Across medical conditions respondents reported using cannabis to effectively address diverse symptoms. Results indicate a substantial disconnect between the therapeutic use of cannabis and research on the risks and benefits of such use; particularly with regard to the anxiolytic and sedative use of cannabis. Authorized and unauthorized users exhibited few meaningful differences with regard to medical conditions and patterns of use, but faced substantial differences regarding access.

Cannabis has a long history of medical use (Abel, 1980; Earleywine, 2005; Iverson, 2008), and after decades of marginalization the therapeutic properties of cannabis and cannabis derivatives are receiving increased attention (Earleywine, 2005; Holland, 2010; Lucas, 2008). Indeed, robust and growing evidence indicates that cannabis has medical benefits for diverse conditions and an acceptable risk profile (Joy, Watson, & Benson, 2003). In response to legal recognition of the constitutional rights of Canadians to access cannabis for therapeutic purposes (CTP), the federal government enacted the *Marihuana Medical Access Regulations* and initiated a centralized program in 2001, and in 2003 Health Canada began to provide CTP to patients. This program authorizes two categories of individuals to possess cannabis for medical purposes; Category 1 includes symptoms associated with HIV/AIDS, arthritis, spinal cord injury or disease, cancer, epilepsy, or MS, whereas Category 2 includes other symptoms and conditions assessed by a physician and a specialist. Those authorized can purchase dried cannabis from Health Canada, can purchase seeds to grow cannabis, or designate a person to grow cannabis on their behalf. In addition, medical cannabis dispensaries that operate under an ambiguous legal status provide CTP and related services to over 50,000 patients across Canada (Lucas, 2008).

Despite widespread concern with the efficiency of the Health Canada program (Holland, 2010), registration has grown exponentially from under 500 registrants in 2002 to over 26,000 in 2012 (Health Canada, 2012a). National surveys indicate substantial access outside of the Health Canada program; recent estimates

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suggest that 400,000 to 1,000,000 Canadians use CTP (Health Canada, 2011). Diverse reasons for use and multiple modes of access complicate the characterization of use of CTP, and health care professionals have expressed concern regarding the dearth of information on CTP; a recent Canadian Medical Association-sponsored survey reported that over 80% of physicians wanted more information on therapeutic indications, clinical guidelines, and risks and benefits of CTP (CMA, 2012).

Several studies have examined CTP use among Canadians. A regional survey reported that approximately 2% of adults used CTP in the past year, primarily to relieve nausea and pain (Braitstein et al., 2001), and a more recent national survey estimated that one million Canadians, or 4% of those aged 15 and older, used cannabis to treat self-defined medical conditions in the previous 12 months (Adlaf, Begin, & Sawka, 2005). Studies of persons living with HIV/AIDS report rates of 15–30% use of CTP, primarily for treatment of nausea, pain, and mood-related symptoms (Belle-Isle & Hathaway, 2007; Ware, Rueda, Singer, & Kilby, 2003). Studies of patients with MS and patients with chronic pain report similar results; approximately 15% of respondents report use of CTP with high levels of perceived effectiveness for diverse symptoms including nausea, pain, and mood (Belle-Isle & Hathaway, 2007; Ware et al., 2003; Clark, Ware, Yazer, Murray, & Lynch, 2004). Studies of CTP from the US, Europe, and Australia report findings that are consistent with those of Canadian studies; CTP is perceived to be an effective treatment for symptoms including pain, nausea, and negative mood (Grotenherman & Schnelle, 2003; Harris et al., 2000; Lucas, 2012; Reiman, 2007; Reinarman, Nunberg, Lanthier, & Heddleston, 2011; Swift, Gates, & Dillon, 2005; Ware, Adams, & Guy, 2005).

In sum, patient-centered research provides evidence for the acceptability and perceived effectiveness of CTP. However, substantial knowledge gaps remain and health care professionals have explicitly called for further research to better specify the parameters for appropriate use of CTP (CMA, 2012). Indeed, to date no studies have directly compared use of CTP across medical conditions or across modes of access (i.e., authorized vs. unauthorized). In the present study we report demographic characteristics, medical conditions and symptoms, reasons for use, perceived effects, and authorized and unauthorized modes of accessing CTP among Canadians. Comparing users of CTP across symptoms and across medical conditions with regard to patterns of use, and perceived effectiveness may help direct future controlled studies of the efficacy of CTP for specific conditions, and inform the development of tailored CTP regimens. In addition, comparing authorized and unauthorized CTP users may elucidate factors that underlie patient adoption of the Canadian CTP program, and help to guide the refinement of the complex process of CTP distribution and monitoring.

Method

Design

We obtained cross-sectional data in 2011–2012 from 628 self-selected current CTP users. Participants were recruited from two contexts; *national* participants completed the survey online from the location of their choice, and *local* participants completed the survey at a cannabis dispensary in the Interior region of British Columbia (BC). This recruitment strategy was designed to allow for comparison of the relatively less controlled online *national* condition with the confirmed CTP users queried in-person in the *local* condition. A total of 702 *national* participants completed the consent form, of whom 541(77%) reported current CTP use. All 87 *local* participants who completed the consent form reported current CTP use. The *national* survey was promoted via organizations and media that serve users of CTP patients (e.g., Canadian AIDS Society, Canadian Aboriginal AIDS Network, Cannabis Culture), and by national advertisements at MC dispensaries. To preserve confidentiality, no identifying data (i.e. IP addresses) were collected for *national* participants. The *local* group was comprised of dispensary members who were either authorized to possess cannabis through Health Canada or had documented confirmation of a medical condition for which CTP is indicated. No confirmation of medical condition was provided for *national* participants; however such confirmation is required to obtain Health Canada authorization and to obtain dispensary membership. Participants in the *local* group were compensated $10 and were aided by research assistants; participants in the *national* group were not assisted or financially compensated.

Table 1
Demographics.

	CTP patients, % (*n*)	Census, %	*Z*
Male	71(443)	49	11.03[a]
Ethnicity			
White	92 (581)	80	7.52[a]
Aboriginal	7 (47)	4	3.80[a]
Age			
18–24yrs old	17 (99)	12	3.86[a]
25–34	26 (158)	16	6.84[a]
35–44	19 (115)	20	.63
45–54	24 (141)	20	2.51
55>	14 (85)	32	9.67[a]
Education			
<high School	4 (27)	15	−7.86[a]
HS Grad	37(234)	24	7.63[a]
% post secondary	58 (367)	61	−1.54
Income			
<$20,000	33 (206)	44	−5.55[a]
$20,000–39,999	26 (165)	27	−.56
$40, 000–59,999	17 (103)	15	1.43
$60,00 +	24 (146)	14	7.22[a]
Residence			
Rural	22 (137)	20	1.25
Urban	78 (485)	80	−1.25

Note: *Z*=One sample *Z-test* for proportions, comparing medical cannabis users to values from the 2006 Canadian Census (Statistics Canada, 2006).
[a] $p < .01$.

The survey was designed to be completed in less than one hour, and consisted of a total of 414 adaptive questions administered online without forced response. The survey was organized hierarchically such that many items were contingent on prior responses; as a result, respondents were presented with diverse item sets and response rates for specific items, and total response times varied accordingly. The survey was developed based on previous research, and on consultations with a community research board comprised of CTP patients and experts, and includes questions drawn from a prior study of CTP use (Belle-Isle & Hathaway, 2007). It queried access, perceived effectiveness, patterns and history of cannabis use, medical diagnoses and symptoms, mood, and demographics (a copy of the survey is available upon request from the first author). The study was approved by the Behavioural Research Ethics Board of the Okanagan campus of the University of British Columbia. All categorical data were compared using X^2. In light of varying response rates across items, total number of responses is reported for each analysis. Due to the large number of comparisons all significance testing was conducted at the $p < .01$ level to minimize the likelihood of interpreting chance results while maintaining power (Nakagawa, 2004).

Results

Preliminary analyses

We compared the responses of *local* participants who reported residency in the province of BC and accessing CTP via

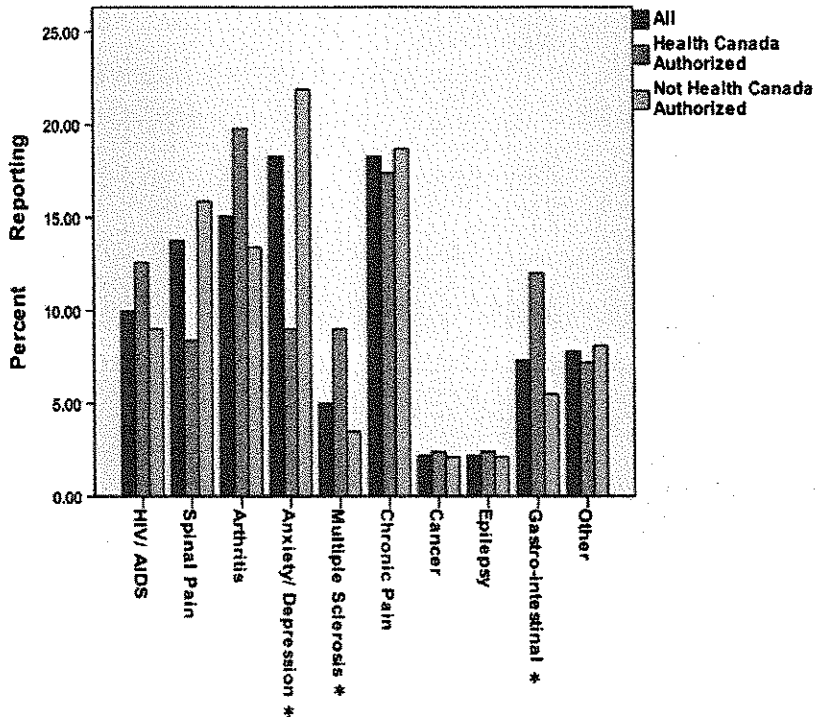

Fig. 1. Primary medical conditions treated with cannabis by authorization. *Note:* Sleep Disorders, Attention Deficit Disorder, Fibromyalgia, Hepatitis C, Parkinson's Disease, Wilson's Disease, Scleroderma, Tourette's Syndrome, and unspecified Psychotic Disorder Conditions each comprised less than 2% of the sample and were aggregated into the category 'Other'. The anxiety and mood disorders category included 35 participants who reported a primary *illness/condition* of anxiety, 34 who reported depression and 40 who reported both anxiety and depression. Comparisons of these groups indicated equivalent profiles with regard to demographic characteristics, health, and use of CTP, and were therefore aggregated for statistical analyses; $n = 502$ * = difference between proportion Health Canada Authorized and Unauthorized $p < 01$.

dispensary ($n = 63$) to *national* participants who reported BC residency and accessing CTP via dispensary ($n = 53$). Analysis indicated no differences with regard to quantity or frequency of cannabis use, and indicated substantial similarity with regard to primary medical condition; the only difference was a smaller proportion of *local* respondents reporting gastrointestinal (GI) condition as primary ($X^2 = 8.94\,(1)$, $p < .01$). This broad similarity between in-person confirmed users of CTP (i.e. *local*) and online respondents increased our confidence in the validity of online responses.

Demographics

Comparisons of the sample to values drawn from the Canadian 2006 Census of Population (Statistics Canada, 2006; Table 1) indicated that male, White, and Aboriginal participants were over-represented. The users of CTP were also younger, had a higher income, and were more likely to have completed high school. The regional distribution was consistent with participation in the Health Canada program (Health Canada, 2012b).

Medical conditions and symptoms

Participants were queried regarding a single primary *condition* treated with cannabis (Fig. 1). Participants also checked all applicable *symptoms* (Table 2) they treated with cannabis from a list. The mean number of symptoms patients endorsed treating was 6.74 ($n = 605$, SD = 3.00, Median = 6.00, Interquartile range = 4.00–8.00). Symptoms reportedly treated with CTP by fewer than 10% of the sample include high blood pressure (9%), tics (8%), regulating blood sugar (7%), seizures (6.%), bladder dyscontrol (6%) and impotence (6%). Aggregate examination across *condition* indicated that pain, anxiety, and sleep problems were the most frequently endorsed symptoms; 57% reported use to address all three symptoms, and 99% endorsed treating one or more of the three.

Symptoms treated with cannabis varied across *condition* (Table 2). Use to address pain symptoms was more prevalent among individuals whose primary conditions were pain-related (i.e., chronic spinal and non-spinal pain, arthritis). Chronic spinal pain participants were more likely to report treating muscle spasms. Participants with arthritis were more likely to report use for inflammation and ocular pressure, and less likely to report use to address anxiety and appetite. Participants who identified mood and anxiety disorders as their primary condition were more likely to use cannabis to address mental health-related symptoms (i.e., anxiety, depression, aggression, mania/psychosis), and were less likely to treat pain, inflammation, and muscle spasms. Participants who identified HIV/AIDS or GI as their primary conditions were more likely to treat symptoms of nausea and appetite, and HIV/AIDS was associated with less treatment of pain and aggression. Overall, cannabis was perceived to provide effective symptoms relief; 72% ($n = 439$) reported that CTP was *always* helpful and an additional 24% ($n = 147$) described it as *often* helpful. The proportion of participants who described CTP as *always* helpful was relatively consistent across conditions. The only difference across groups was relatively lower endorsement of *always* helpful (55%) by participants with HIV/AIDS ($X^2 = 10.04\,(1)$, $n = 593$, $p < .01$). Over half (57%, $n = 358$) of participants reported using other medications to address the symptoms they were treating with CTP. Of these, 79% ($n = 281$) described CTP as having fewer side effects than the concurrent treatment.

Use patterns

History of non-therapeutic cannabis use prior to therapeutic use was reported by 82% ($n = 441$) of participants.

Table 2
Symptoms addressed with medical cannabis by condition.

	All		Pain-spinal			Pain–nonspinal			Arthritis			Mood			HIV/AIDS			GI		
	n	%	*n*	%	X^2	*n*	%	X^2	*n*	%	X^2	*n*	%	X^2	*n*	%	X^2	*n*	%	X^2
Sleep	502	85	68	83	0.35	93	85	<.01	80	90	1.91	99	93	5.7	47	78	2.4	33	77	2.54
Pain	486	82	80	98	15.13[a]	102	94	11.56[a]	86	97	14.67[a]	56	52	81.21[a]	41	68	9.07[a]	40	93	3.62
Anxiety	463	79	65	79	0.04	85	78	0.02	57	64	12.92[a]	106	99	32.81[a]	44	73	1.05	29	67	3.34
Depression	394	67	55	67	<.01	68	62	1.16	51	57	4.24	98	92	36.26[a]	34	57	3.08	27	63	0.33
Appetite/weight	331	56	43	52	0.52	56	51	1.21	35	39	11.98[a]	61	57	0.04	46	77	11.47[a]	33	77	8.02[a]
Nausea	294	49	36	44	1.34	56	51	0.13	33	37	6.82[a]	43	40	4.86	47	78	21.71[a]	35	81	18.48[a]
Inflammation	291	49.	51	62	6.31	52	48	0.14	79	89	65.23[a]	25	23	35.23[a]	20	33	6.83[a]	25	58	1.44
Spasms	280	48	58	71	20.69[a]	53	49	0.07	50	56	3.2	23	22	35.33[a]	20	33	5.34	22	51	0.255
Headache	237	40	44	54	7.21	56	51	6.99[a]	36	40	<.01	38	36	1.18	15	25	6.4	12	28	2.9
Aggression	140	24	19	23	0.01	28	26	0.28	16	18	1.92	42	39	17.40[a]	5	8	8.75[a]	8	19	0.67
Drug Withdrawal	76	13	10	12	0.04	17	16	0.88	10	11	0.25	18	17	1.81	8	13	0.01	1	2	4.61
Ocular Pressure	68	12	11	13	0.33	11	10	0.27	19	21	9.92[a]	8	8	2.1	7	12	<.01	1	2	3.85
Mania/Psychosis	67	11	9	11	0.01	11	10	0.21	7	8	1.27	25	23	18.72[a]	4	7	1.46	5	12	<.01
Respiratory	67	11	5	6	2.62	20	18	6.5	14	16	1.99	12	11	<.01	3	5	2.68	6	14	0.31
Skin Conditions	63	11	8	10	0.08	7	6	2.54	13	15	1.7	16	15	2.51	3	5	2.26	5	12	0.04

Note: X^2 = Comparison of each groups versus aggregation of other groups.
[a] $p < .01$.

Mean age was 17.30 years ($n = 540$, SD = 7.08, Median = 16, Interquartile range = 14.00–18.00) for first use and 28.35 years ($n = 538$, SD = 11.25, Median = 25, Interquartile range = 19.00–37.00) for first therapeutic use. Individuals with and without history of non-therapeutic use did not differ with regard to demographic characteristics, or conditions and symptoms. Most participants who reported prior use reported increased use with the initiation of therapeutic use; 33% reported a large increase and 32% a small increase, whereas 7% reported a large decrease and 10% a small decrease. Aggregate analyses indicated that 40% ($n = 167$) of users fell into the modal quantity of use category of *more than 14 grams per week*, and that 42% ($n = 226$) fell in the modal frequency of use group reporting *2–3 uses per day*. Among the group that used more that 14 grams per week, the median weekly amount used was 28 grams (Interquartile range = 21–45). Comparisons of the six medical conditions that each account for 5% or more of the sample (Table 3) indicated no difference with regard to modes of use and few differences in patterns of use; a larger proportion of individuals identifying HIV/AIDS as primary condition were among the groups with lowest quantity and frequency of use, and those who identified anxiety and/or depression as primary conditions were less likely to fall in the most frequent use group. Overall health quality was also associated with frequency of use such that participants who described their overall health as *fair* or *poor* (34%, $n = 161$) were overrepresented in the most frequent use group ($X^2 = 8.31$ (1), $n = 473$, $p < .01$).

Access

Aggregate examination indicated that 32% ($n = 167$) of respondents had Health Canada authorization to possess CTP. An additional 12% ($n = 64$) had applications in process, and 3% ($n = 13$) had applied and been rejected. The proportion of authorized individuals varied across condition (Fig. 1); individuals who identified anxiety and/or depression as primary condition were less likely to be authorized ($X^2 = 13.13$ (1), $n = 502$, $p < .01$), whereas a greater proportion of MS ($X^2 = 11.08$ (1), $n = 502$, $p < .01$) and GI ($X^2 = 8.68$ (1), $n = 502$, $p < .01$.) participants were authorized. Most participants reported using more than one mode of accessing CTP; the mean number of access modalities was 1.89 ($n = 500$, SD = .88, Median = 2.00, Interquartile range = 1.00–2.00). Authorization was a determinant of access (Fig. 2): the mean number of access modalities for authorized individuals was 2.11 ($n = 162$, SD = .98, Median = 2.00, Interquartile range = 1.00–3.00) compared to 1.78 ($n = 337$, SD = .81, Median = 2.00, Interquartile range = 1.00–2.00) for unauthorized users (F (1, 497) = 16.26, $p < .01$). Authorized users were more likely to access CTP via Health Canada ($X^2 = 11.88$ (1), $n = 443$, $p < .01$), to grow for themselves ($X^2 = 31.42$ (1), $n = 493$,

Table 3
Characteristics of cannabis use by condition.

	All		Pain-spinal			Pain-nonspinal			Arthritis			Mood			HIV/AIDS			GI		
	n	%	*n*	%	X^2	*n*	%	X^2	*n*	%	X^2	*n*	%	X^2	*n*	%	X^2	*n*	%	X^2
Amount per week (Grams)																				
≤2	42	9	5	8	0.1	9	10	0.13	3	4	2.59	9	10	0.3	11	27	18.01[a]	1	3	1.68
2.1–5	60	13	8	13	<.01	11	12	0.05	10	13	0.04	11	13	<.01	5	12	<.01	0	0	5.46
5.1–9	85	18	7	11	2.44	22	24	2.81	11	15	0.63	24	28	6.81[a]	6	15	0.33	6	17	0.02
9.1–14	76	16	15	24	3.04	15	16	<.01	15	20	1.06	11	13	0.89	4	10	1.3	6	17	0.04
>14	212	45	29	45	0.01	35	38	2	46	48	0.41	32	37	2.66	15	37	1.18	22	63	5.08
Frequency of use																				
< daily	58	11	6	9	0.4	13	13	0.31	3	4	4.72	13	14	1.06	13	25	10.85[a]	2	5	1.4
1x day	71	14	7	10	0.71	16	16	0.43	12	16	0.32	17	19	2.31	8	15	0.12	1	3	4.17
2-3x	174	33	21	31	0.19	31	30	0.56	26	34	0.01	36	39	1.77	16	30	0.24	14	37	0.24
4x+	221	42	34	50	1.96	43	42	0.01	36	47	0.78	26	28	8.86[a]	16	30	3.48	21	55	2.88
Preferred mode of use																				
Smoke ($n = 513$)	293	57	35	54	0.33	62	61	0.94	41	53	0.55	48	53	0.86	35	67	2.45	24	65	0.98
Vaporize ($n = 502$)	217	43	31	49	1.05	42	43	<.01	30	39	0.67	37	41	0.3	22	44	0.01	16	43	<.01
Oral ($n = 501$)	139	28	16	26	0.13	29	30	0.21	29	39	5.25	25	26	0.1	15	31	0.22	8	22	0.75

Note: X^2 = Comparison of each groups versus aggregation of other groups.
[a] $p < .01$.

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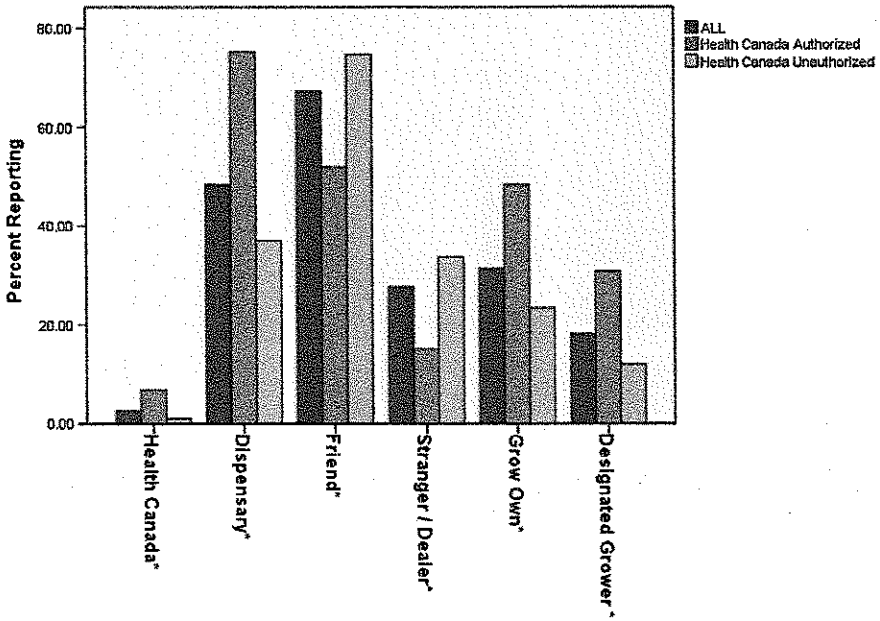

Fig. 2. Modes of Access. *Note:*. * = difference between proportion Health Canada Authorized and Unauthorized $p < 01$; $n = 498$.

$p < .01$), have a designate grow for them ($X^2 = 25.85$ (1), $n = 493$, $p < .01$) or use a dispensary ($X^2 = 54.46$ (1), $n = 444$, $p < .01$). In contrast, unauthorized users were more likely to access CTP from a friend ($X^2 = 25.46$ (1), $n = 495$, $p < .01$) or from a stranger ($X^2 = 18.69$ (1), $n = 494$, $p < .01$).

Discussion

Canadians use cannabis to treat diverse conditions and symptoms in a manner that only partially overlaps with the federally authorized program. There is considerable consistency with regard to patterns of use and reported effectiveness; nearly all respondents used cannabis to treat pain, anxiety, or sleep disturbances, and over half used it to treat all three symptoms. We also observed consistency across participants with and without histories of non-therapeutic cannabis use, which suggests that, with regard to CTP, individuals who may enjoy non-therapeutic use of cannabis were not different with regard to therapeutic application of cannabis from those participants who may have been less likely to expect extra-therapeutic benefit. The substantial minority of respondents who were federally authorized to possess cannabis exhibited few differences from unauthorized users with regard to symptoms treated and patterns of use, but differed considerably with regard to mode of access.

Most respondents reported using CTP to treat conditions that are explicitly listed within the federal program; however, a large contingent also reported use for other conditions. Comparisons of symptoms treated across conditions indicated high levels of congruence (e.g., respondents with pain-related conditions were more likely to use cannabis to address pain symptoms), but also reflected substantial consistency across conditions. Specifically, use to treat sleep disturbances, and to a lesser extent anxiety and depression, was consistently high across conditions. However, despite widespread use for anxiolytic and sedative purposes, participants who reported anxiety or depression as primary reason for CTP use were less likely to have obtained federal authorization to access CTP. This may be due to the absence of these conditions among those explicitly listed by the federal program, but may also reflect accentuated stigma associated with the use of cannabis to address mental health issues. Indeed, stigma has been identified as a substantial barrier to accessing care for mental health conditions such as depression and anxiety (Brown et al., 2010), and this may be compounded by the considerable stigma associated with use of CTP (Bottorf et al., 2013) to create a substantial barrier to accessing treatment. Research that further elucidates the appropriateness of using cannabis to treat anxiety and depression is required to guide effective treatment and help to reduce stigma.

Patterns of use were also consistent across medical conditions, with the only notable difference being slightly lower levels of use among respondents with HIV/AIDS, a difference which may be due to intermittent use to address nausea. Most participants reported initiating non-therapeutic use prior to use of CTP, and noted increased levels of use associated with the transition to therapeutic use. This reported increase is consistent with our observation that the median level of therapeutic use exceeds typical levels of non-therapeutic use (Reinarman, Cohen, & Kaal, 2004; Hazekamp et al., 2013; but see also Hazekamp & Heerdink, 2013), and suggests a potentially meaningful distinction between therapeutic and non-therapeutic use. In contrast, the relative consistency of use among CTP-users suggests that CTP regimens might transfer well across conditions, and enjoy good adherence. The most pronounced differences across respondents involved modes of access, such that unauthorized users were much less likely to access CTP from authorized, or semi-authorized (i.e. dispensaries) sources. This discrepancy contrasts with the pronounced similarity between authorized and unauthorized users on indicators of health and use of CTP, and suggests that the current system of authorization may not be discriminating among qualitatively different groups.

The primary limitations of this study are common to online medical surveys such as potential for multiple responses from a single respondent, a potentially unrepresentative sample, and lack of physician confirmation of medical conditions. In addition, response bias related to participant self-selection, and recruitment through organizations that support medical cannabis patients likely resulted in overrepresentation in our sample by individuals who respond favourably to CTP. In light of this potential bias, our characterization of the therapeutic use of cannabis should be interpreted with caution pending replication from research that employs a more systematic recruitment approach. However, these limitations are counterbalanced by several methodological

strengths including the inclusion of an in-person subsample, engagement of a community research board in the development and dissemination of the survey, and general adherence to established standards for reporting internet-based surveys (Eysenbach, 2004).

Conclusions

This was the largest and most comprehensive study to date of the therapeutic use of cannabis in Canada. We draw three primary conclusions from the data. First, reasons for use and perceived effectiveness were generally consistent across medical conditions; respondents overwhelmingly reported using cannabis to effectively address pain, sleep disturbance, and anxiety. Second, further research is required to address the substantial disconnect between the therapeutic use of cannabis and research on the risks and benefits of such use. This is particularly evident with regard to the anxiolytic and sedative use of cannabis; extrapolation from our sample to the national population of CTP users suggests levels of use for anxiolytic and sedative purposes that may be comparable to the number of Canadians who currently use benzodiazepine and other sedatives (Kassam & Patten, 2006). Such widespread use suggests a need for the systematic evaluation of the effectiveness and adverse effects of cannabis for the treatment of these conditions, as well as comparisons of cannabis with the widely-used pharmaceutical products that currently represent frontline treatments. Finally, our findings highlight the apparent discrepancy in access to cannabis across CTP users. Authorized and unauthorized users exhibit few meaningful differences with regard to medical conditions and patterns of use, but face substantial differences regarding access; many seriously ill Canadians risk increased stigma (Bottorf, Bissell, Balneaves, Oliffe, Capler & Buxton, 2013), legal sanction, and other negative outcomes associated with accessing cannabis from illegal markets. At the time of this writing the federal medical cannabis program is undergoing substantial structural changes. The present study provides a baseline for assessing the impact of these changes, the most important of which must surely involve providing a program that facilitates informed, safe, legal, and affordable access to a source of CTP for ill Canadians.

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Conflict of interest statement

None of the authors have any conflicts of interest with regard to the contents of this manuscript. Access.

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Survey on Barriers to Access to Cannabis for Therapeutic Purposes in Canada

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Abstract

Background: There is increased interest in the therapeutic potential of cannabis in recent decades. Canada, the Netherlands, Israel and some states in the United States have developed programs to allow access to cannabis for therapeutic purposes (CTP). In Canada, enrollment represents fewer than 5% of the estimated users of CTP. The discrepancy between the number of Canadians who report using CTP and the rate of utilization of the federal CTP program suggests the existence of barriers to access to this program. **Methods:** The present study draws on data from the Cannabis Access for Medical Purposes Survey. We employ a health services analytical framework, developed to define the concept of 'access' and its relationship to patient satisfaction, to examine barriers to access to CTP. We define barriers to access as areas of poor fit between clients and services and use five dimensions to examine access to CTP: *accommodation*, *accessibility*, *availability*, *affordability*, and *acceptability*. **Results:** Our findings reveal that it is difficult for Canadians to find a physician to support their application to access CTP. Accessing CTP from unauthorized sources is common; only 7% of respondents accessed CTP exclusively from authorized sources. Accessibility to CTP was positively associated with the presence of medical cannabis dispensaries, though they are excluded from the regulatory regime. Access to CTP varied by medical condition and general quality of health. Affordability of CTP is a significant barrier to access that should be addressed under future programs. **Conclusions:** Strategies need to be developed to encourage scientific inquiry into CTP and address the barriers to access to CTP and the stigma and controversy that surround CTP and strain patient-physician relationships.

Keywords: cannabis, medical cannabis, cannabis for therapeutic purposes, regulations, barriers to access, health services analytical framework, Canada

Survey on Barriers to Access to Cannabis for Therapeutic Purposes in Canada

Background

After a period of marginalization, there is increased interest in the therapeutic potential of cannabis in recent decades. Canada, the Netherlands, Israel and some states in the United States have developed programs to allow access to cannabis for therapeutic purposes (CTP) (Shelef, Mashiah, Schumacher, Shine, Baruch &, 2011). An estimated one million Canadians, or 4% of those aged 15 and older, reported using cannabis to treat self-defined medical conditions in the previous 12 months (Adlaf, Begin, & Sawka, 2005; Belle-Isle & Hathaway, 2007). Court cases in Canada have confirmed the constitutional right of Canadians to choose cannabis as medicine without fear of criminal sanction (e.g. *R. v. Parker, Wakeford v. Canada, Hitzig et. al. v. Canada, R. v. Mernagh, R. v. Smith*), and in 2001, the *Marihuana Medical Access Regulations* (MMAR) established guidelines for Canadians to obtain legal authorization to possess CTP. As of December 2012, 28,115 Canadians had obtained an authorization under these regulations to possess CTP and obtain CTP from a legal source (Health Canada, 2013). Although uptake of the federal program has increased in recent years, this enrollment represents fewer than 5% of the estimated users of CTP in Canada. The discrepancy between the number of Canadians who report using CTP and the rate of utilization of the federal CTP program suggests the existence of barriers to access to this program.

To obtain authorization to legally possess CTP under the MMAR, Canadians are required to obtain the written support of a physician on an application form and then apply to a federal authority. Those authorized can purchase dried cannabis from Health Canada, produce their own cannabis, or designate a person to grow cannabis on their behalf. In 2014, the MMAR are scheduled to be replaced by the *Marihuana for Medical Purposes Regulations* (MMPR).

Under the MMPR, Canadians who wish to use CTP will need to obtain a medical document directly from a physician or nurse practitioner, similar to a prescription, which they will then submit to a commercial licensed producer. Both personal and designated licences to produce cannabis will be phased out. These imminent changes make it timely to analyze barriers to access to CTP under the current regulatory regime and to examine how new programs might address or exacerbate existing barriers.

In addition to authorized sources of CTP, medical cannabis dispensaries, also known as compassion clubs, represent a parallel source of CTP, providing CTP and related services to over 40,000 patients in Canada (Canadian Association of Medical Cannabis Dispensaries, 2013). Medical cannabis dispensaries arose in Canada in 1997 in response to demand for a community-based, safe, and quality controlled source of CTP (Capler, 2010). These dispensaries predate, and are not officially recognized by, the MMAR and operate under a legally ambiguous status (Belle-Isle, 2006). Additionally, many Canadians access CTP through friends, illicit self-production, and the street market.

The present study draws on data from the largest survey of Canadians who use CTP to date, the Cannabis Access for Medical Purposes Survey (CAMPS). We employ a health services analytical framework, developed to define the concept of 'access' and its relationship to patient satisfaction (Penchansky & Thomas, 1981), to examine barriers to access to CTP under the current program.

A health services analytical framework to examine barriers to access.

Penchansky and Thomas (1981) offered a framework to define 'access' and its relationship to patient satisfaction in the context of health services research. Others have adapted this framework to examine barriers to health care and health services in low-income countries

(Jacobs, Ir, Bigdeli, Annear, & Van Damme, 2012; Peters et al., 2008). For the purposes of our study, and in keeping with Penchansky and Thomas (1981), we define barriers to access as areas of poor fit between clients and services and use five dimensions to examine access to CTP: *accommodation*, *accessibility*, *availability*, *affordability*, and *acceptability*. Our study uses these dimensions as a lens through which to consider both access to authorization to possess CTP, as well as access to a source of CTP.

Accommodation refers to the "relationship between the manner in which the supply resources are organized to accept clients...and clients' ability to accommodate to these factors and the clients' perception of their appropriateness" (Penchansky & Thomas, 2008, p. 128). We conceptualize accommodation as an overarching dimension that broadly taps the appropriateness of the current model of CTP access in Canada with regard to meeting patients' needs. *Accessibility* refers primarily to the geographic location of services in relation to the location of the people in need of those services (Pechansky & Thomas, 2008; Peters et al., 2008). With regard to CTP, we examine the influence of provincial region of residence and community type (i.e. rural, suburban, and urban) on access both to physicians to obtain support to possess CTP, and to a source of cannabis. *Availability* refers to the adequacy of available services according to the nature of patient needs (Pechansky & Thomas, 2008; Peters et al., 2008). In the CTP context, we examine how medical conditions and general quality of health impact availability of physicians to support applications, the responsiveness of the administrative process required to obtaining authorization to possess CTP, and the availability of sources of CTP. *Affordability* reflects the relationship between the costs of services and products and the patients' willingness and ability to pay for them (Pechansky & Thomas, 2008; Peters et al., 2008). We address this dimension by examining associations among income, costs associated with CTP, and ability to

access CTP. *Acceptability* covers patients' attitudes regarding service providers and how they perceive their service providers' attitudes toward them (Pechansky & Thomas, 2008; Peters et al., 2008). To examine this dimension we review indices of patient-physician communication, stigma with regard to communication with physicians, and patients' attitudes to the official program.

Literature review on barriers to access to CTP in Canada.

A few studies have touched on issues related to barriers to access to CTP in Canada. In 2005, the Canadian AIDS Society conducted a survey of people living with HIV/AIDS which revealed that the majority of those who used or wanted to use CTP had spoken to their physician about CTP, and that only a small minority reported lack of physician support to be a substantial barrier to access (Belle-Isle & Hathaway, 2007). That study also found that just over one third of respondents had applied to the federal medical cannabis program, with many respondents describing barriers including the onerous, complicated or intimidating requirements of the program, mistrust of government, concerns about the repercussions, negative impression of the program, and lack of awareness of the program. Further, 86% of respondents reported obtaining CTP from illegal sources, including friends, dispensaries, unauthorized self-cultivation, and street dealers, whereas 8% had a license to produce their own CTP, 4% had a licensed designated grower and fewer than 2% reporting purchasing CTP from Health Canada. A more recent survey that was limited to federally authorized users of CTP reported similarly low levels of obtaining CTP from Health Canada, and high levels via dispensaries and licenced self-cultivation; however, these respondents reported generally high levels of satisfaction with the federal program (Lucas, 2012a).

Studies of physicians' attitudes and practices have identified their substantial concerns with the current state of CTP use and regulation in Canada. Jones and Hathaway (2008) found that the majority among a sample of family physicians, medical residents and medical students felt that, with regard to CTP, they "did not have access to the quality of evidence to which they are accustomed and with which they felt comfortable" (p. 170). The investigators also found that physicians tended not to ask their patients about their cannabis use and patients tended not to tell. A recent survey conducted by the Canadian Medical Association (Canadian Medical Association, 2012) revealed similar results; the majority of physicians believe they lack sufficient information on risks, benefits, and appropriate use of CTP. The same survey reported that one third of physicians never support their patients' request for CTP, whereas more than half do so only occasionally or seldom.

In sum, findings regarding CTP use in Canada indicate relatively low uptake of the authorized program on the part of patients and substantial discomfort on the part of physicians, suggesting a generally poor degree of "fit" between client and service. The present study presents a theoretically informed examination of the extent and nature of barriers to accessing CTP as experienced by Canadians. In light of the internationally expanding role of cannabis within the medical pharmacopeia, the elucidation of these barriers has the potential to inform and refine the development of CTP programs, and might more broadly contribute to the understanding of barriers to access for emerging and potentially stigmatized therapies.

Methods

The study was approved by the Behavioural Research Ethics Board of the University of British Columbia. The research team consisted of academic researchers, representatives from community-based organizations and non-governmental organizations, and people who use CTP.

The research thus borrowed from a participatory approach. The survey collected cross-sectional data from 628 self-identified current users of CTP in 2011-2012, both online at the national level and at a local British Columbia medical cannabis dispensary. This recruitment design allowed a comparison of the online *national* condition with the confirmed CTP users queried in-person in the *local* condition. Of the 702 *national* participants, 541(77%) reported current CTP use. All 87 *local* participants reported current CTP use. Organizations and media that serve people who use CTP as well as dispensaries assisted with promoting the survey (e.g., Canadian AIDS Society, Canadian Aboriginal AIDS Network, social media). No identifying data (i.e. IP addresses) were collected, to ensure confidentiality. The *local* group consisted of members of the dispensary who were either authorized to possess cannabis through Health Canada or had documented confirmation of a medical condition for which CTP is indicated. Participants in the *local* group received a $10 compensation and help from research assistants; participants in the *national* group were not assisted or financially compensated.

The questionnaire consisted of 414 questions designed to be completed in less than one hour. It queried demographics, detailed CTP use, communications with health care providers, access to and experiences with the federal medical cannabis program and a supply of CTP and general indicators of health and well-being. The questionnaire also included questions drawn from the Barriers Questionnaire (Ward et al., 1993) and from prior studies of CTP use (Belle-Isle & Hathaway, 2007; Lucas, 2012a). It was administered online, and organized in a hierarchical manner such that exposure to many items was contingent on prior responses. As a result, the number of recorded responses varies across items and no participants completed all items. All reported percentages are based on number of responses to given items rather than on the entire

sample. In order to enhance clarity we accompany all reported percentages with number of responses. Comparisons were conducted using χ^2 tests.

Results

Demographics.

The 628 respondents were 71% male, 29% female and 0.5% transgender and other genders, 92% Caucasians and 7% First Nations and Metis. Mean age was 39.10 years (SD = 13.12), median household income was $30,000 - $39,999, 96% had completed secondary school and 58% had completed some post-secondary education. Responses were obtained from all ten Canadian provinces and one of the three territories, and self-reported living in urban (47%), suburban (32%), and rural or remote areas (22%) (Table 1). Respondents reported using CTP for anxiety and depression, pain, arthritis, spinal pain, HIV/AIDS, multiple sclerosis, cancer, epilepsy and a variety of other illnesses. Medical use of cannabis was mainly reported for the treatment of pain, followed by nausea, mood, spasticity and other symptoms. A detailed description of the demographic and medical characteristics of this sample is available elsewhere (Walsh et al., 2013).

Accommodation.

Accommodation refers to the appropriateness of the current model of CTP access to meeting patients' needs. Experiencing obstacles to accessing CTP was reported by 86% of respondents (n = 420). Respondents described obstacles as affecting their mood, enjoyment of life, sleep, general activity, normal work outside or inside the home, and relationships (Figure 1). Most respondents (81.1%; n = 489) reported discussing the use of CTP with a physician, and almost one third of respondents (32%, n = 156) reported that they had sought a new physician in relation to their use of CTP, with the majority of those (57%, n = 89) changing physicians more

than once. Respondents reported equivocation on the part of physicians with regard to recommending and authorizing use of CTP. Among respondents who discussed CTP with their physicians, 29% (n=143) reported that physicians recommended they access CTP but refused to endorse their application for authorized access.

Nearly half of respondents (48%, n = 245) had applied for a federal authorization to possess CTP, of whom 68% (n=167) received authorization, 5% (n=13) reported they did not, and 26% (n=63) had applications that were under review at the time of the survey. Among applicants to the federal CTP program, 59% (n=145) found the process difficult or very difficult, and 47% (n=114) reported being somewhat or completely unsatisfied with the program. Incongruent accommodation between patients and services is further evidenced in access to a source of CTP; the federal program makes available a single strain of dried cannabis, whereas 93% (n = 415) of respondents identified access to a specific preferred strain, a variety of strains, and/or alternative CTP products (e.g. baked goods, tinctures) as important options. Indeed, less than one third of respondents (31%, n= 139) accessed CTP from authorized sources (i.e. licensed self-production, licensed designated producer, direct purchase from the federal program) (Figure 2), and more than three quarters (76%, n = 106) of respondents who had access to authorized sources also accessed CTP from unauthorized sources (i.e. dispensary, friend, street, unlicensed self-production, unlicensed designated producer). Overall, only 7% (n= 33) of respondents accessed CTP exclusively through authorized sources.

Accessibility.

Accessibility refers to the influence of provincial region of residence and community type (i.e. rural, suburban, and urban) on access both to physicians to obtain support for an authorization to possess CTP and to a sources of cannabis. The rate of experiencing obstacles to

access to CTP did not differ according to community type (urban, suburban or rural) (X^2 = 1.39 (2), p = 0.50) or region (X^2 = 5.32 (4), p = 0.27). The proportion of those who had spoken to a physician regarding CTP use varied according to region with the highest level in British Columbia (88%, n=191), and lowest in the Maritimes (71%, n=29) (X^2 = 16.58 (4); p<.01). Across regions, respondents from rural areas were more likely than urban or suburban respondents to discuss CTP with physicians; 89% (n=116) of rural respondents discussed use of CTP with a physician, compared to 80% (n=224) of urban and 77% (n=144) of suburban respondents (X^2 = 7.59 (2); p = 0.02). Rural residents were also more likely to report having received federal authorization to possess CTP (41%, n = 45), relative to suburban (36%, n=58) and urban dwellers (26%, n = 63) (X^2 = 8.69 (2), p = .01). The proportion of respondents who reported changing physicians for reasons related to CTP use was stable across regions (X^2 = 3.11 (4); p = 0.54) and across community types (X^2 = .19 (2); p = 0.67).

With regard to accessibility to sources of CTP, regional differences were identified in the proportion of respondents who accessed CTP from a dispensary, with higher levels among respondents from British Columbia (70%, n=118) and Ontario (41%, n=68) and lower use among residents of the Prairie (18%, n=11) and Maritime (25%, n=7) regions (X^2 = 62.61 (4); p < .01). A complementary pattern of results emerges from examining access to cannabis from a friend or acquaintance, with higher levels among residents of the Prairies (80%, n=52) and Maritimes (88%, n=28) regions and lower levels from British Columbia (58%, n=106) (X^2 = 18.23) (4), p< .01) (Figure 3). Participants who lived in rural, suburban and urban areas differed with regard to the extent to which they produced their own cannabis, with the highest level of self-production among respondents from rural areas (48%, n=51), followed by suburban (31%, n=46) and urban residents (25%, n=58), (X^2 = 18.25 (2); p < .01).

Availability.

Availability in this context refers to how medical conditions and general quality of health impact availability of physicians to support applications to access CTP, the responsiveness of the federal government's administrative process required to obtaining authorization to possess CTP, and the availability of sources of CTP. The rate of experiencing obstacles to access to CTP differed across medical conditions, such that individuals who identified HIV/AIDS as their primary condition were less likely to report obstacles (70%, n=33), (X^2 = 10.29 (1), $p < .01$). Physician communication also varied according to medical conditions, such that a greater proportion of individuals with HIV/AIDS (93%, n=55), (X^2 = 5.51 (1); p = .02), and arthritis (91%, n=80), (X^2 = 4.54 (1); p = .02) discussed CTP with their physicians, whereas respondents with anxiety/depression as primary condition were less likely to discuss CTP with a physician (64%, n=69), (X^2 = 27.68 (1); p < .01). Respondents with HIV/AIDS were also relatively less likely than other patients to change physicians for reasons related to CTP (11%, n=6), (X^2 = 13.14 (1); p < .01). Having physicians recommend CTP but refuse to endorse applications for authorized access was less prevalent among respondents with HIV/AIDS (13%, n=7), (X^2 = 10.90 (1); p < .01), and more common among respondents with chronic pain that was not due to spinal injury or arthritis (51%, n=40), (X^2 = 12.43 (1); p < .01).

Respondents who reported *fair to poor* general health were more likely than respondents who reported *good to excellent* general health to discuss CTP with a physician (91%, n=147) (77%, n=240) (X^2 = 13.59 (1); p <.01),to have obtained federal authorization (42%, n=68) (27%, n=85) (X^2 = 10.59 (1); p <.01), and to access CTP through authorized means (36%, n = 57) (25%, n=76) (X^2 = 6.00 (1); p =.02). However, comparisons according to general health of respondents identified no differences with regard to experiencing obstacles (X^2 = .16 (1); p =.68),

(X^2 = .16 (1); p =.68), changing physicians related to CTP (X^2 = .39 (1); p =.57), or having physicians recommend CTP but refuse to endorse an application for authorization (X^2 = .08 (1); p =.81).

With regard to sources of CTP, almost one third of the respondents (31%, n = 155) reported self-producing CTP, of whom 50% (n=77) were licensed to produce CTP for personal use. The proportion of licensed versus unlicensed self-producers was consistent across medical conditions (X^2 = 2.01 (8); p = .98). However, self-producers who reported *fair to poor* general health were more likely to be licensed (64%, n=30) than were those who reported *good to excellent* general health (42%, n=43) (X^2 = 6.05 (1); p =.01). Approximately one third (34%, n=42) of self-producers reported that it was difficult or very difficult to learn to cultivate cannabis. The proportion of self-producers who reported difficulty was consistent across medical conditions (X^2 = 9.04 (8); p = .34) and general health quality (X^2 = .39 (2); p = .58). Reported difficulties associated with self-production included arrest (16%, n = 24) and break-ins (12%, n = 19). Among the 339 respondents who provided reasons for not self-producing CTP, the most prominent reasons were lack of space (43%, n=146), expense of set up (37% n=124), and legal concerns (32%, n=108). The extent to which lack of space was identified as a reason for *not* self-producing differed according to community type, such that urban residents were most likely to report this reason (52%, n=91), followed by suburban (35%, n=36), and rural residents (31%, n=17) (X^2 = 12.04 (2), p <.01). No such difference were identified for expense (X^2 = 3.01 (2), p =.22) or for legal concerns (X^2 = 2.59 (2), p=.27). The most important reason for self-producing was quality (39%, n=52), followed by price (36%, n=47), avoiding the black market (29%, n=40), selection of a specific strain of cannabis (24%, n=33), and safety (12%, n=15).

Of those who reported that someone else produced CTP for them (18%, n=90), 67% (n=60) had designated producers who were licensed. Difficulties finding a designated producer were reported by 39% (n=35) of respondents with designated producers, and the proportion reporting such difficulties was stable across medical conditions (X^2 = 7.14 (8); p = .52) and health quality (X^2 = .27 (1); p = .66).

Affordability.

Affordability refers to costs associated with CTP and ability to pay according to income. Costs to access CTP occur both in the process of obtaining physician support for authorization to possess CTP and in obtaining a supply of cannabis. Many applicants (40%, n = 98) were charged by their physician for the service of having their application completed, with charges ranging from $10 to $800. The proportion of respondents who were charged by physicians to complete the application varied according to income such that a relatively smaller proportion of the lowest income group (≤$20,000/yr) were charged (30%, n=26, X^2 = 7.18 (1); p < .01), and a larger proportion of the $40,000-60,000/yr group were charged (62%, n=21, X^2 = 6.76 (1); p =.01). Among participants who reported buying CTP (n=433), the median amount reportedly spent was $200 (Inter-quartile Range = $100-$400) per month. Experiencing obstacles did not differ across income groups (X^2 = 3.17 (3); p = .37), however 54% (n=278) of respondents reported that they were *sometimes or never* able to afford to buy sufficient quantity of CTP to relieve their symptoms, and approximately one third (33%, n=173) reported that they often or always choose between cannabis and other necessities (e.g. food, rent, other medicines) because of lack of money. The proportion of respondents who reported that they were *sometimes or never* able to afford to buy sufficient quantity of CTP differed according to income such that it was most frequently reported by the lower income group (72%, n = 123) and least frequently reported by

the highest income group (≥ $60,000/yr) (30%, n = 36) (X^2 = 51.26 (3); $p < .01$). The frequency of reports of choosing between CTP and other necessities followed a similar pattern, with highest levels of reporting among lowest income (51%, n = 88) and lower levels at highest income (11%, n=13) (X^2 = 56.93 (3); $p < .01$). The proportion of respondents who reported financial strain associated with CTP also varied according to health status such that approximately two thirds of respondents who reported *fair to poor* general health were *sometimes or never* able to afford sufficient CTP (67%, n=107) compared to 48% (n=147) of respondents who reported *good to excellent* health (X^2 = 15.56 (1); $p < .01$). Respondents reporting poorer health were also nearly twice as likely to report choosing between CTP and other necessities (48% (n=78) versus 25% (n=79), X^2 = 25.85 (1); $p < .01$).

The proportion of respondents who obtained authorization varied according to income, such that 40% (n=68) of respondents in the lowest annual income group obtained authorization compared to 28% (n=95) of respondents from higher income groups (X^2 = 6.86 (1); $p = .01$). Income was not associated with discussing CTP with a physician (X^2 = 1.48 (3); $p = .69$) or with changing physicians for reasons associated with CTP (X^2 = 1.14 (3); $p = .79$). Income was also not associated with accessing CTP from an authorized source (X^2 = 2.61 (3); $p = .46$).

Acceptability.

Acceptability refers to patients' perceptions of physicians' attitudes regarding CTP and the official program and indices of patient-physician communications. Respondents reported some reluctance regarding communication with physicians related to CTP. Approximately half of the respondents (48%, n=277) reported that they had at some time wanted to discuss CTP with *a* physician but had not done so. Among respondents who wanted to discuss CTP but refrained, 38% (n=105) had not discussed CTP with *any* physician. The most frequent reason for not

discussing CTP despite a desire to do so was "don't feel comfortable" (62%, n= 172), followed by "illegal" (46%, n= 127), and "can't afford cannabis" (9%, n=25). Although our sample was comprised of *current* users of CTP, queries regarding *past* avoidance of CTP also evinced patient concerns regarding potential reactions from physicians and others; the most frequently cited reason for avoiding CTP was "I could be discriminated against" (60%, n = 326), followed by "Doctors might find it annoying to be asked about cannabis" (51%, n = 275), "Discussing cannabis could distract a doctor" (17%, n=90) and "It could make me drowsy" (17%, n=90). Answers to an open ended question related to physicians' perceived negative response to CTP included – "After multiple negative responses from doc, I've stopped broaching the subject."; "He shut me down every time I brought it up." Several responses also indicated concern that discussing CTP with a physician might have a negative impact on their patient/physician relationship – "fear of getting no treatment at all"; "fear of losing my doctor"; "I am afraid they will black list me as a patient and I would not have access to health care!" Compared to their communication with their physician regarding other medical issues, half of the respondents (50%, n = 235) were less satisfied with their communication about the use of CTP, and 31% (n = 146) reported that they often or always felt discriminated against by their physician because of their use of CTP.

Discussion

Access to CTP involves both legal authorization to possess CTP and access to a source of cannabis. Our results reveal substantial barriers related to both components of access involving dimensions of *accommodation*, *accessibility*, *availability*, *affordability*, and *acceptability*.

Obtaining authorization to possess CTP requires the support of a physician, and the majority of respondents had discussed the use of CTP with a physician. However, a large

proportion of respondents spoke to several physicians and many changed physicians in order to access CTP. Ultimately, less than one third of respondents had obtained authorization that allowed them to legally possess CTP, indicating that despite the existence of a legal framework, a substantial number of chronically and seriously ill Canadians continue to access CTP without legal authorization and from illegal sources. This discrepancy suggests poor *accommodation* of the federal CTP program to client needs. Indeed more than 85% of respondents reported experiencing obstacles to accessing CTP. Among the minority of respondents who engaged with the federal program, over half found the process difficult, and nearly half were dissatisfied with the program. Among those who managed to obtain access to authorized sources of CTP, three quarters also accessed unauthorized sources. In sum, fewer than 10% of our sample accessed cannabis exclusively from authorized sources, which suggests substantial barriers to efficient and acceptable authorized access.

The *availability* of sources of CTP varied across Canada. Although medical cannabis dispensaries are not recognized under existing regulations, British Columbia and Ontario have numerous active medical cannabis dispensaries, whereas other regions do not have any, or as many, active dispensaries. Our finding of regional differences in the *accessibility* to CTP, with residents in BC and Ontario more likely to access CTP from a dispensary, was expected. Other regional differences may also be attributable to the presence of dispensaries. Specifically, BC has the greatest density and longest history of dispensary activity (Lucas, 2012b), and BC residents were more likely to have discussed CTP with a physician and less likely to purchase CTP from a friend or acquaintance. Although the cross-sectional nature of our study prevents assertions regarding causality, these findings indicate that the presence of cannabis dispensaries is

associated with increased physician consultation around CTP and reduced prevalence of illegal access through friends and acquaintances.

Also related to the dimension of *availability* were the findings that rural respondents were more likely to communicate with their physicians regarding CTP, to have obtained federal authorization to possess CTP, and to self-produce. Further inquiry is required to fully elucidate the factors that underlie the increased adoption of the federal program by rural residents. However, the increased space associated with rural living may contribute to these differences. Indeed, rural residents who abstained from self-production were less likely than urban and suburban residents to cite space restrictions as a factor that contributed to their decision not to produce CTP.

Medical conditions and general health were associated with differences in *availability* of CTP. In particular, respondent with HIV/AIDS experienced fewer obstacles, were more likely to discuss CTP with physicians, less likely to change physicians related to CTP, and less likely to have physicians recommend CTP but refuse to endorse authorization. The relatively lower levels of obstacles facing people living with HIV/AIDS attempting to access CTP may be attributed to several factors, including the relatively more established efficacy of the therapeutic uses of cannabis for the management of symptoms related to HIV/AIDS, the long history of grassroots advocacy for the use of CTP by the HIV/AIDS movement, and the potentially greater alliance between health care providers and patients among this community. As such, the relatively fewer barriers experienced by individuals living with HIV/AIDS suggest that further research into factors that have facilitated access to CTP among such individuals might help develop strategies to improve access for other groups. These findings also raise the possibility that prior research that focused exclusively on HIV/AIDS patients who use CTP (e.g. Belle-Isle & Hathaway, 2007)

may present an underestimate of the obstacles experience by the broader community of people who use CTP.

Also related to the dimension of *availability*, individuals who identified anxiety and/or depression as primary reasons for using CTP were less likely to discuss CTP use with physicians. This difference may reflect characteristics of these conditions, as behavioral inhibition and reduced communication may be associated with depression and anxiety (Angélico, Crippa, & Loureiro, 2013; Tse & Bond, 2004). Alternately, this finding may reflect perceived reluctance on the part of physicians to recommend CTP for psychiatric symptoms. Given the prevalence of anxiety and depression in the general population, and the substantial problems with extant pharmacological treatments such as benzodiazepines and SSRIs (Gartlehner et al., 2011; Uzun, Kozumplik, Jakovljević, & Sedić, 2010), our findings of high levels of unauthorized CTP use to address these conditions suggest that further effort is required to better determine the antidepressant and anxiolytic efficacy of CTP.

General health status was also associated with difference in the availability of CTP, such that poorer health was associated with higher rates of physician communication and authorized access. However, no differences according to general health status were observed with regard to experiencing obstacles to access, changing physicians related to CTP and physicians recommending CTP but refusing to endorse applications for authorized access. Nevertheless, our findings indicate that over a quarter of patients in poor health had the experience of physicians recommending CTP and refusing to assist with authorization. This finding points to the need for further education to address equivocation and reluctance on the part of physicians to assist patients in obtaining legal access to CTP.

Our examination of *affordability* identified further obstacles to optimal CTP use, with over half of respondents indicating that financial consideration interfered with their ability to treat symptoms with cannabis. Of course lower income individuals were most vulnerable to this obstacle, with approximately half of participants in the lowest income group reporting having to choose between CTP and other necessities. Even a third of the highest income group reported difficulty affording CTP. Affordability appeared to disproportionately impact the most seriously ill patients, such that the group who reported fair to poor health were twice as likely as healthier patients to report having to choose between CTP and other necessities. Surprisingly, the lowest income group were more likely to have obtained authorization to possess, which suggests that it is the cost of cannabis per se, rather than the cost of obtaining authorization, that presents the primary barrier to affordability. The ubiquity of CTP-related financial strain highlights the need for developing approaches to mitigate financial barriers and integrate CTP within a subsidized medicine framework.

In light of the considerable stigma and controversy that surrounds the use of CTP (Bottoroff et al., 2013), and evidence from surveys of physicians that indicate discomfort with CTP (Jones & Hathaway, 2008; Canadian Medical Association, 2012), we were not surprised that patients' perception of service providers' attitudes toward CTP users constituted substantial barriers to *acceptability* of services. Indeed, almost half of the respondents had at some point wanted to discuss cannabis for medical purposes with a physician but avoided doing so, most commonly citing fear of discrimination and feelings of discomfort. Reports of patient-physician interaction suggest that such fears may not be unfounded; half of respondents were relatively less satisfied with CTP-related physician interactions than with interactions that were unrelated to CTP, and nearly one third reported experiencing CTP-related discrimination on the part of

physicians. The large proportion of patients who changed doctors to access CTP, and who reported that physicians recommended CTP but would not sign official authorizations, provides further evidence of lingering discomfort related to CTP on the part of some physicians. This discomfort may stem from their stated lack of knowledge about the medical use of cannabis (Jones & Hathaway, 2008; Canadian Medical Association, 2012) and their disapproval of smoking as a route of administration for any treatment (Canadian Medical Association, 2012). It may also stem from their personal views on cannabis use, which may be an interesting topic for further inquiry. Organizations such as the Canadian Consortium for the Investigation of Cannabinoids have developed programs to help educate physicians on the relative harms and benefits of CTP, and the past decade has witnessed a notable increase in the international acceptance of the therapeutic potential of cannabis. This increased prominence, together with the concerted efforts of CTP advocates and educators, may play a valuable role in helping to reduce barriers related to acceptability of services.

The cross-sectional nature of our study does not permit causal inferences and it is possible that unmeasured factors may play an important role in determining access to CTP. Our sample consisted of mostly male, Caucasian and well educated respondents and our findings may not reflect the situation of other Canadians who use CTP. An additional limitation involves response biases related to participant self-selection, and recruitment through organizations that support people who use CTP. These factors likely resulted in overrepresentation in our sample by individuals who are strongly invested in increasing access to CTP; it is possible that barriers to access may be less pronounced or otherwise different were we to collect data using a more systematic approach to recruitment. Conversely, barriers to access to CTP may be greater for those who may not have access to online resources or organizations that support people who use

CTP. We also focused on barriers to access for those who are using CTP and did not delve into the barriers for people who may want to use CTP but are not able to overcome barriers to access. These limitations are balanced by several strengths, including a relatively large national sample that tapped into both authorized and unauthorized CTP users across diverse medical conditions and health statuses. The engagement of both community and academic experts in the construction and dissemination of the survey is a further strength of our study, as it increased the breadth, relevance and validity of our queries. More broadly, our examination of issues related to access to CTP was guided by a theoretically informed analytical framework which added to our confidence regarding the dimensions that are central to access to health services.

Conclusion

Utilizing a health services analytical framework, CAMPS provides useful data to examine barriers to access to CTP in terms of dimensions of *accommodation, accessibility, availability, affordability, and acceptability*. An in-depth analysis of barriers to access to CTP provides insights into access to CTP under the current regulatory framework and may help inform the provision of safe and efficient access to CTP under future regulatory regimes (e.g., the new MMPR which come into force on April 1, 2014).

Our findings reveal poor *accommodation* of the current system of legal access to CTP to client needs due to difficulties in obtaining the required support of a physician. Less than one third of respondents had obtained authorization to legally possess cannabis for medical purposes. Under the new MMPR, Canadians will need to obtain a medical document similar to a prescription from a physician or a nurse practitioner in order to have legal access to CTP. Given the reservations physicians had with signing a medical declaration on the current application form under the MMAR, it is possible that physicians will be even more reluctant to prescribe

CTP within the new regulatory framework, as noted in the statement released by the Canadian Medical Association on June 10, 2013 (Canadian Medical Association, 2013). It is encouraging that nurse practitioners will be allowed to prescribe CTP under the new MMPR in jurisdictions where they can prescribe, though it remains to be seen whether this will result in better access to CTP.

The current system further fails to accommodate access to a legal source of CTP, as only 7% of our sample accessed cannabis exclusively from authorized sources. The current regulations do not include medical cannabis dispensaries, and the new MMPR will not integrate them into the regulatory system. Our findings show that *accessibility* to CTP was associated with the presence of medical cannabis dispensaries. Regions that have such dispensaries also had increased physician consultation around CTP and reduced prevalence of illegal access through friends and acquaintances. Including medical cannabis dispensaries under the regulatory regime could facilitate better access to CTP.

The *availability* of CTP varied by medical condition. In particular, respondent with HIV/AIDS experienced fewer obstacles, while individuals with anxiety and/or depression experienced more. Furthermore, the general quality of health was also associated with differences in the availability of CTP, such that poorer health was associated with higher rates of physician communication and authorized access. Perhaps this finding indicates that Canadians wait until they are in desperate need of therapeutic options where other options have failed before they gather enough courage to speak to their physician about CTP. Perhaps physicians are more comfortable supporting the use of CTP for Canadians who are in poorer health. Further inquiry could shed light on this. Regardless of their health status, however, it remained difficult for Canadians to find a physician to support their application to the federal program, further

indicating a need to build a stronger body of evidence regarding the appropriate therapeutic uses of cannabis for specific conditions and to better inform physicians of the evidence that does exist.

Affordability of CTP remains a significant barrier for many Canadians. Our findings reveal that this is especially true for the most seriously ill. Under the new MMPR, Canadians who use CTP will no longer have the cost-effective options of producing their own cannabis or designating a producer. The move to commercial licensed producers will increase the price of CTP, as indicated in the government's Regulatory Impact Analysis Statement regarding the new MMPR (Government of Canada, 2012). Strategies to mitigate these financial barriers and to integrate CTP within a subsidized medicine framework must be developed.

Finally, strategies need to be developed to address the stigma and controversy that surrounds CTP and strain patient-physician relationships. These barriers to *acceptability* impede frank and open discussions about CTP and have a negative impact on continuity of care. The ongoing prohibition of cannabis and associated anti-cannabis messages have tarnished its reputation as a potentially beneficial and safe therapeutic option, thwarted scientific inquiry and stigmatized both the plant and its users. Perhaps the current international climate of cannabis policy reform will bring about alternative policies to regulate cannabis and will slowly open doors for more rational and sensible investigation and education regarding its therapeutic uses.

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CANNABIS ACCESS FOR MEDICAL PURPOSES SURVEY (CAMPS):
PATIENT CHARACTERISTICS, PATTERNS OF USE & BARRIERS TO ACCESS

This is Exhibit "D" referred to in the affidavit of [illegible]
sworn before me at [illegible]
this 15 day of [illegible] 2014

A Commissioner for taking Affidavits

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- Jamie Marshall, Interior Health Authority
- Trevor Stratton, Canadian Aboriginal AIDS Network
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This work was supported by a grant from the

UBC Institute for Healthy Living and Chronic Disease Prevention.

Methods

- Cross-sectional national & local online & in person
- 628 self-selected current users of cannabis for therapeutic purposes
- Collected between July 2011 and August 2012

Demographics

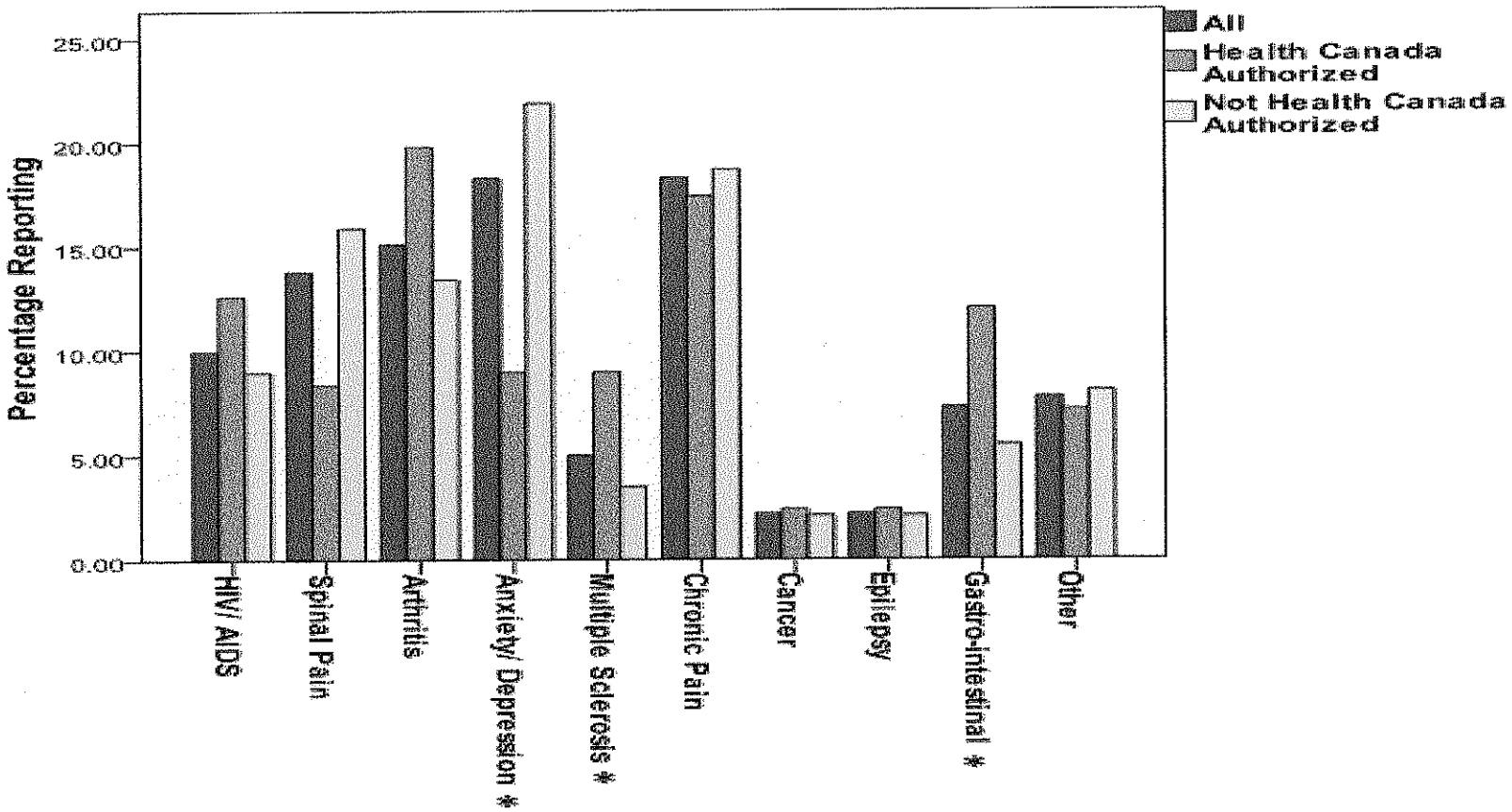
	CTP (%)	Census (%)	Z
% male	71	49	11.03*
% white	92	80	7.52*
% aboriginal	7	4	3.80*
Age			
18-24yrs old	17	12	3.86*
25-34	26	16	6.84*
35-44	19	20	.63
45-54	24	20	2.51

Demographics

	CTP(%)	Census (%)	Z
Education			
<high School	4	15	-7.86*
HS Grad	37	24	7.63*
post secondary	58	61	-1.54
Income			
<20,000	33	44	-5.55*
20,000-39,999	26	27	-.56
40, 000-59,999	17	15	1.43
60,00 +	24	14	7.22*
Region			
Rural	22	20	1.25

Medical Conditions – Authorized / Unauthorized

32.49% Health Canada authorized (12.45% in process)



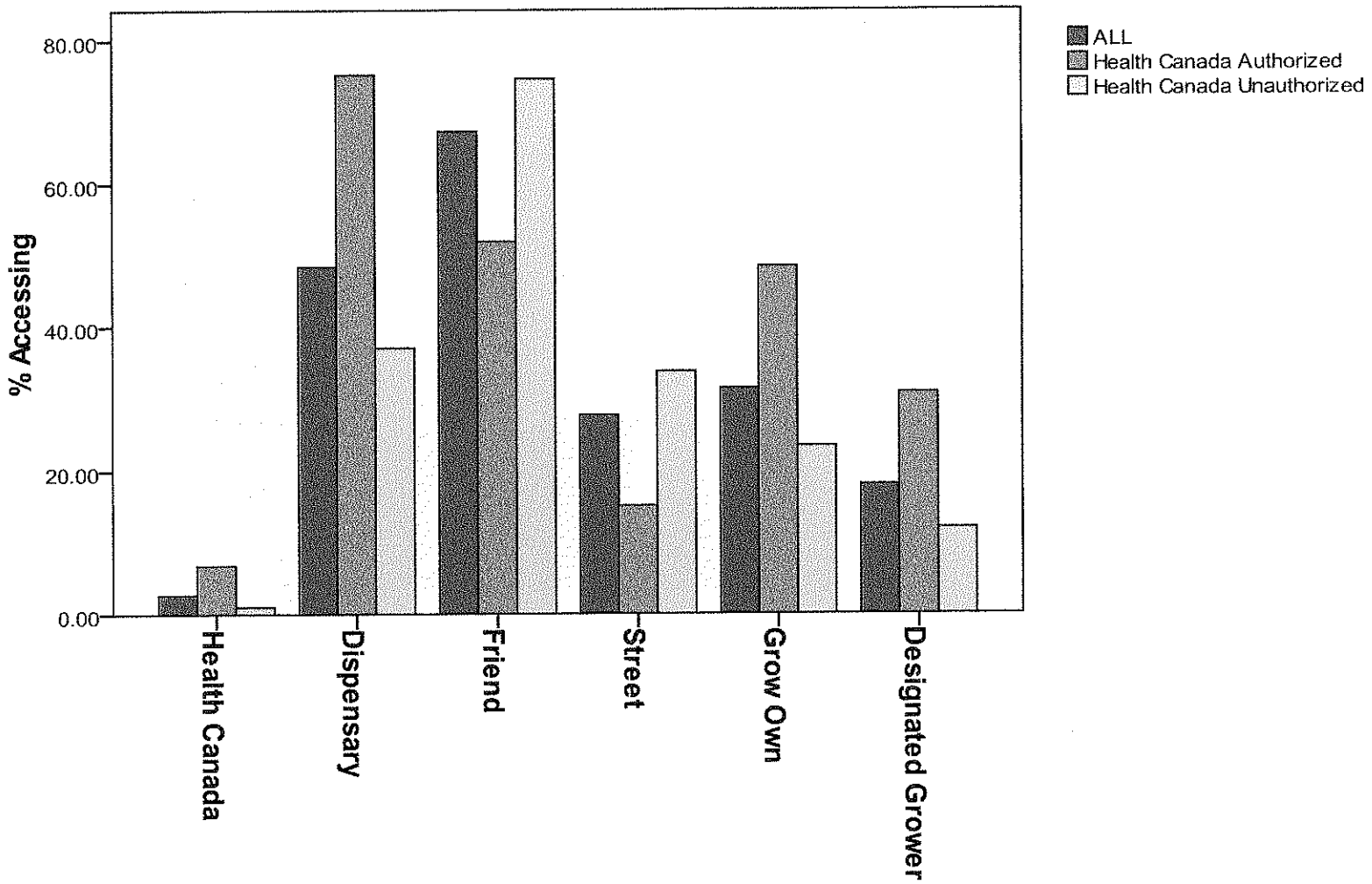
Medical Conditions - Symptoms

	All	Pain – Spinal	Pain - Nonspinal	Arthritis	Mood	HIV/AIDS	GI
Sleep	85.3%	82.9%	85.3%	89.9%	92.5%	78.3%	76.7%
Pain	81.8%	97.6%**	93.6%**	96.6%**	52.3%**	68.3%**	93%
Anxiety	78.3%	79.3%	78%	64%**	99.1%**	73.3%	67.4%
Depression	66.1%	67.1%	62.4%	57.3%	91.6%**	56.7%	62.8%
Appetite/ Weight	56.0%	52.4%	51.4%	39.3%**	57%	76.7%**	76.7%**
Nausea	49.4%	43.9%	51.4%	37.1%	40.2%	78.3%**	81.4%**
Inflammation	48.3%	62.2%	47.7%	88.8%**	23.4%**	33.3%	58.1%
Spasms	46.8%	70.7%**	48.6%	56.2%	21.5**	33.3%	51.2%
Headache	40.5%	53.7	51.4	40.4%	35.5%	25%	27.9%

Patterns of Use

	All	Pain Spinal	Pain	Mood	Arthritis	HIV/AIDS	GI
Amount per week (Grams)							
≤2	8.8%	7.8%	9.8%	10.3%	4%	26.8%*	2.9%
2.1-5	12.6%	12.5%	12%	12.6%	13.3%	12.2%	0%
5.1-9	17.9%	10.9%	23.9%	27.6%	14.7%	14.6%	17.1%
9.1-14	16%	23.4%	16.3%	12.6%	20%	9.8%	17.1%
>14 (Median = 28)	44.6%	45.3%	38%	36.8%	48%	36.6%	62.9%
Freqency of Use							
< daily	11.1%	8.8%	12.6%	14.1%	3.9%	24.5%*	5.3%
1x day	13.5%	10.3%	15.5%	18.5%	15.6%	15.1%	2.6%
2-3x	33.2%	30.9%	30.1%	39.1%	33.8%	30.2%	36.8%

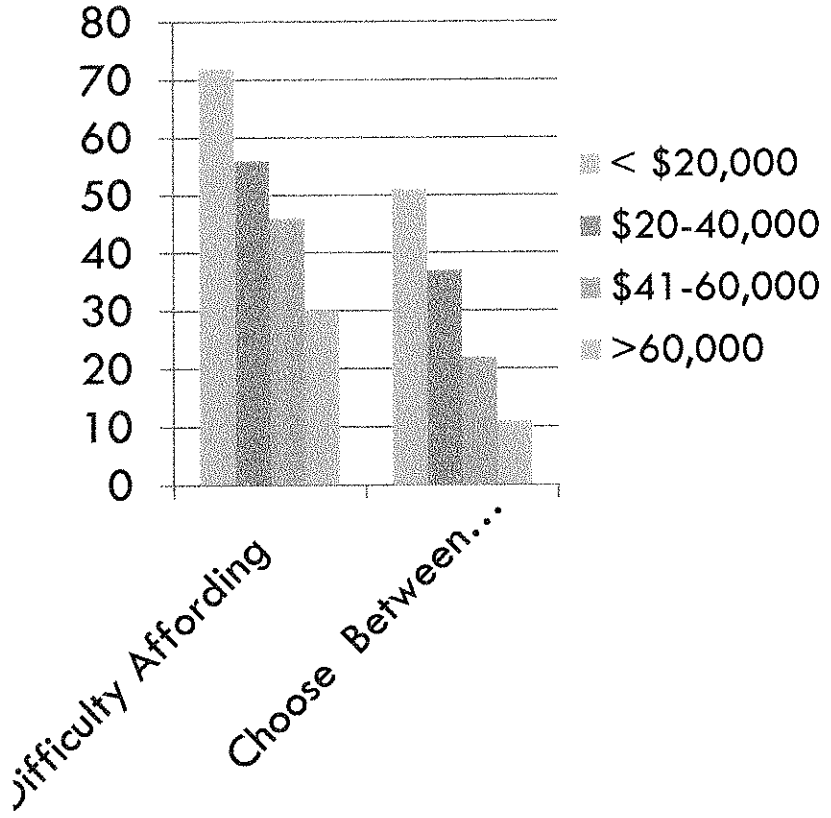
Access - Modes

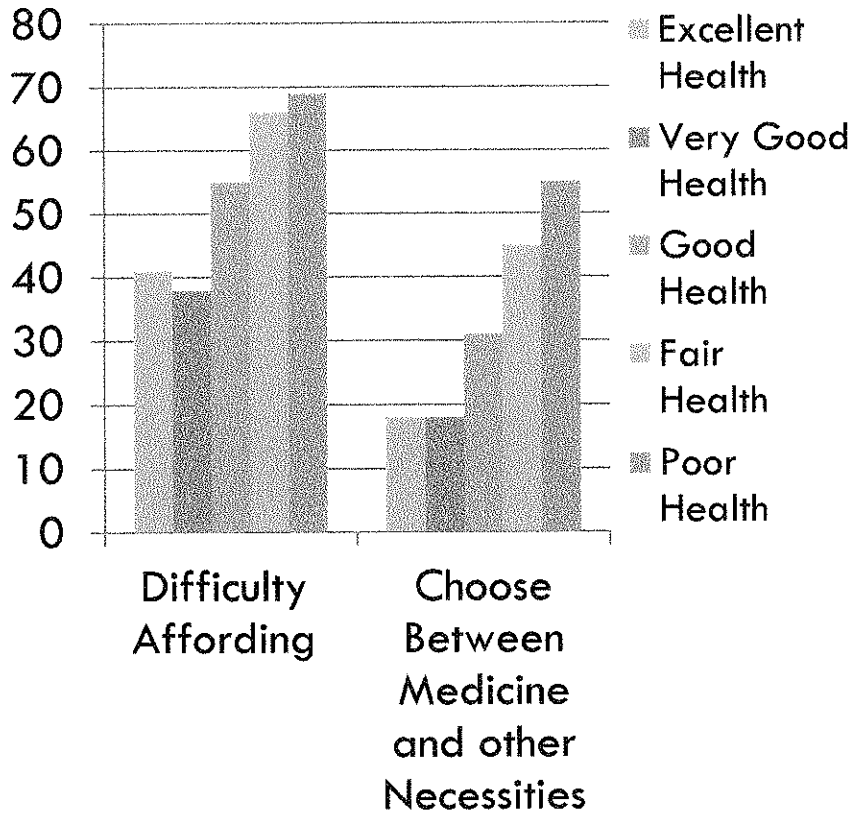


Access – Obstacles

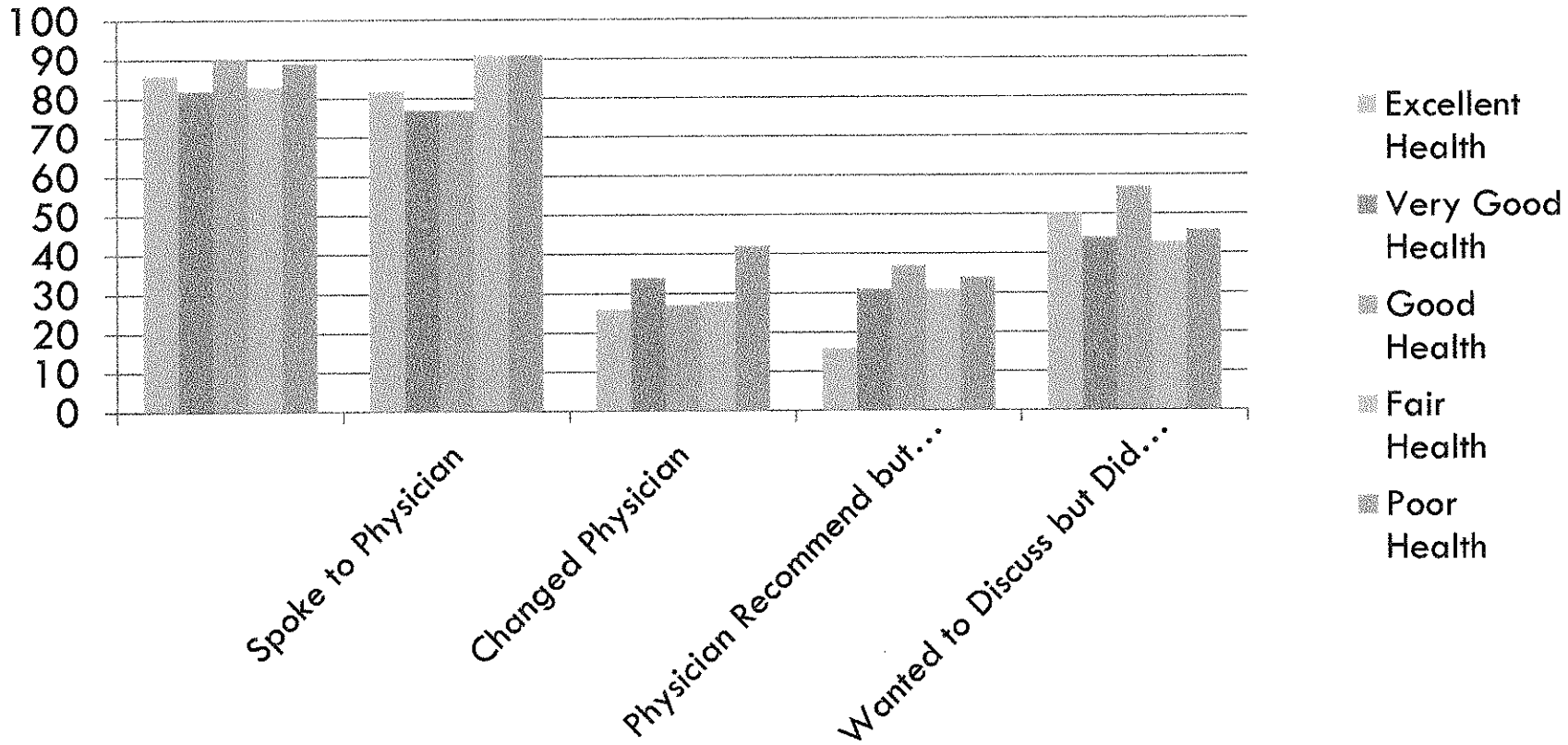
- Difficulty finding a physician to sign application:
  - 32% changed physicians
    - 38% did so once
    - 27% did so twice
    - 24% did so three times or more
  - 48% wanted to discuss cannabis but did not do so
    - fear of discrimination
    - feelings of discomfort
    - fear of annoying the physician
  - 50% relatively less satisfied with CTP-related physician interactions than with interactions that were unrelated to CTP
  - 31% felt discriminated against

Access – Affordability

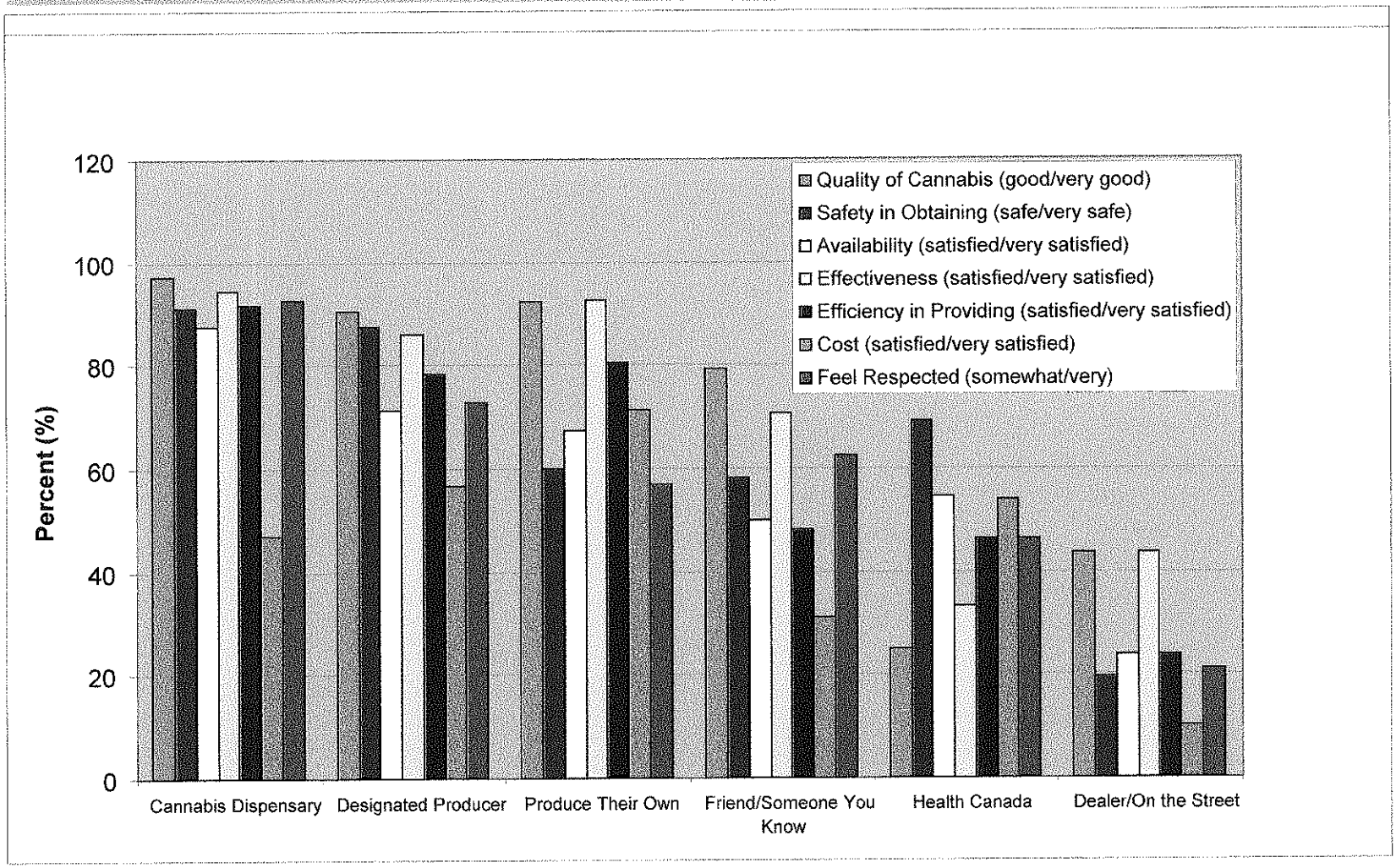




Access – Availability



Access – Modes



Discussion

- Reasons for use and perceived effectiveness were generally consistent across medical conditions; respondents overwhelmingly reported using cannabis to effectively address pain, sleep disturbance, and anxiety.

- A substantial disconnect between the medical use of cannabis and research on the risks and benefits
  - Particularly evident with regard to the anxiolytic and sedative use
  - Extrapolation from our sample to the national population of CTP users suggests that the number who use cannabis for these purposes is comparable to the number who currently use benzodiazepine and other sedatives (Kassam & Patten, 2006).

Discussion

- Authorized and unauthorized users exhibit few meaningful differences with regard to medical conditions and patterns of use, but face substantial differences regarding access
  - many seriously ill Canadians risk legal sanction and other negative outcomes associated with accessing cannabis from illegal markets.
- Medical cannabis users are nearly unanimous with regard to experiencing substantial obstacles to access
- Affordability is a substantial barrier to access – respondents from all income groups reported difficulty affording medical cannabis
  - Worse among those with the poorest health
- Physician communication is also a substantial barrier to access
  - A substantial portion of even the most seriously ill patients have had recommendations to use medical cannabis and support denied for obtaining legal access
- Medical cannabis dispensaries are the preferred mode of access across multiple dimensions of patient satisfaction

Cost-Benefit Analysis of Regulatory Changes for Access to Marihuana for Medical Purposes

Final Report

December 2012

Prepared by:

David Stambrook, Senior Economist, Delsys Research Group Inc.

Derek Ireland, Ph.D., Senior Economist, Delsys Research Group Inc.

Wei Xie, Senior Policy Analyst, Delsys Research Group Inc.

This is Exhibit "E" referred to in the affidavit of Zachary Walsh sworn before me at Kelowna BC this 15th day of Jan 2014

A Commissioner for taking Affidavits for British Columbia

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Final Report

Cost-Benefit Analysis of Regulatory Changes for Access to Marihuana for Medical Purposes

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Table of Contents

Executive Summary

The Government of Canada requires a Cost-Benefit Analysis (CBA) to be undertaken as part of the Regulatory Impact Assessment process involved in publication of certain proposed Regulations in the Canada Gazette – Part 1. This requirement was applicable for the development of the proposed Marihuana for Medical Purposes Regulations (MMPR), which will replace the existing Marihuana Medical Access Regulations (MMAR).

The Marihuana Medical Access Program (MMAP) is governed under the Marihuana Medical Access Regulations pursuant to the Controlled Drugs and Substances Act (CDSA). The current regulations came into effect in 2001 after Canadian courts ruled that individuals demonstrating a medical need for marihuana have a Charter right to possess marihuana and to have reasonable access to a legal source of supply. The MMAR provide a process for Canadians to legally obtain access to marihuana for medical purposes by applying to Health Canada for an authorization to possess (ATP) and, if applicable a license to produce.

An authorization to possess dried marihuana for medical purposes requires application by an individual to Health Canada. The individual must obtain physician support for their application to access dried marihuana.

Persons authorized by Health Canada to possess may obtain access to dried marihuana via three supply methods:

1. Government supply: purchase of dried marihuana from Health Canada through a contracted government supplier;

2. Personal-use production: under a Personal Use Production License (PUPL) to produce for their own use; or

3. Designated-person production: under a Designated Person Production License (DPPL) where another individual produces for a person authorized to possess dried marihuana.

About 60% of current persons with an ATP access marihuana through PUPL, 20% access through DPPL, 10% access through the Government supply and 10% appear to access marihuana from unknown supply sources. As of August 13, 2012 there were 21,986 ATP persons under the MMAP. The MMAP has grown at an exponential rate since its inception and has generated a number of public policy concerns.

In 2009, following the expression of significant stakeholder concerns with the current program, the Minister of Health instructed Health Canada officials to conduct a review of the MMAP. In 2011, the Government of Canada proposed changes to the regulatory framework based on the concerns that had been expressed. There was a public and targeted stakeholder consultation on these proposed regulatory reforms, which will lead to the publication of draft regulations in Canada Gazette-Part I, for which the CBA was undertaken.

Proposed Regulatory Changes

The objective of the proposed Marihuana for Medical Purposes Regulations is to reduce the risks to public health, security and safety of Canadians, while significantly improving the way in which individuals access marihuana for medical purposes.

To reduce the risks to public health, security and safety of Canadians, a new supply and distribution system for dried marihuana would be established that relies on commercial production of marihuana for medical purposes. Security requirements would be in place for the production site and key personnel of the licensed producer (LP). Standards for packaging, transportation and record-keeping would contribute to achieving security objectives.

The process for individuals seeking to access marihuana for medical purposes would no longer require application to Health Canada. Individuals would obtain marihuana, of any strain commercially available, by obtaining the support of a health care practitioner (a physician or, potentially, a nurse practitioner), and subsequently purchasing marihuana from commercial producers that are licensed by Health Canada under the proposed regulations. Quality and sanitation standards appropriate for a product for medical use will be in place. In line with other controlled substances, personal and designated production of marihuana for medical purposes would be phased-out. This would reduce the health and safety risks to individuals and to the public, while allowing for a quality-controlled and more secure product for medical use.

CBA Methodology and Results

Both quantitative and qualitative analytical methods were applied in the CBA. The study developed and applied a consistent approach to modelling the Status Quo scenario (existing policy and regulations) and the Policy scenario (proposed policy and regulations). There were four basic components of the quantitative (i.e., quantified and monetized) model for each of the two cases:

- User benefits and costs: Costs associated with the production and consumption of marihuana for medical purposes through authorized methods;

- Program administration costs: Costs borne by Health Canada in the exercise of authorization, licensing and inspection powers under the regulations;

- Safety costs: Costs associated with health and safety consequences of residential marihuana cultivation, which focus on the risk of residential fires from production licenses, especially in cases of misuse and supply of the illegal market; and

- Security costs: Costs associated with violence and home invasions directed at residential marihuana cultivation misuse and supply of the illegal market.

The quantitative analysis focused on a "Reference case" which represents the most likely outcome of the regulatory change. Sensitivity analysis of the results was undertaken by identifying key parameters associated with uncertainty/risk, and modelling a likely range and

distribution of these parameters whose impact on the results was explored probabilistically using a Monte Carlo method.

The study focused on the consumption of marihuana for medical purposes obtained from a legal source of supply. The broader issue of illicit market supply and use was considered to be outside the scope of the study. The only aspect of illegal activity that is included is the misuse of residential production licenses under the Status Quo scenario and its likely decline in the Policy scenario.

Reduction in Residential Fire Risks

The focus on safety impacts was on the risk and consequences of residential fires resulting from faulty electrical wiring, overloading of electrical circuits, tampering with electrical usage monitoring and other electrical system malfunction arising from indoor marihuana cultivation. The analysis assumed that under the proposed policy, the risks of property damage, personal injury or death resulting from marihuana production-related fires would be significantly reduced but not completely eliminated. Over the period from 2014-24, the social costs of adverse safety events related to marihuana for medical purposes production was estimated to be reduced by about 40% under the proposed regulations, at a present value of $64.32 Million. This represents annualized savings (avoided costs of property damage, injury and death from residential fires) of approximately $9.58 Million per year for 10 years.

Reduction in Risk of Break-Ins/ Home Invasion

The focus of the security impacts was on the risk and consequences of home invasion, violence targeting residential production involved in misuse, and criminal activity related to marihuana distribution on the illegal market. Information from Canadian law enforcement authorities on misuse of production licences, home invasions and shootings was used as the basis to estimate the risk of violence. Overall, the analysis valued the projected reduction in the risks of break-ins/home invasions due to the proposed policy at $0.38 Million in 2014, rising to $26.48 Million in 2024. The present value of security cost savings under the proposed policy was estimated at approximately $89.03 Million over the policy impact period, with an average annualized value of $13.27 Million. The proposed policy would have lower security costs (over 40% lower than under the status quo) due to the reduction in misuse activity that results from the expectation that eliminating personal and designated production in favour of a commercial licensing scheme would deter individuals interested in exploiting the current Program.

Program Administration Costs Savings

Under the current Program, Government administration costs have increased significantly as the number of Program participants has grown. In the absence of the proposed regulatory changes, the analysis assumed a continuation of the growth in Program applications and corresponding substantial increases in the cost to Health Canada to authorize possession and licensed production of marihuana for medical purposes, provided that program participation continues to grow at the current rate. The CBA estimated that the administration cost of the current Program would increase from $20.63 Million in 2014 to over $120M in 2024 in the

absence of any changes. These costs include salary, employee benefits and accommodation costs associated with dedicated staff, operations and maintenance costs, training, supplies and other corporate overhead costs.

Under the proposed Policy scenario, Health Canada would eliminate the role it plays in determining eligibility of persons to access a supply of marihuana for medical purposes, and return to its traditional role as a regulator of industry. This results in significant administrative cost savings over the policy impact period. Under the Policy scenario assumed for the new regulated market, the regulatory proposal was estimated to lead to more than a 90% reduction in Health Canada's administrative expenditures. The present value of administration costs savings over 10 years was estimated at $478 Million. On average, the proposed regulations would generate administrative cost savings of approximately $71.24 Million per year over this period.

Producer Surplus Gains

The proposed regulations would establish a regulated commercial market for the production and sale of marihuana for medical purposes. Private industry participation in the proposed regime is expected to yield benefits to society. Under the status quo, marihuana is either produced through private arrangements or at a cost to the tax-payer. There are no benefits to society at large beyond the benefits to the individuals involved. Under the proposed regulations, there would be beneficial impacts for the industry, over and above the benefits to the individuals involved in the market. The analysis measured this change in welfare by estimating a change in producer surplus gains under the proposed policy. No producer surplus is derived in the status quo. The CBA found that the new regulated market would generate an overall producer surplus of $2.64 Million in the first year of implementation 2014, rising to about $110 Million in 2024 as the market expanded. The present value of producer surplus gains over the policy horizon (2014-2023) was estimated at $339.85 Million or about $50.65 Million (annualized average) per year for 10 years.

Reduction in Deadweight Loss

The CBA estimated the deadweight loss under the current marihuana access regime from the effective subsidy to supply that resulted in excess demand relative to what a market equilibrium quantity would be. The value of this economic efficiency loss was relatively small as the Government supply component in the CBA model was comparatively small. Under the proposed regulations, the analysis assumes the imposition and payment of the regular consumption tax (HST) by consumers of marihuana under the proposed framework. Both the presence of an effective subsidy in the government supply market for the status quo and the assumed, potential imposition of tax on purchases in the commercial market were projected to cause welfare losses to society by distorting market signals and causing sub-optimal allocation of scarce resources.

The economic efficiency loss under the status quo was estimated to be reduced by about $1.51 Million during the first year of implementation (2014), rising to about $7.70 Million in 2024. This represents an average annualized reduction of about $5.03 Million or a total present value of approximately $33.74 Million over 10 years. Overall, the reduction in deadweight loss is small and not a significant benefit of the regulatory change.

In total, the present value of benefits of the proposed regulations was estimated to be $1.005 Billion from 2014-2024. On average, this represents an annualized savings of approximately $149.77 Million each year for 10 years.

The CBA projected the negative impacts of the proposed policy on social welfare on the basis of a change in the welfare of the individuals most directly affected by the regulatory change. Because the available scientific evidence does not conclusively support use of dried marihuana for therapeutic purposes, the causal relationships between the use of the substance and purported medical benefits are inconclusive. Thus, the analysis chose to measure the change in individual welfare under the policy directly by estimating the change in users' consumer surplus. Economic theory does not require the existence of scientifically proven medical benefit in order to measure the welfare implications of a public policy change. The observation that some in society are willing to pay to obtain marihuana for medical reasons was deemed as a sufficient basis for measuring a change in consumer welfare.

Loss of Consumer Surplus

Consumer surplus was estimated as the area under the demand curve and above the price consumers would potentially pay for marihuana under the proposed MMPR. Under the proposed policy, the analysis projected a reduction in the number of authorized users of marihuana for medical purposes vis-à-vis the Status Quo, and a reduction in the quantity consumed due to a potential increase in the price of marihuana in the regulated market. Under this scenario, the CBA predicted a significant loss of consumer surplus from this policy change.

The analysis assumes a price change from about $7.60 per gram to about $8.80 per gram over the 10 year period. This assumption reflects the potentially higher cost of producing marihuana in the new commercial market, compared to personal or designated production under the current MMAP. The higher price also reflects the potentially higher product quality due to quality control measures to limit contaminants and toxic substances and to ensure a product of consistent quality over time. The analysis assumes that this projected price change would lead to a decrease in the relative number of individuals who obtain marihuana for medical purposes from a legal source by about 30% over the next 10 years compared to the Status Quo scenario.

The total quantity of marihuana consumed was also estimated to decrease. On average, the loss in consumer surplus (representing the total social costs of the proposed regulations) was estimated to be about -$166 Million per year. The present value over 10 years was estimated to be about $1.115 Billion. (The study did not estimate consumer surplus for any consumption derived from illicit supply sources).

Business Compliance Costs

Business compliance costs were estimated as 10% of overall supply cost. On this basis, business compliance costs were estimated to be about double under the proposed Policy scenario. As business compliance costs are incorporated in the supply cost for both the Status Quo and Policy scenarios, they do not form part of the CBA. The business compliance costs mostly fall on medium and large business (as opposed to smaller businesses), as the scale of licensed producer activity (in terms of employees and sales revenue) is expected to grow beyond that of a small business after two years.

Net Present Value

The Reference case, representing the most likely outcome of the cost benefit model, was the focus of the quantified results for the net present value over a ten year forecast period from FY2014-15 to FY 2023-24. The net present value was calculated to be -$109.7 Million with an annualized value of -$16.35 Million. This loss in consumer surplus results from reduced relative growth in consumption and a higher supply price, due mostly to the shift from less-costly home production to a commercial market with appropriate regulatory controls and oversight.

The Status Quo scenario was modeled on the assumption that Government resources required to administer the current Program would continue to grow over time to fully accommodate the required Program uptake, in terms of numbers of persons wanting to access a legal source of marihuana for medical purposes. The Program administration cost was projected to increase from $13.8 Million (FY2013-14) to over $120 Million (FY2023-24). In reality, it is highly unlikely that such additional resources would be available to accommodate the forecast increase in Program participation in an era of fiscal restraint.

Results by Stakeholder

Government, especially the federal government, is the main beneficiary of regulatory change, through the reduction in Health Canada's program administration costs.

Industry, especially medium-sized business, is also a beneficiary in terms of producer surplus benefits and the expansion of a regulated industry to supply marihuana for medical purposes that could grow to more than $1.3 Billion per year in annual sales by the end of the forecast period. It is important to note that producer surplus is not related to profitability and should not be taken as such an indicator.

Households, especially users of marihuana for medical purposes authorized under the MMAR, are the stakeholder that is most impacted by the reduction in consumer surplus. The general public, in contrast, benefits slightly in terms of reduced deadweight loss and the reduced safety costs, which would be borne through residential insurance. The general public would be a major beneficiary if the government benefits were attributed to them as ultimate taxpayers.

Results by Region

Several regions have negative overall impacts, as these are dominated by the consumer surplus reduction, which is allocated based on MMAP participation. The two regions with disproportionate shares of MMAP participation (relative to population) are British Columbia and the Atlantic region (primarily Nova Scotia). Some regions are shown to have positive overall impacts as the locus of government activity is in Ontario (where there are savings from lower administrative costs) and the locus of the existing marihuana production activity is in the Prairie region.

Sensitivity Analysis

A full assessment of the sensitivity of the net present value result to all key parameters was undertaken using Monte Carlo probabilistic methods. The results showed that there was substantial variability in the estimate (a range of -$26 Billion to +10 Billion, with a mean of -$1.688 Billion).

The sensitivity analysis highlighted an inherent uncertainty regarding various impacts of the proposed regulatory change. These uncertainties arise due to:

i) the rapid growth in the number of persons wishing to access marihuana for medical purposes under the proposed supply and distribution scheme;
ii) the fundamental change that the elimination of individual production licenses will bring about;
iii) the complex dynamic behaviour that arises from: a) price elasticity effects (for non-trivial effective price change); b) deterrence effects related to criminal misuse of production licenses; and c) the market entry and price-setting mechanics and dynamics involved in the establishment of a new industry and market; and
iv) the inherently unknown outcome for the end state in FY2023-24.

There are plausible parameter values that would give rise to a very large negative net present value as well as those that would give rise to a very large positive value. The parameters with the biggest impact on the quantitative result influence the valuation of the consumer surplus (the supply costs for personal use and designated person supply and the price elasticity of demand in the status quo). The other parameters with large impacts are an affordability parameter relative to mean annual income which limits the quantity of marihuana for medical purposes consumed in the policy scenario with higher supply price; and parameters which estimate the volume of marihuana consumed in the status quo.

Qualitative Discussion

The qualitative discussion uses the major findings from the Literature Review, Stakeholder Consultations and other sources to describe some of the additional benefits, costs and risks of the regulatory change that may be important over the longer term, but cannot be quantified and monetized at this time because of data constraints and the unique attributes of the policy scenario.

Major attention is given to:

i) additional safety and security issues, impacts and possible benefits;

ii) reductions in information, administration and other transaction costs for users, the medical community and other stakeholders;

iii) the possible longer-term benefits from the full establishment of a large, competitive and innovative industry for users of marihuana for medical purposes, the economy and Canadian society; and

iv) the longer term possibility that a fully functioning and reasonably competitive, efficient and innovative market will promote the process of "reverse diversion", whereby the legal market expands at the expense of the illicit drug market.

These qualitative benefits could be substantial over the longer term, but they are highly contingent on a number of economic, social and regulatory factors and would likely become measurable and substantive only near the end of, or after, the ten-year projection period for the quantified CBA.

Conclusions

There is no Pareto efficient result that supports a statement that one option is superior. The Reference case (Policy scenario) results indicate that the sum of benefit and cost changes across all stakeholders is slightly negative. It can be characterized as being only slightly negative because the sensitivity analysis of the result shows a wide range of possible outcomes with a central tendency near zero.

One class of stakeholder bears the cost (in terms of a reduction of benefits) from consumer surplus - namely the users of marihuana for medical purposes. The remaining stakeholders (e.g., the general public, government, commercial producers) are made better off.

These results are qualified in the analysis by highlighting some of the methodological challenges facing the discipline of cost benefit analysis in such a rapidly growing Program context involving fundamental change and complex dynamic behavioural responses.

Economists measure user benefit in terms of consumer surplus. The available scientific evidence does not support the acceptance of marihuana for medical therapeutic use. However, Canadian courts have ruled that individuals have a legal right to possess marihuana for medical purposes and that the Government of Canada has a legal duty to provide reasonable access to marihuana for such purposes. The consumer surplus measure is not evidence, in any fashion, of the existence of medical benefits attributed to the consumption of marihuana for medical purposes. Therefore, the significant consumer surplus over the forecast time period that is reduced by the proposed regulatory change (due to lower consumption levels and higher supply price) may arguably be discounted by policy makers.

This analysis has monetized and quantified the benefits to be gained from reducing risks to public health and safety, to the extent possible, and these benefits are significant in number and value. The Reference case does not show these to outweigh the loss in consumer surplus. It may be that the ability of economists to apply a social valuation to these impacts may not adequately reflect a social valuation of the maintenance of public health and safety.

In addition, it is possible that there will be substantial benefits that can only be assessed qualitatively at this time. These include greater reduction in safety and security risks, reduced costs for consumers, and the benefits of establishing a competitive and innovative legal industry of marihuana for medical purposes.

This CBA report is divided into six sections:

Chapter One presents an overview of Access to Marihuana for Medical Purposes.

Chapter Two profiles Stakeholder groups who may be affected by the proposed regulatory changes: Consumers and Households; Industry; and Government.

Relevant literature on marihuana use, crime prevention and public safety, regulatory compliance and system dynamics theory are summarized in Chapter Three.

Chapter Four discusses the CBA methodology. A description of the model developed and used in deriving monetized valuations of costs and benefits for the status quo and policy scenarios is presented.

The results of the analysis as well as a discussion on qualitative effects are presented in Chapter Five, followed by a series of conclusions of the overall study in Chapter Six.

Each of these sections is discussed in detail in the next pages.

CHAPTER ONE

1.0 Overview – Access to Marihuana for Medical Purposes

Access to marihuana for medical purposes in Canada is governed under the Marihuana Medical Access Regulations (MMAR) pursuant to the Controlled Drug and Substances Act (CDSA).

The current MMAR came into effect in 2001. They provide a process for Canadians to legally obtain access to marihuana for medical purposes. Currently, persons with an Authorization to Possess (ATP) may obtain marihuana from one of three legal sources:

1. Under a Personal Use Production License (PUPL) to produce for themselves;
2. Under a Designated Person Production License (DPPL), where another designated individual can produce for them; or
3. Through purchase of dried marihuana from Health Canada through a Government Supplier.

The Marihuana Medical Access Program (MMAP), which administers the MMAR, has grown at an exponential rate from 2003 to 2012. With this growth, a number of concerns have been identified. These include:

- Escalating cost under the contract with the government supplier;
- Increasing administrative burden/cost of managing the MMAP under Health Canada;
- Negative impacts on communities and law enforcement where personal and designated production occurs; and
- Concerns from the medical community that they do not have sufficient information about marihuana for medical purposes to allow them to appropriately discuss risks and benefits with their patients.

A review of the MMAP was undertaken by Health Canada during 2010-11, which gave rise to a significant public consultation process and subsequent proposed regulatory changes.

1.1 Government Objectives

In 2010, the Minister of Health committed to a review and reform process for the MMAP with four pillars:

1. Protection of public health,
2. Safety and security;
3. Provision of reasonable access to marihuana for medical purposes; and
4. Examination of the overall costs to the Government of Canada.

1.2 Access to Marihuana for Medical Purposes

Authorization to possess marihuana for medical purposes requires application by an individual to Health Canada. The individual must obtain physician support for their access. Unlike medical therapies and drugs that are authorized by Health Canada – after scientific review of clinical studies which have demonstrated clinical efficacy and safety– dried marihuana for medical purposes has not been authorized for sale and distribution in Canada because its benefits have not been scientifically proven to outweigh its risks. This has complicated government policy, especially after Canadian courts ruled that the Government of Canada has a responsibility to ensure reasonable access to a legal source of marihuana for individual use for medical purposes.

In response to Canadian court rulings, the MMAR provide a structure that allows Canadians to access a legal supply of marihuana for medical purposes. Two categories of patient symptoms are recognized:

> Category 1: individuals who suffer various symptoms (related to Multiple Sclerosis, severe arthritis, cancer, epilepsy, HIV/AIDS, spinal cord injury/disease or for compassionate (end-of-life) care).
>
> Category 1 individuals must have a physician signature in support of the application for Authorization to Possess; and
>
> Category 2: individuals who suffer any other symptoms for which conventional treatments have been deemed inappropriate.
>
> Category 2 individuals must have a physician signature in support of the application for Authorization to Possess and an assessment by a specialist in an area relevant to the treatment of the individual's medical condition (unless the physician is such a specialist).

Once an individual has applied and been approved for an Authorization to Possess, they can:

1. Apply to access the Government Supply of dried marihuana. This is provided through a firm contracted by the government, Prairie Plant Systems (PPS), with deliveries made directly to a residence using regular courier service;

2. Apply for a 'Personal-Use Production License' (PUPL), with seeds for cultivation that are available from PPS; or

3. Designate someone else to produce on their behalf under a 'Designated-Person Production License' (DPPL) with seeds for cultivation available from PPS.

Historically, persons with an Authorization to Possess dried marihuana under the MMAR have been comprised of:

- 60% who access marihuana for medical purposes through personal production;
- 20% who access marihuana for medical purposes through designated production;
- 10% who purchase dried marihuana for medical purposes from Health Canada; and
- 10% for whom there is an unaccounted supply.

1.3 Government Supply Contract

Since 2000, the Government of Canada has contracted for the supply of marihuana for medical purposes with Prairie Plant Systems Inc. (PPS). Initially, this arrangement was established to support research on the risks and benefits associated with the use of marihuana for medical purposes.

Persons who rely on the government supply pay a flat fee of $5.00 per gram, with no additional shipping cost. The supply cost for the government supply is around $11.00 to $12.00 per gram. As a result, there is an effective subsidy to the user of more than 50% of the product cost.. This price structure was introduced in 2003 and was based on an estimated number of 300 individuals participating per year. About 2,300 persons are expected to rely on the government supply during FY2012-13.

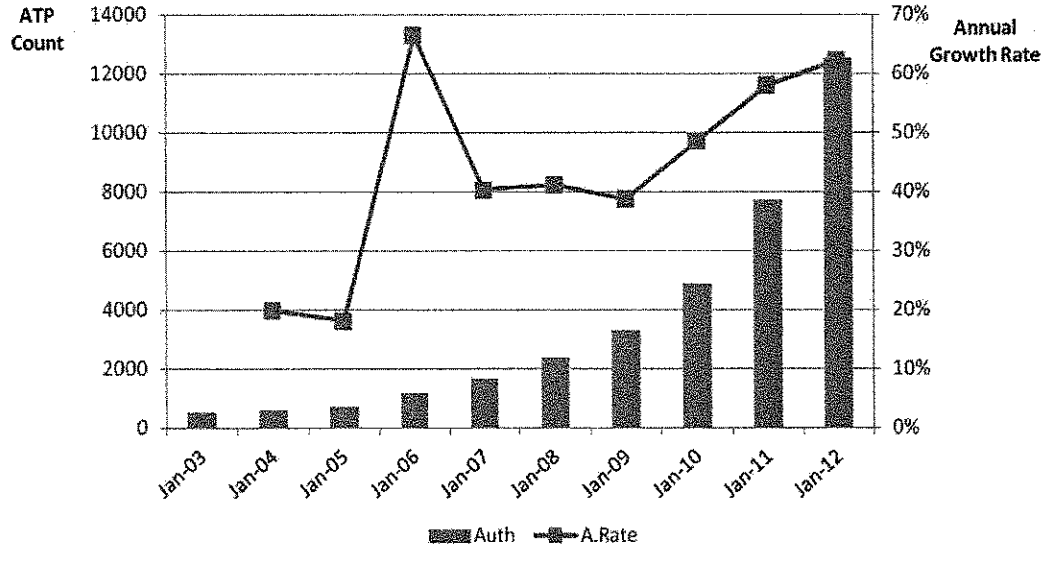
In 2003, the government supply contract was expanded to meet Court-imposed requirements, under the Canadian Constitution, to provide reasonable access to a legal source of marihuana for medical purposes to approved users. The existing contract was amended to cover the period to October 2008. The contract was then re-awarded to cover the period to October 2011. A competitive RFP process was undertaken during 2009-10 in which PPS was the successful bidder to provide the government marihuana supply through to March 2014 (including an option year).

The current (2010) contract involved an estimated contract price (over 3 fiscal years) of $16.8M with an option to extend to the 2013-14 fiscal year.

1.4 MMAP Activity Volumes

As of August 13, 2012, there were 21,986 persons with Authorizations to Possess. The exponential growth of MMAP over time is shown in Figure 1.1, which documents a nine year cumulative growth rate of 43%.

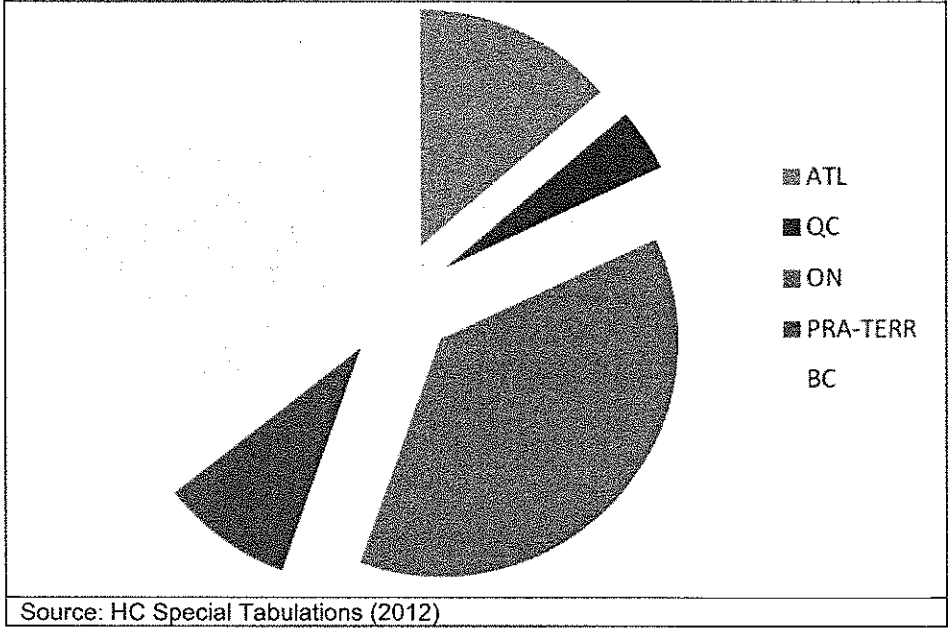
Figure 1.1 – Growth of MMAP (Persons with AP)



Source: HC website, HC data (2012)

Figure 1.2 shows Authorizations to Possess by region. Certain provinces have shares of MMAP participation that exceed their population shares, most notably British Columbia and Nova Scotia. The share of MMAP participation for Quebec is disproportionately lower than its population share.

Figure 1.2 – Authorizations to Possess (ATP) By Region



Source: HC Special Tabulations (2012)

In 85% of recent ATP applications, there was a single reported disease condition, while in 15% of cases there were two or more disease conditions reported.

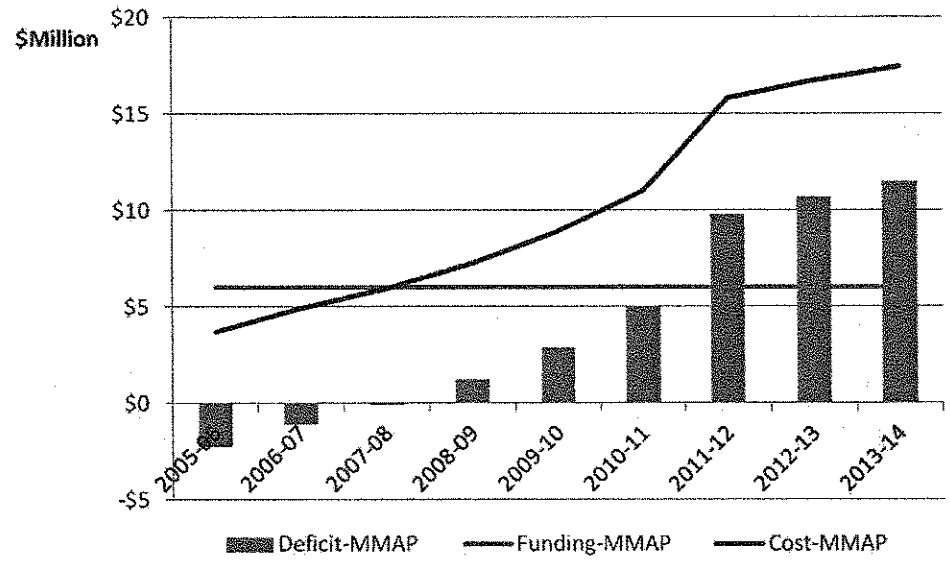
The majority (72%) of ATP applications involved Category 1 medical conditions (i.e., severe arthritis, spinal cord injury, spinal cord disease, multiple sclerosis, cancer, AIDS/HIV, epilepsy or others) while a minority (28%) involved Category 2 diseases for which a specialist (in addition to a General Practitioner) had to support the application. The Category 2 medical conditions included: chronic pain, Crohn's Disease and Hepatitis B and C.

1.5 MMAP Program Costs

Since FY2005-06, the MMAP has been resourced at an 'A-base' funding level of $6.0M per year. Against this, program costs (comprised of HC salary, O&M and corporate costs for program administration and the contract costs for the government suppler) have risen sharply in response to the exponential increase in the number of ATP-persons. This is shown in Figure 1.3, which shows program costs of $8.9M (FY2009-10) with forecast growth to $17.5M (FY2013-14). Roughly half of MMAP program costs relate to HC program administration; the other half relate to the contract costs for the production and distribution of marihuana for medical purposes.

The expected program deficit would increase from $2.9M (FY2009-10) to $11.5M (FY2013-14) and continue to grow over time. In the current fiscal restraint environment this is a major challenge.

Figure 1.3 – Forecast Growth of MMAP Costs ($Million)



Source: HC Supplemental Funding Request (2010)

1.6 Concerns with MMAP

Residential marihuana cultivation, which is authorized under PUPL and DPPL production licenses, is the primary concern related to safety and security.

Canadian law enforcement authorities have documented alleged cases of misuse of marihuana production licenses relating to diversion of product to the illicit market. Some 190 cases of alleged criminal misuse were reviewed over the period from 2003 to 2010. Some of these involved the presence of a weapon (8% of misuse cases), violent attacks and home invasion (8%) and shootings (1%). About half of the misuse incidents involved persons holding production licenses who had previous criminal records.

It may be more onerous for law enforcement to obtain an entry warrant at a residence that is a licenced production site (PUPL or DPPL) where it is believed that marihuana is being diverted to the illegal market, as the existence of this legal operation cannot likely on its own constitute reasonable and probable grounds that an offence has been committed. This means that evidence over and above the mere existence of residential marihuana production must be obtained through investigation, intelligence gathering, tips received, the presence of unusually high electrical consumption, etc., in order for police to have the requisite reasonable and probable grounds on which to obtain a search warrant for a MMAP site. This need for evidence beyond the existence of residential cultivation of marihuana is referred to in this analysis as the need for additional evidence. As stated earlier, it follows that law enforcement, under the new program, may be able to obtain search warrants with only evidence of residential cultivation, as all residential cultivation of marihuana will be illegal.

Law enforcement authorities believe that current production levels can generate much higher yields per marihuana plant than what is estimated by Health Canada for the purpose of determining the 'maximum number of plants' permitted to be grown to generate a reasonable

legal supply for medical use. Their concern is that persons have the opportunity to grow well in excess of their authorized daily amount for medical use and also supply to the illicit market from their excess supply (even if they are within the approved limit of marihuana plants).

Health Canada has limited inspection resources to ensure compliance with the conditions of production licenses in residences and cannot enter a residence without the homeowner's consent in the absence of a warrant. In 2010, Health Canada carried out inspections of 75 MMAR production license sites. Of the 27 sites for which a person answered the door, only 55% allowed inspection of the residence and 45% refused the inspection.

Residential marihuana cultivation (usually indoor hydroponic) gives rise to various safety concerns. There is an increased risk of fire associated with 'jerry-rigged' modifications to home electrical systems by unqualified individuals. It is recognized that residences used for marihuana production have a much higher risk of residential fire than a normal residence. The review based on Canadian law enforcement information of MMAP misuse identified an electrical hazard in 12% of cases and there were 2 cases (1%) where residential fires had occurred.

In addition to fire risk, the presence of high humidity (from poor ventilation of indoor cultivation) can lead to mould build-up that is associated with an increased prevalence of asthma-related symptoms such as chronic wheezing, irritation symptoms, and non-specific symptoms. There is also potential exposure to chemical contamination from pesticides and fertilizers.

There is also broader social concern with the exposure of children to marihuana through home-based marihuana cultivation. The presence of marihuana at home increases potential drug access, exposure to potential illegal activities, criminal association and possible home invasion. The police noted that children were present in 15 of the alleged misuse cases (8% exposure rate).

These concerns are addressed, where possible (given available empirical literature and empirical data), in the methodology section of this report.

1.7 Regulatory Proposal

Under the proposed regulatory changes:

- Physicians and nurse practitioners will provide the patient with a medical document which will then authorize the patient to order marihuana from a Licensed Producer (LP). The patient will then register to become a client of the LP and the LP will verify the information provided by the patient. Health Canada will play no direct role in this process;
- Residential marihuana cultivation will no longer be authorized;
- The production and distribution of marihuana for medical purposes will be restricted to producers who apply to be licensed for this purpose by Health Canada as a LP;
- Patients will register and order dried marihuana directly from an LP by phone, fax, mail or on-line and be required to provide an original medical document from an authorized health care practitioner in support of their registration;
- The LP will determine whether: a) the physician/nurse practitioner document is genuine; b) the physician/nurse practitioner document has not been tampered with; and c) the

physician/nurse practitioner is in good standing with an appropriate professional licensing authority;

- The LP will ship marihuana directly to their registered client, or to a physician/nurse practitioner, pharmacist or hospital;
- The LP 'product label' will act as necessary proof of authorization of possession of marihuana for medical purposes;
- Health Canada will manage the licensing, auditing and inspecting of LPs;
- The LP is the commercial entity that will supply dried marihuana to meet the authorized demand for the use of marihuana for medical purposes, subject to commercial viability; and
- The commercial market will determine the price of supply/demand of marihuana for medical purposes in an unregulated manner.

The proposed changes anticipate the commercial viability of LP entrants and a high degree of competition in the market, which should lead to efficient production and prices that are sufficiently competitive so as to lead to continued growth in volumes demanded by individuals with a healthcare practitioner's support to use marihuana for medical purposes.

1.8 Potential Benefits of the Regulatory Proposal

Under the proposed changes, the regulations will no longer specify the disease conditions for which marihuana may be authorized by physicians or other authorized health care providers. In addition, Health Canada will no longer be involved in:

- subsidizing marihuana for medical purposes; and
- managing the authorization process to access a legal source of marihuana and having access to confidential personal medical information.

Law enforcement will no longer be unsure about:

- whether marihuana cultivation is permitted in a residence (as all such production will be illegal).

Fire/emergency services and municipal authorities will no longer be unsure about:

- whether a residence may pose a safety threat as a result of the cultivation of marihuana for medical purposes under the MMAR, with potential fire/electrical hazard, toxic chemical hazard and mould hazard.

The purpose of the subsequent sections in this report is to present the results of the CBA conducted to assess and quantify the social benefits and costs that are likely to arise from the regulatory proposal, by inducing behavioural change that alters the level of net social benefits.

CHAPTER TWO

2.0 Stakeholder Summary

This section presents a portrait of various agents and actors in society who are likely to be affected by the proposed regulatory changes governing access to marihuana for medical purposes. In general, stakeholders affected by the public policy change fall into three broad categories: a) households or consumers; b) businesses or industry; and c) governments. The proposed regulations are expected to impact individuals and institutions in all three categories.

A. CONSUMERS & HOUSEHOLDS

2.1 Current and Future Users of Marihuana for Medical Purposes

The first category of consumer stakeholder includes those persons currently engaged with the Marihuana Medical Access Program (MMAP). These are individual Canadians who have been authorized to possess marihuana for medical purposes in response to a particular medical condition. There were 21,986 such persons as of August 13, 2012. It is important to note, however, that the number of participants in the MMAP has grown exponentially over the past ten years, with 40% year-on-year growth from 2003 to 2010, and then 60% from 2010 to 2011. This dramatic growth is crucial to understanding the needs of both the Status Quo and the Policy scenarios, as this is a consumer base that is rapidly expanding.

Of the current MMAP participants, there are four categories of supply source:

a) those who are licensed to grow their own marihuana for medical purposes (Personal Use Production License or PUPL);

b) those who have designated another individual to grow marihuana for them (Designated Person Production License, or DPPL);

c) those who purchase marihuana directly from the Government of Canada supply; and

d) those whose source of supply is unknown.

Individuals in these four categories constitute the foundation of the authorized demand for marihuana for medical purposes in Canada. This is distinct from the overall demand for marihuana, which includes the illegal use of the marihuana for recreational purposes, as well as unauthorized use of marihuana for medical purposes, both of which are beyond the scope of the regulations and this study.

Under the MMAP, the two provinces with the heaviest usage of marihuana for medical purposes per capita are British Columbia (6.7% of MMAP participants are in BC), and Nova Scotia (5.6%).

The MMAR allow access to marihuana for medical purposes for persons with the following conditions: Multiple Sclerosis; Spinal Cord Injury; Spinal Cord Disease; Cancer; AIDS/HIV Infection; Severe Arthritis; Epilepsy; and End of Life (Category 1). There is also a category for

conditions beyond the contemplated scope, where access to marihuana for medical purposes requires support from a medical specialist (Category 2).

Under the proposed regulations (Policy scenario), the current MMAP participants will become the core customer base for the new LPs. They will drive most of the demand for the LPs' products.

The proposed regulations would eliminate the PUPL and DPPL designations. As a result, all Canadians who use marihuana for medical purposes would be required to obtain their marihuana from LPs (and, possibly from pharmacists, physicians or nurse practitioners who could also be authorized to stock and sell it). The new regime would eliminate the specification of medical condition categories that are eligible for access to marihuana for medical purposes, which could potentially expand the number of legal users.

A successful policy regime would have the capacity to reach new users, provided they obtain the support of a healthcare practitioner, who are price- and risk- sensitive, and who might obtain marihuana from the illegal market as they seek relief for their symptoms. These persons might have found the current MMAR program to be difficult to deal with.

New program participants might be attracted away from the illegal market to the new regime through a combination of:

a) prices that are lower than those prevailing in the illegal market;

b) a product of higher quality;

c) a product with higher assurance of availability from LPs under legal and normal business conditions;

d) removal of legal threats and/or social stigma related to marihuana use; and

e) belief that marihuana could be used by patients with a wider variety of symptoms.

It is estimated currently that there are roughly 450,000 marihuana users in Canada who report using marihuana for medical purposes. Provided they obtain the support of a healthcare practitioner, these persons could potentially make a strong market base for LPs[1].

2.2 General Canadian Population

A change to the MMAR will also have an impact on the general population of Canada – i.e., persons who do not use or purchase marihuana for medical purposes. Despite not being active participants (or consumers) of marihuana for medical purposes, the general population is nevertheless affected by marihuana production and consumption in two important respects.

[1] The Canadian Alcohol and Drug Use Monitoring Survey (CADUMS) for 2011, administered by Jolicoeur et Associé for Health Canada, identified that 1.6% of Canadians aged 15 years and over reported using marihuana in the past

Firstly, there is extensive evidence (elaborated further in the Literature Review and other sections of this report) that residential production of marihuana raises public safety concerns. These include increased risk of fire, exposure to toxic chemicals and mould, and potential ground water contamination from improper waste disposal. Secondly, according to law enforcement officials, residential production of a controlled substance tends to produce adverse public security issues – increased risk of burglary, home invasion, criminals convening in areas where they believe marihuana is being grown, and potential violence against individuals who are carrying marihuana.

The MMAR impact on the general Canadian population has been documented by law enforcement, and is largely due to the misuse of PUPLs and DPPLs as de facto "grow ops" under the legal cover of a MMAR production license. In the Policy scenario, all non-LP production of marihuana becomes illegal by definition, making any non-LP "grow ops" illegal and, therefore, no longer an unintentional by-product of the MMAR.

B. INDUSTRY, BUSINESS & MEDICAL SERVICES

2.3 Physicians/Medical Community

There are 69,700 licensed physicians in Canada (2011 Census), which is a ratio of 203 physicians per 100,000 Canadians. This number is divided between 35,350 family medicine practitioners, and 34,350 specialist physicians. Under both the existing MMAR and the proposed Policy scenarios, physicians play a key role in supporting an individual's access to marihuana for medical purposes. As with the treatment of all symptoms and conditions, they are responsible for assessing and evaluating their patients' medical needs to determine the most appropriate and effective treatment.

Under the MMAR, the paperwork required to support the patient's application for authorization to access marihuana for medical purposes has been characterized by physicians as onerous. If the patient's medical condition is not covered under the nine recognized conditions listed (i.e., Category 1), the MMAR require patients to seek advice from a specialist to support the patient's application as appropriate in light of their symptoms and overall treatment plan.

Physician willingness to support the use of marihuana for medical purposes varies considerably from province to province, with British Columbia and Nova Scotia having the highest rate of support. Under the MMAR, physicians bear a time cost to support program administration in filling out the necessary paperwork to support patient authorization for the use of marihuana for medical purposes.

Under the proposed Policy scenario, the need to recommend a specialist will be eliminated, as there is no category of allowable conditions. Furthermore, the document required to be completed by physicians is anticipated to be much less complex and time-consuming to complete.

In addition to physicians, it is anticipated that other health care practitioners (e.g., nurse practitioners) will also be able to support the access to marihuana for medical purposes, if authorized by their provincial regulatory authorities.

Health Canada will no longer play a role in authorizing user access to the regime, although it will continue to support health care providers through the support and review of scientific investigation of the health effects of using marihuana for medical purposes.

2.4 Pharmacists

There are 30,550 pharmacists in Canada (2011 Census). Pharmacists are regulated health care professionals who assist their patients with access to, and information regarding, pharmaceutical products and medical therapies to safely achieve health outcomes at home, in the community and in hospitals. The current MMAR allow for pharmacists to dispense marihuana that has been produced by a licensed dealer under contract with Her Majesty in right of Canada to the holder of an authorization to possess. This provision was added in 2005 when some provinces and territories expressed an interest in allowing pharmacists to undertake this activity. While it is permitted under the current MMAR, dispensing of marihuana for medical purposes by pharmacists has never been done to date.

In the proposed Policy scenario, pharmacists would be able to distribute dried marihuana, as supplied to them by LPs, provided that this is permitted under provincial/territorial law.

By adding an additional class of product to their operations, pharmacies could stand to increase their revenues. Pharmacies already must adhere to stringent security requirements because of the controlled substances in their inventories. It is possible that they may incur increased costs in terms of complying with new regulations with respect to security requirements and potential risks of increased criminal activity (e.g., burglary) due to the presence of a substance with strong black market demand. The potential role of pharmacists in supporting access to marihuana for medical purposes is still undecided.

2.5 Licensed Producers (LP) of Marihuana for Medical Purposes

Under the proposed regulations, the Government of Canada will license commercial producers (individuals and/or incorporated businesses) to produce and distribute dried marihuana for medical purposes. These licensed producers (LPs) will be responsible for growing cannabis, storage of dried marihuana, security requirements, regular reporting about product quality and adherence to various regulations and distribution to eligible consumers. Over 100 companies have indicated an interest in applying for an LP license and participating in this regulated market. However, considerably fewer are expected to meet the minimum standards established by the new regulations.

In summary, under the proposed regulatory process:

- Consumers will consult their physician (or other authorized health care provider), who will assess their condition and determine if marihuana for medical purposes is an appropriate component of a treatment plan;
- The physician/health care provider will fill out a short medical document with standardized content;
- The patient can then choose from which LP they would like to obtain their legal supply of dried marihuana, in the authorized amount and via courier delivery;

- LPs will have flexibility in terms of their business operations. They will not be restricted in the number and type of cannabis strains they supply. They will have flexibility in product pricing and regarding the scale of their operations (subject to inspection and to the approved production volume associated with a specific facility). However, they will not be able to operate "storefront" sales locations, and their marketing and promotional activities will be limited as a result of marihuana's status as a controlled substance. All marihuana will be distributed in dried form. All LPs must provide standardized packaging and labelling for their product, and ensure its safe and secure distribution (with signatures required at all transition points during delivery).

LP start-up costs will be significant in the short term, as they are required to obtain a license, to establish a secure indoor growing area, to provide sufficient manpower and infrastructure to grow crops, to prepare operations for mandatory inspections by Government of Canada and to provide regular reporting to the Health Canada's Office of Controlled Substances (OCS). LPs will pay for their supply of seeds, production supplies (e.g., water, electricity, equipment, packaging materials, etc.) and provision of a secure delivery system.

LPs will benefit from the opportunity to participate in the new industry of providing marihuana for medical purposes directly to eligible consumers. They will be free to compete within the bounds of the regulations and grow their client base. Projecting the size, number, productive capacity and viability of LP is the crux of the Policy case and is a matter of particular focus in the analysis.

C. GOVERNMENTS

2.6 Municipal Governments

There are 5,600 municipalities in Canada of varying sizes and socio-demographic composition. These municipal governments will be impacted by the proposed regulations in two key respects. First, they currently shoulder the burden of the majority of the public safety and security costs identified above (e.g., fires, burglary) as the responsible agencies (e.g. fire department, police service) are generally funded municipally. Under the current MMAR, municipal governments have consistently highlighted the dangers of residential production of marihuana.

Second, municipal governments would potentially be involved in the business regulation of LPs, through land-use zoning, business permitting and by-law inspection of LP facilities. Municipalities will generally require that LPs be registered as a business entity and pay for municipal services like any other business. It is possible that LP production facilities and places of business may require a greater response from municipal agencies and first responders if they become the undue target of crime. Commercial indoor marihuana production by LPs may also impact on municipal land-use or environmental by-laws where applicable.

Municipal governments are also responsible for the fire departments that must respond to the increased risk of fire from residential indoor marihuana cultivation. While all forms of residential marihuana cultivation likely involves a higher fire risk than the baseline (i.e., for all family residences), the evidence from fire services data is that the risk of fire resulting from electrical wiring/equipment and risks related to faulty installation or construction are likely to be much higher when the legal scale of approved marihuana cultivation is exceeded and the MMAR production activity is misused.

2.7 Law Enforcement Agencies

Law enforcement in Canada is handled in three tiers – Federal, Provincial/Territorial, and Municipal. There are 64,150 police officers in Canada or roughly 206 police officers per 100,000 Canadians. There are two likely impacts of the existing and proposed regulations on this group. First, under the current MMAR, law enforcement has reported incidents of robbery and, more rarely, violence towards households or individuals growing marihuana under a DPPL or PUPL. These are typically handled by municipal police forces.

Second, law enforcement has also reported cases of alleged misuse of the DPPL or PUPL by criminal elements. These cases of misuse may be investigated by some combination of municipal and/or provincial police service (depending on the level of illegal activity). Law enforcement agencies have documented almost 200 alleged cases of abuse of the MMAR over a six year period from 2003-10 which, when accounting for the likelihood of detection, might support an estimate that 35% of DPPL and PUPL production involves some degree of misuse and diversion of marihuana intended for personal medical use to the illicit market.

Of special note are the issues noted by law enforcement officers when investigating alleged misuse (e.g., growing more than licensed, diverting marihuana supply to the illegal market) in connection with a DPPL or PUPL. In such cases, evidence over and above the mere existence of residential cultivation will likely be required to obtain a search warrant. This increases the cost of investigating marihuana violations to law enforcement, as more resources must be dedicated to investigation and evidence collection. Under the Policy scenario, this becomes irrelevant, since all residential production becomes illegal.

2.8 Provincial/Territorial Governments

The ten provinces and three territories are currently indirect participants in the MMAP. Under the existing program, they have no role in approving authorizations to possess and use marihuana for medical purposes. Currently, dried marihuana is not covered by any provincial or territorial health/drug plan as an approved treatment for which there is co-insurance related to the purchase of medication.

Under the Policy scenario, the role of provinces and territories would change. LPs would be subject to standard provincial/territorial oversight or regulations that are typical for a business of their size and context (e.g., environmental regulations) but would also derive tax revenue from them in terms of: a) corporate income tax; and b) HST or provincial sales tax on the sale of marihuana for medical purposes.

In addition, provinces/territories may face pressure to include coverage for marihuana for medical purposes under their respective health/drug plans. They may also, in their discretion, expand the range of health care professionals who could authorize the use of marihuana for medical purposes (e.g., nurse practitioners) and may also allow pharmacies to distribute to authorized users.

2.9 Federal Government

The Government of Canada administers the existing MMAP. Under the MMAP, the Government of Canada faces three main cost pressures.

First, it has engaged a Government Supplier under contract – Prairie Plant Systems (PPS) – to provide marihuana for medical purposes to authorized users. This contract was the result of an open competition in 2000, followed by subsequent amendments. PPS produces a contracted amount of dried marihuana, which is distributed to individuals at a price of $5.00 per gram. The size of the MMAP has grown exponentially over the past ten years resulting in amendments to the contract with PPS to provide an adequate legal supply.

Second, Health Canada is responsible for administration of the MMAP. Individual Canadians fill out forms and apply for an authorization to possess and use marihuana for medical purposes (ATP). In addition, the Government of Canada bears the administrative costs of processing applications for PUPLs and DPPLs. As of August 13, 2012 there were 21,986 ATP persons under MMAP, and this number is expected to continue to rise to 40,000 ATPs by 2014. Processing and monitoring active ATPs requires system and human resource support.

Third, the Government of Canada is subject to ongoing litigation with respect to the MMAR.

The contract with PPS will expire at the end of March 31st, 2014. This will generate cost savings related to the effective subsidy (i.e., the difference between the actual supply cost and the price paid by users). Program administration costs will diminish, as rather than processing and licensing individual applicants, the Government of Canada will only deal with the licensing and inspection related to a small number of LPs. These LPs will be subject to regulatory oversight, including security and quality inspections, as well as regular reporting and business license extensions. LPs would also be subject to corporate income tax.

Under the MMAP, the licensing and administration of ATPs is handled by a dedicated team within Health Canada, along with the management of the contract with the Government Supplier. In the Policy scenario, licensing and administration related to LPs will be incorporated into the operations of the Office of Controlled Substances.

CHAPTER THREE

3.0 Literature Review Summary

The fundamental challenge of this CBA is to articulate and substantiate a Reference case that corresponds to the way the future will likely unfold under the proposed regulations. There are no similar regulations elsewhere in the world, so there is limited opportunity to learn from the experience of others. The analysis is predicated on the founding and growth of a new marihuana for medical purposes industry that does not currently exist and that will operate under a unique set of regulatory requirements and market conditions. There is significant inherent uncertainty related to how users and the producers in this new industry will behave, for which we look to evidence in the literature in several fields for guidance.

For clarity, the literature consulted and cited has been broken into four categories:

1) Cannabis/Marihuana Use and Trafficking: While there is no direct comparison to the proposed Canadian system, other jurisdictions (notably California, Israel and the Netherlands) have developed regulatory regimes for the use of marihuana for medical purposes, which can, to some extent, be used as reference points. Additionally, there are studies of Canada's existing MMAP, including internal data from Health Canada, which can assist in an understanding of the nature of the existing Canadian market for marihuana for medical purposes.

2) Crime Prevention and Public Safety: A principal criticism of the existing regime is that it results in misuse of personal and designated production licenses to divert marihuana to the illegal market. These activities have been examined by Canadian law enforcement authorities and other sources.

3) Regulatory Compliance Theory: Any new regulatory regime must consider the immediate, short-term and long-term impacts of regulation. In this specific scenario, the government must establish a regulatory structure that empowers and enables a new industry to be created in a short 'ramp-up' period to ensure that those who require marihuana for medical purposes can access a legal supply. The regulatory regime should encourage and cultivate a competitive market, allowing purchasers of marihuana for medical purposes to enjoy the benefits of an industry that competes on the merits of price, quality and other product attributes. The regulatory regime must be secure and sustainable, without undue regulatory burden. It must also consider the compliance of existing stakeholders, particularly those who are currently engaged in the MMAP. How existing "Personal-Use" and "Designated" Producers will interact with the new regime is crucial, and compliance theory literature is reviewed to investigate the likely outcomes.

4) System Dynamics Theory: One methodology used to support this CBA is System Dynamics – a mathematical modeling discipline which focuses on modeling the causal relationships in complex social, economic, and environmental systems. System Dynamics, unlike much economic modeling, assumes that systems are rarely in equilibrium and that unforeseen consequences of policy changes and non-linear changes in outcomes can often occur due to the complex feedback relationships that

exist in real-life systems. The System Dynamics literature is reviewed in the following analysis, where relevant.

3.1 Cannabis/Marihuana Usage and Trafficking

A series of reports from consultations with multiple stakeholders, conducted by Health Canada in regards to the MMAP, was analyzed. This included feedback from doctors, government officials, law enforcement, compassion clubs and individual Canadians, often with personal stories of their use of marihuana for medical purposes and experience with the existing regulatory regime. This review provided a framework to understand the current regime and its challenges, and to identify further resources to pursue.

Existing personal-use growers, designated growers and participants in the current MMAP were largely opposed to the new regulatory proposals. A minority of participants, largely those who were not growing or who had found a designate, had mixed response to the new regime. However, the comments of some participants and other stakeholders, when combined with inferences from the literature, suggest that these groups could benefit from the proposed regulations via: (i) easier access to marihuana for medical purposes, which would lead to lower information and other transaction costs, as well as shorter delays; and (ii) greater product choice and "freedom of choice" from a regulated industry that, in time, would be producing a product of higher and more predictable and reliable quality.

A review of studies [Dandurand et al (2002), Easton (2004), Jaworski (2009), Lucas (2009), Patton-Bodnarchuk (2004), Plecas et al (2005), Tjepkema (2004)] identified key trends in Canadian marihuana use and trafficking.

A review of studies [Ben Amar (2006), Hazekamp (2006), Health Canada (2010b), Seamon (2007) Williams-Skeel (2006)] of the medical perspective on the use of cannabis for medical purposes was also assessed There is some clinical evidence to suggest modest therapeutic benefits of smoked or vaporized cannabis for a limited number of medical conditions but the clinical trials have generally been of very short duration, and have used a small number of patients, many of whom were already experienced with cannabis.

Health Canada's published information for health care practitioners (Health Canada, 2010b) indicates that:

a. Precise dosages for cannabis have not been established. The complex pharmacology of cannabinoids, inter-individual differences in cannabinoid bioavailability, prior exposure to and experience with cannabis, the variable potency of the plant material, and different dosing regimens used in different research studies all contribute to the difficulty in reporting precise doses or establishing uniform dosing schedules;

b. While there are many anecdotal reports concerning the therapeutic value of cannabis, clinical studies supporting the safety and efficacy of smoked cannabis for therapeutic purposes in a variety of disorders are limited but slowly increasing in number and;

c. The risk/benefit ratio of marihuana should be carefully evaluated in patients with the following medical conditions (because of individual variation in response and tolerance to its effects, as well as the difficulty in dosing):

i. patients with cardiac disorders (i.e., concerns re: hypotension, possible hypertension, syncope, tachycardia, or myocardial infarction);

ii. patients with respiratory insufficiency such as asthma or chronic obstructive pulmonary disease (concern re: smoked marihuana);

iii. patients with a history of substance abuse including alcohol abuse (concerns re: risk to abuse marihuana and risks regarding developing dependencies);

iv. patients with mania, depression, or schizophrenia who should be under careful psychiatric monitoring (concern re: exacerbation of such illnesses);

v. patients receiving concomitant therapy with sedatives, hypnotics or other psychoactive drugs such as opioids (concern re: additive or synergistic effects on the central nervous system);

vi. patients should be advised of the negative effects on memory and to report any mental or behavioural changes that occur after using marihuana; and

vii. patients with ongoing chronic hepatitis-C should be strongly advised to abstain from daily cannabis use (concern re: marihuana use as a predictor of steatosis severity in these individuals, i.e., worsening of the disease).

This medical assessment and overall concern regarding marihuana's use as a 'treatment' was supported by the feedback from the Canadian medical community during the Health Canada consultations [CMA (2011)] and the "needs assessment" conducted with family doctors at the College of Family Physicians of Canada (CFPC) Family Medicine Forum in Montréal in November 2011. Key concerns cited by medical professionals and practitioners were:

Lack of scientific evidence, information and guidance available to the ordinary physician on the risks and benefits of marihuana for medical purposes;

Lack of established/regulated standards and clinical practice guidelines on prescribing practices for marihuana for medical purposes;

Medical support has too much similarity with typical prescriptions under the new regime (which is seen as a negative feature by the medical community and a positive feature by many other stakeholders);

Lack of guidance on 'prescribed dosage' and 'period of treatment time', and the potential impact on medical legal liability;

The risk of "over-prescribing" marihuana, particularly given the absence of clinical practice guidelines for its usage. This risk creates additional costs and burdens for physicians because they need to conduct additional oversight and monitoring;

Pressure on physicians who are the sole practitioners in their communities to support the use of marihuana for medical purposes despite their discomfort on medical grounds; and

Lack of research and/or a clinical trial component in the reform proposal.

A wide body of literature on the economic considerations of marihuana use and trafficking has been considered in the context of the broader policy of marihuana legalization. Much of these economic considerations are also valid within the context of this more focused assessment of the regulatory change and the use of marihuana for medical purposes. This CBA does not address the larger policy issue related to marihuana legalization. Key studies [Becker et al (2006), Bretteville-Jensen-Line (2006), Godfrey et al (2002), Kilmer et al (2010), Kilmer-Pacula

(2009), McDonald et al (2005), Pacula et al (2003), Rhodes et al (2000), Single (1998)] suggest that economic regulation, rather than prohibition, of access to marihuana for medical purposes would generate economic benefits that far outweighed the costs associated with pursuing and prosecuting low-level crime like marihuana dealing.

Key considerations for potential LPs, which are relevant for assessing the impact of the proposed regulation, include:

The cost of applying for and receiving a license and approvals from local governments;

The full cost of investment, including: financing costs; information and transactions costs (which can be significant for a new industry); costs of establishing the distribution system and relationships with suppliers; costs of attracting, hiring and training the work force; and the costs of meeting the safety, security, quality, record-keeping and other regulatory costs (many of which are 'sunk costs' that may be difficult to recover in the event of company, industry and/or regulatory failure);

The cost of operation, including: costs of labour and intermediate inputs (goods and services) from suppliers' on-the job training; ongoing regulatory compliance; and providing reliable information on their products to doctors, Health Canada and other stakeholders;

The cost of adapting to and complying with new regulatory requirements after start-up; and

Any regulatory constraints on advertising and marketing.

3.2 Crime Prevention and Public Safety

Crime prevention studies [Bowles (2010), Cohen (1998, 2010), Cohen et al (2004), Dhiri-Brand (1999), Reppetto (1976), Roman (2010)] have shown that any attribution of benefits to government law enforcement must take into account the 'displacement effect' of crime reduction on shifting (rather than diminishing) criminal activity. This literature has also developed willingness-to-pay or economic costs of criminal activities.

An economically-rational deterrence effect on illicit drug activity was developed [Chang et al (2008)] using a calibrated general equilibrium model result for the United States (US) to determine optimal drug policy for a low-income neighbourhood. This model analyzed the consequence of both demand-side and supply-side drug policies and compared welfare gains through calibrated simulation analysis in a manner similar to a general-equilibrium tax incidence model.

Effectively, drug trafficking was treated as an occupational choice with employment and drug transactions modelled in a search-theoretic manner. The drug market equilibrium was established through supply/demand interaction and the entry of drug dealers continued until expected (risk-adjusted) pure profit was eliminated. The extent to which community members opted for a career in the drug market determined the supply of drugs by the community.

This model and its results were considered relevant to this study as it was the only empirical model in the literature that provided a behavioural response of drug trafficking to changes in the probability of conviction. The calibrated simulation results indicated that a 10% increase in the

probability of criminal conviction for drug trafficking or production would decrease the number of active dealers by 0.26%.

Additionally, a consortium of twenty (20) law enforcement agencies [RCMP (2010)] (representing services to perhaps more than 75% of the Canadian population) reviewed 190 cases over a six to seven year period in which police made an investigation of a residence for which a person held a valid MMAR production license (PUPL, DPPL)[2].

A review of alleged 'misuse' cases (Figure 4.7 below) showed that the number of such alleged misuse cases as a proportion of MMAR authorizations to possess varied from 1.5-3.0% over 2005-2010. However, there is a low estimated rate of police detection for illegal marihuana cultivation (i.e. grow operation). One British Columbia (BC) study estimated this rate at 5% [Dandurand et al (2002)] while another study estimated the rate for Quebec at 2.5% [Bouchard (2007)]. If a higher (10%) rate of detection is assumed, this implies that the estimated rate of MMAP 'misuse' could be in the range of 15-30%. The lower rate of 5% detection would imply an estimated rate of MMAP 'misuse' in the range of 30-60%.

Health Canada regulatory analysis dealing with cigarette ignition propensity [Health Canada (2005)] used fire statistics from the Canadian Association of Fire Chiefs Annual Report – Fire Losses in Canada for various years to estimate probabilities of fires. The analysis followed this approach using available average Canadian data for a five year period (1998-2002) that involves the most recent data available.

3.3 Regulatory Compliance Theory

The theory of regulatory compliance was assessed to better understand how the proposed regulations might impact the behaviour of persons already accessing marihuana under the MMAR and persons who always have an option to access marihuana for medical purposes from the illegal market. In particular, this study explored what evidence exists to help anticipate the expected regulatory compliance of Canadians under the proposed new regulatory regime. The success or failure of the new LP industry is predicated in the assumption that, as in other regulatory regimes, the new regulations will be enforced such that the requirements are obeyed by persons subject to the regulations.

Key insights were derived for three key issues relevant to the transition between the existing and new regulatory regimes of accessing a legal supply of marihuana for medical purposes:

1) Monitoring regulatory performance and the behavioural response of agents following regulatory change;

2) Impact of regulatory change on compliance performance and market dynamics; and

3) Impact of inspection on compliance motivation and relationship between the regulatory authority and the affected population.

[2] RCMP (2010) *An Analysis of National Cases Related to the Marihuana Medical Access Regulations.* The law enforcement agencies including RCMP, OPP, SQ and municipal police in Toronto, Montreal, Vancouver, Ottawa, Calgary, Edmonton etc.

A) Monitoring Regulatory Performance

Existing regulators taking on new and unfamiliar responsibilities typically encounter limitations in their ability to measure and report on performance [Sparrow (2000, 2008)]. Although the proposed regulations are patterned on the existing regulatory regime for controlled substances, the performance management and reporting by Health Canada will likely be based on the following:

Presumed relationships between inputs, outputs, intermediate outcomes and final policy outcomes from the logic model and "theory of the regulation";

Qualitative and anecdotal information and complaints from the media, competitors, business customers, civil society groups and other affected and interest groups on the determinants of compliance and other indicators of outcomes and results; and

Improvements to compliance and other outcomes resulting from projects that mitigate a specific regulatory problem, risk or harm, and which are selected because of their ability (based on the theory and logic model) to contribute to the higher level outcomes and objectives of the regulatory regime.

In the context of the uncertainty of establishing a new and commercially viable LP industry to supply a legal source of marihuana for medical purposes, Health Canada will need to closely monitor the performance of LPs as they ramp up to full production. This may be challenging in terms of accessing information beyond what is required to meet regulatory requirements.

B) Impact of Regulatory Change

The proposed regulations make fundamental changes to the marihuana for medical purposes supply industry. Generally, regulatory change results in the expansion or contraction of regulations affecting an existing stakeholder group. However, the proposed regulatory regime for marihuana for medical purposes will fundamentally change who is being regulated. As this is an uncommon occurrence, the literature was investigated to determine the likely results of a fundamental shift in the focus of government regulation, in particular, how Health Canada's focus (away from licensing of individuals and towards licensing commercial producers) will change the incentives and behaviour of individuals.

Changes in regulatory scope and reach (i.e., the affected population and their attitudes) could have either a positive or negative influence on compliance and other intermediate and final outcomes [May-Koski (2004)]. These outcomes will depend on:

(i) The affected population's experience, resources and interest in complying with the regulation;

(ii) Structural change and (possible) market concentration in the industry, which could either improve compliance (i.e., fewer firms are easier to regulate) or make compliance more problematic (i.e., larger and more powerful firms can increase political lobbying and regulatory capture, and lead to the "too-big-to-fail" erosion of enforcement);

(iii) Changes in political, voter and consumer interest and media attention can change regulatory compliance and performance over time [Sparrow (2000, 2009)];

(iv) Changes in a regulated market's growth and profitability can result in competitive turbulence and greater compliance variation, especially during market downturns when cost cutting pressure can reduce compliance resources; and

(v) Rapid market growth and entry of new regulated firms can also place pressure on the regulatory authority's inspection and enforcement during times when investment and market pressures are focused on increased production, perhaps to the point where the firms may cut corners in complying with regulations.

C) Impact of Inspection

The establishment of a new LP market under the proposed regulations requires a series of inspections, particularly at the start-up phase of the new businesses. Regulatory compliance theory [May-Koski (2004)] highlights the importance of the relationship between inspectors and regulated industry managers which may create positive and negative motivations and trade-offs between the two. For example, inspectors that are collegial, respectful, less formalistic and provide good information on the requirements of the regulation can increase positive motivations through shared information, learning, "mental models", problem solving and a "social contract" between the regulator and affected population. Such an approach also reduces negative motivations through increasing transparency, demystifying the regulation and its enforcement and compliance programs, and reducing the fear, risk and uncertainty that promote negative motivations towards compliance.

3.4 System Dynamics

Marihuana use results from a complex set of relationships and interactions between markets and stakeholders (e.g., governments, users, doctors, law enforcement authorities, suppliers). A System Dynamics approach [Sterman (2000), Morecroft (2007)] captures the inter-relationships between these system elements and enables the analysis of causal loops that affect the behaviour of the overall system.

System Dynamics (as opposed to Systems Thinking) requires "causally-closed" models [Richardson (1991)], as the causes of the behaviour exhibited by the system must be found endogenously – within the structure of the system model itself. While there will be external inputs and outputs which have an impact on the magnitude of the system's operations, the causal relationships which create that behaviour must be entrenched within the system itself.

The CBA benefited from a System Dynamics model of individual and firm behaviour over time for the regulated marihuana for medical purposes supply industry. This model involved: LPs, production capacity, strategic resources, market processes, production processes, pricing impacts, projected growth, projected users etc.

The System Dynamics model was based heavily on various studies related to modeling and the conceptualization process [Forrester (1961), Randers (1980), Vennix et al (1992), Hodgson (1992), Saeed (1992), Richardson et al (1992), Winch (1993)] which include examples of the process and structure of developing an industry model, including how consumers gain awareness of products, the development of supply, marketing, distribution, and consumer usage patterns.

Specific studies that were relevant to regulatory compliance and legal/illegal market dynamics included:

a) Homer (1993, 1997), which developed a 'War on Drugs' model to understand cocaine prevalence trends and policy impacts. The model captured the cocaine market mechanism including supply, demand, price, and market actors as well as how the criminal justice system interacts with the illicit market;

b) Lyneis (1999, 2000), which developed a detailed, calibrated model to support the development of business strategies. It focused on market share and resource allocation between competing companies and assessed cost-benefit tradeoffs of business strategies. Lyneis (2000) also explained the causes for market behaviours and illustrated that System Dynamics models can "provide more reliable forecasts than statistical (non-structural models);

c) Cavana-Clifford (2006), which tested the causality between tobacco import behaviour and government policy options in New Zealand;

d) Dudley (2004), which examined the inter-relationships between demand, price and forecast stock and log availability, log harvesting capacity, log exports and the impact of an export ban on Papua New Guinea;

e) Delsys Research Group (2012), which developed a qualitative system dynamics model depicting the "theory of the business" for the new consumer product safety regulatory regime at Health Canada; and

f) Tawileh et al (2009), which developed a model of alcohol misuse, which touched on many of the same issues as marihuana use for medical purposes, including law enforcement and doctor/patient relations.

Specific studies that were relevant to business and user dynamics included:

g) Sterman (2000), which modeled commodity cycles and examined how price functions to balance supply and demand, and examined the business supply chain mechanism and how business adjusts capacity to meet orders and demand; and

h) Delsys Research Group (2004), which developed a strategic 'business flight simulator' for First Nations Statistical Institute. This business-planning tool modeled inter-relationships between market demand for statistical services, production, human resources and financing.

Specific studies that were relevant to licensing, compliance and law enforcement issues included:

i) Delsys Research Group (2008), which mapped broadcasting and telecom licensing processes and tracked information flows into and through the process. The model included unavoidable re-work cycles and tested how to sustain organizational capacity to meet performance requirements;

j) Morecroft (2007), which focused on drug-related crimes and modeled inter-connections between drug users, street market, police and the community; and

k) Delsys Research Group (2005), which developed simulation models to support strategies for combating mass-marketing fraud, including: entry, exit, marketing activity investment, ROI, and sales success rates (i.e., victim responsiveness). The models tested different compliance strategies, including law enforcement activities and related deterrent effects.

Other literature that was specific to identification of variables and parameters required in the CBA model is cited in the Methodology section.

CHAPTER FOUR

4.0 CBA - Methodology

This section describes in detail the methodology used in the Cost Benefit Model to estimate the Status Quo and Policy scenarios over the forecast period and the Net Present Value difference between them for monetized benefits and costs.

This section is divided into sub-sections that describe the following components:

1. Persons Accessing A Legal Supply of Marihuana for Medical Purposes;
2. Status Quo – Program Administration Costs;
3. Status Quo – User Benefits & Costs;
4. Status Quo – Safety Costs;
5. Status Quo – Security Costs;
6. Status Quo – Summary of Benefits & Costs;
7. Policy – Transition Model (April 2014);
8. Policy – Demand Curve;
9. Policy – Supply Curve;
10. Policy – LP Market Equilibrium;
11. Policy – User Benefits & Costs;
12. Policy – Safety Costs;
13. Policy – Security Costs;
14. Policy – Program Administration Costs;
15. Policy – Summary of Benefits & Costs; and
16. Net Present Value (Policy vs. Status Quo)

The methodology description will address each of these components separately.

It is important to note that the CBA focuses on the consumption of marihuana obtained from legal sources of supply for medical purposes. The broader issues of illicit market supply and use (except the potential misuse of residential production licenses under the MMAR and in the Policy scenario) are outside the scope of the study.

4.1 Persons Accessing a Legal Supply of Marihuana for Medical Purposes

The CBA study estimates a pool of potential persons who, over time, would be interested in accessing a legal source of marihuana for medical purposes. This was used to estimate the time path of authorized marihuana users in the Status Quo scenario. Following the development of a Transition Model, this pool of potentially eligible marihuana users was also used to estimate the path of legal users in the Policy scenario.

4.1.1 Future Growth & Likely Upper Bound

Health Canada data on persons with Authorization-to-Possess (ATP) status were available for the month of January values from 2003 to 2012 (Figure 1.1 above). This data showed exponential program growth of over 40% per year since 2006.

It is difficult to confidently assume that such exponential growth can continue for another ten years, as there is good reason to believe that there is a natural ceiling towards which the level would approach (or a steady- state growth path that is much lower than 40% per year).

Assuming that exponential growth of 40% per year continues for the 12-year forecast horizon from 2012 to 2024, this would effectively project an ATP level of about 690,000 persons in 2024.

The Canadian Alcohol and Drug Use Monitoring Survey (CADUMS) for 2011, administered by Jolicoeur et Associé for Health Canada, identified that 1.6% of Canadians (aged 15 years and over) reported using marihuana, hashish, hash oil, or other cannabis derivatives in the past year for medical purposes. This would suggest that there were 420,000 persons in 2011 who may use marihuana for medical purposes. Of these persons, about half reported that their medical reason for cannabis use was related to a chronic pain condition, while the other half reported use related to nausea or vomiting, lack of appetite or weight loss, depression, multiple sclerosis or spinal cord injury, epilepsy, anxiety or nerves, glaucoma, insomnia and other unspecified reasons.

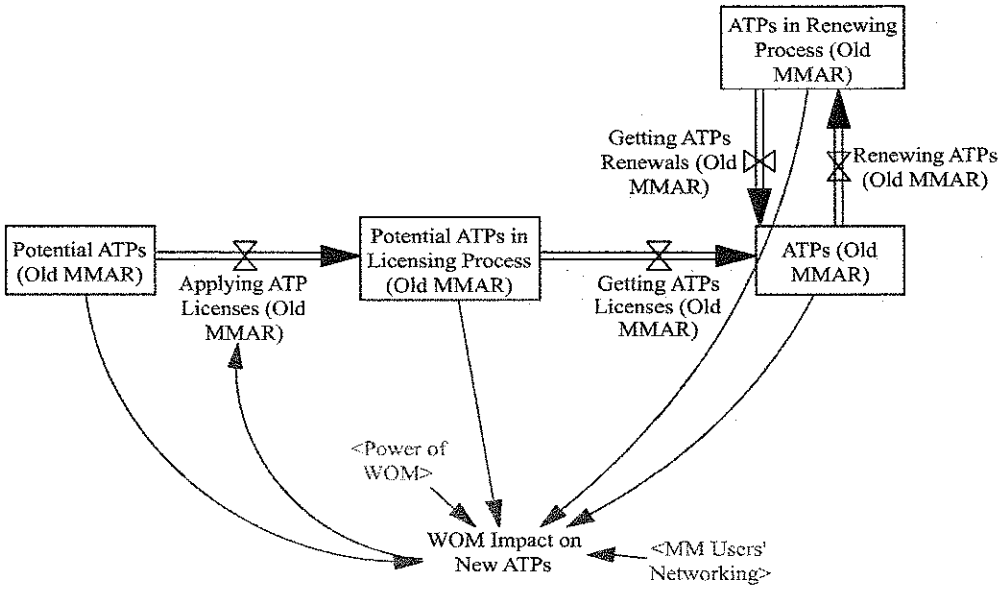
For the purpose of modelling the future growth of the MMAP (in the Status Quo scenario) over the forecast period from 2014-15 to 2023-24, the analysis used an upper bound (or ceiling) of 450,000 Canadians who might become participants in the MMAP as the Reference case. In order to provide a sensitivity analysis, the range of upper limit was assessed from 250,000 to 650,000 persons participating in the MMAP.

A System Dynamics model[3] of program uptake was developed to track the growth of the program (to 2012) and to forecast program uptake to 2025. This continuous simulation model used differential equations to calculate variable changes over time. Figure 4.1 shows a

[3] System Dynamics simulation models map the causal relationships that determine the behaviour of complex systems and use differential equations to account for dynamic changes in stocks (accumulations) and flow processes over time. These models can be calibrated to replicate known data and can be used to rigorously assess how complex interaction and feedback processes in economic, environmental and social systems influence behaviour over time. They can help identify potential unanticipated consequences of policy proposals in both public and private sector contexts. Systems Dynamic models were used to inform the CBA with respect to the growth of MMAP usage both with and without resource constraints under the Status Quo scenario, as well as the transition process between the Status Quo and Policy scenarios. These models also informed other aspects of the regulatory change process.

simplified model structure in which potential ATP persons move through a process to become aware of, and apply for, access to the existing MMAP regime.

Figure 4.1 – Status Quo – System Dynamics Model
ATP Awareness, Application, Approval Process



Source: Delsys Research

The ATP process models the movement of potential ATP persons through the license application and renewal activities. The full model captures the complex dynamics of how Health Canada issues and renews ATPs, DPPLs and PUPLs, and provides access to the Government supply of marihuana for medical purposes.

The upper bound (ceiling) is represented by the sum of four stocks: 1) potential ATP persons; 2) persons applying for an ATP in the licensing process; 3) persons with an ATP; and 4) ATP persons involved in the renewal of their ATP, where:

Ceiling Value = Potential ATP + ATP Applications + Existing ATP + ATP Renewals

For the Reference case (i.e. deterministic case), the study assumed there are 450,000 persons who might be in need of marihuana for medical purposes (for simplicity, it is assumed that this is constant over the forecast period to 2025). As there were 4,884 ATP persons in January 2010, the majority of persons were in a 'potential pool' of persons who might want to access the MMAP regime. As the number of persons with ATP grows over time, the size of the potential pool drops.

There is no Health Canada marketing or promotion of the MMAP, even though historical growth has been about 40% per year over several years. Peer influence (i.e. 'word-of-mouth' - WOM) is assumed to be the dominant process that continues to drive MMAP growth. Such a process is often modeled in System Dynamics.

ATP Applications = Existing ATP * WOM Factor * [Potential ATP / Ceiling Value]

The resulting path of ATP persons over time is an 's'-shaped logistics curve. This curve initially tracks and continues the historical exponential path of growth before slowing and approaching the ceiling value asymptotically.

Over time, with infirmity of a growing and aging Canadian population, the effective ceiling could rise. However, it is likely that the effective ceiling on the number of ATPs would be reached before 2024 and would involve a slowing of the rate of growth to some value less than 40% per year.

The System Dynamics model produced outputs for January values which allowed calculation of monthly compound growth rates. These allowed a monthly time series to be generated so that fiscal year annual average values could be determined.

The System Dynamics growth path is expressed in terms of the percentage movement towards the asymptotic upper limit (ceiling). In order to allow for a different value for the upper limit, the CBA model used the shape-path of the percentages and adjusted these to reflect that the starting value (i.e. the value for FY2013-14) was a different percentage of the different ceiling value. This can be seen in Figure 4.2, which shows several paths for the percentage movement towards the asymptotic upper limit (for ceiling values of 250,000, 450,000 and 650,000). The shape of the paths is similar to a logistics ('s'-shaped) curve.

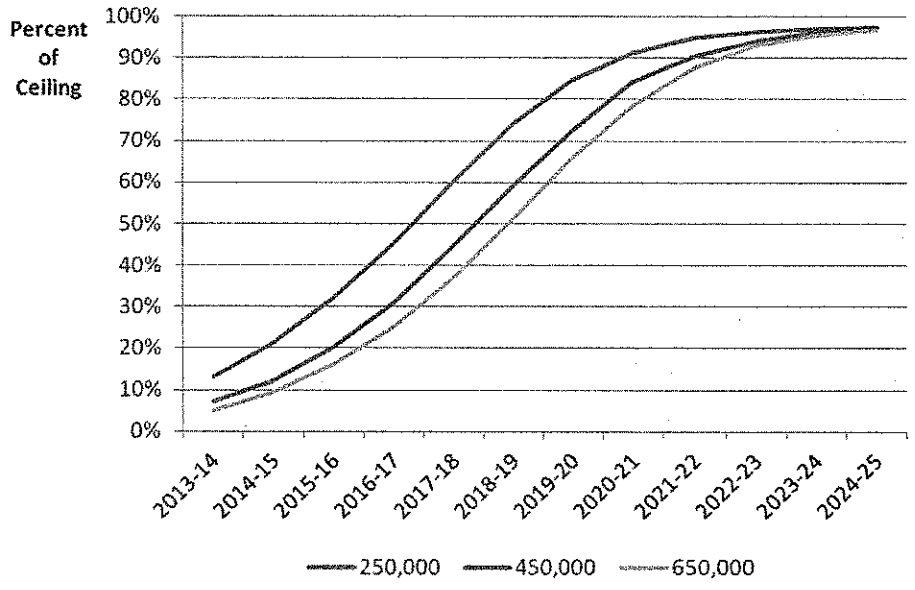
The CBA model for ATP in the Status Quo scenario is of the form[4]:

(01) ATP(t) = Upper Limit Value * % of Ceiling(t)

where the percent of ceiling at time (t) is based on the System Dynamics growth path (for a ceiling of 450,000) and adjusted for the difference in starting value. This path is determined for the aggregate number of ATP persons[5].

[4] Numbered equations focus on calculations that are embedded in the CBA Model.
[5] Effectively, the percentage increment was estimated as a polynomial of degree two relative to the lagged value of the ceiling. This produced a good fit for the System Dynamics growth path.

Figure 4.2 – Status Quo – ATP Forecast Growth Path
As % of Ceiling Value Showing Upper Limit Values



Source: Delsys Research

4.1.2 Status Quo – Composition by Supply Method

Under the MMAR, there are various supply methods that an ATP person can use to access legally produced marihuana for medical purposes:

- Access the Government Supply (these are referred to as ATP-G);
- Grow their own supply under a Personal Use Production License (PUPL) (referred to as ATP-P); or
- Arrange for their supply to be grown by a designated person under a Designated Person Production License (DPPL) (referred to as ATP-D).

For the purpose of the CBA, it is important to forecast the composition of these different types of MMAP participants. In addition to these streams of ATP users, it also turns out that a substantial proportion of persons with an ATP-G to access the Government Supply do not in fact ever place an order through Health Canada to access this supply. Therefore, as this study needed to estimate the actual usage of the Government Supply, the stream of ATP-G persons was subdivided into two types:

- Persons who do, in fact, access the Government Supply (referred to as ATP-GS); and
- Persons who do not access the Government Supply (referred to as ATP-O).

While there has been variation of time in the relative proportions of these ATP supply types, there is guidance from Health Canada that the current proportions are roughly:

- 10% ATP-GS: who access the Government Supply;

- 10% ATP-O: who access unknown supply;
- 60% ATP-P: who grow their own supply under a PUPL; and
- 20% ATP-D: who arrange for their supply to be grown under a DPPL.

The model for ATP-P in the Status Quo scenario is of the form:

(02) ATP-P(t) = ATP(t) * %share-P

where the percent share of ATP who hold PUPL is fixed over the forecast period.

The model for ATP-D in the Status Quo scenario is of the form:

(03) ATP-D(t) = ATP(t) * %share-D

where the percent share of ATP who hold DPPL is fixed over the forecast period.

The model for ATP-G in the Status Quo scenario is of the form:

(04) ATP-G(t) = ATP(t) * (1 - %share-P - %share-D)

and is calculated as a residual to be consistent with the above forecasts for ATP (total) and ATP-P and ATP-D.

The model for ATP-GS in the Status Quo scenario is of the form:

(05) ATP-GS(t) = ATP-G(t) * %share-GS

where the percent share of ATP-G who actually access the Government Supply is fixed over the forecast period.

The model for ATP-O in the Status Quo scenario is of the form:

(06) ATP-O(t) = ATP-G(t) * (1 - %share-GS)

and is calculated as a residual to be consistent with the above forecasts for ATP-G and ATP-GS.

These share parameters were assumed to be fixed over the forecast period. In order to provide sensitivity analysis, the percentage shares for ATP-P and ATP-D was varied over a range and the share of the residual ATP-G was divided between ATP-GS and ATP-O based on a percentage that also varied over a range.

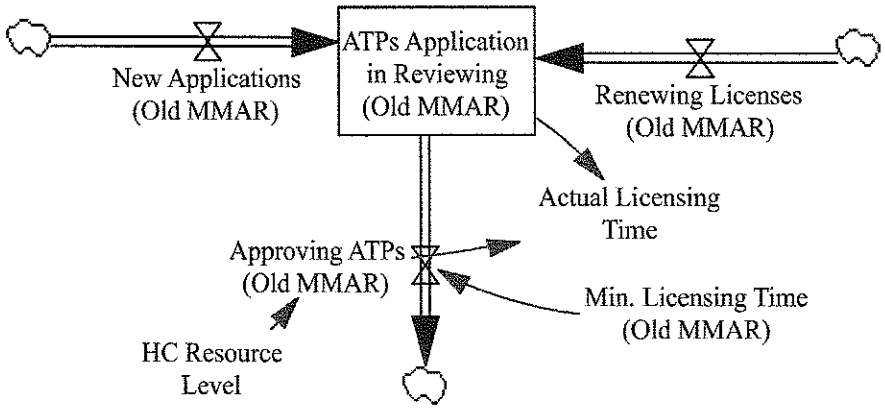
4.1.3 Future Growth and Upper Bound Under Resource Constraint Scenario

Since the MMAR were introduced, Health Canada has been faced with escalating program costs due to the increasing numbers of ATPs - over 40% in the past 7 years. MMAP costs increased from $3.7 million in 2005 to $16.7 million in 2012. A scenario in which program costs must scale resources to meet an exponential growth in demand is unsustainable for any

regulator. However, this analysis adopted a Status Quo scenario that nevertheless assumed that resources would scale as necessary to meet the demand. The reason this approach was adopted was two-fold: 1) There was no basis on which to base an assumption about what proportion of required resources the government would be willing to allocate; and 2) a scenario in which resources were not scaled would have implied the government would tolerate significant delays in issuing ATPs to users.

With a limited budget, it is inevitable that the number of ATPs will experience slower growth compared with an unlimited budget Status Quo scenario. An alternate to the Status Quo scenario was analyzed using a System Dynamics model that illustrated how a budget limitation impacts on program performance. Figure 4.3 shows the model for the MMAP licensing process, including new applications and renewal applications.

Figure 4.3 – Resource Constraint – System Dynamics Model
ATP Applications & Backlog Process



Source: Delsys Research

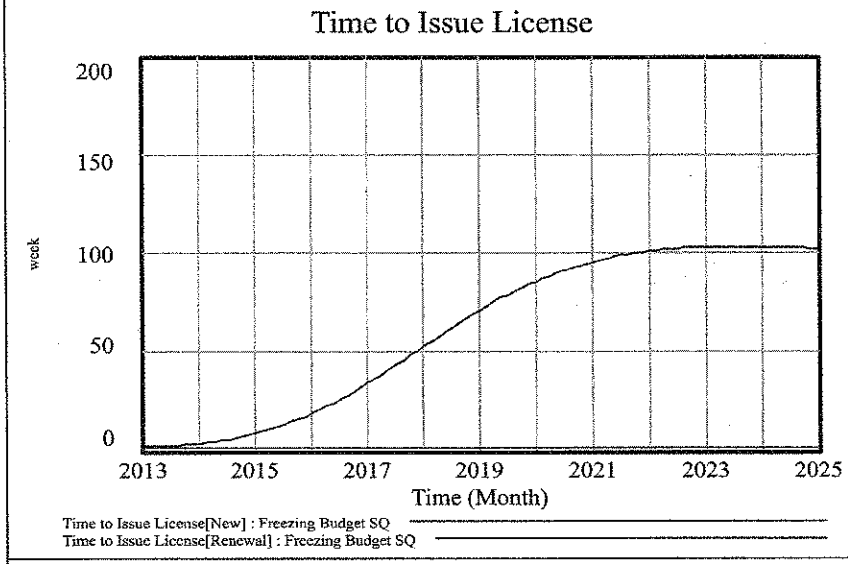
The constrained-budget scenario assumed that MMAP administration was frozen at current levels effective April 1, 2013 (estimated at $4.87 million per year). With this resource level, Health Canada forecasts that there would be 27,847 individuals authorized to possess marihuana for medical purposes by April 1, 2013[6]. In other words, this resource level would allow the MMAP to process 10,767 new applications and renew 17,080 existing licenses per year.

Figure 4.4 shows MMAP service performance relating to the time required to issue and renew ATP licenses. In the constrained-budget scenario, the average time to renew a license remained the same – approximately 0.54 weeks in the study period. This level of performance was achieved by giving greater priority to licensing renewals as opposed to issuing new licenses, a management decision designed to minimize the service gap for existing ATPs. The consequence, however, of the assumed budget freeze, coupled with the priority on renewals, was that the time to issue new licenses increased from 1 week to 102 weeks by 2025. This

[6] Health Canada forecast. As of August 13, 2012, there were 21,986 ATPs. This number is in line with the projected amount of 20,452.

result occurred because increasing program capacity was dedicated to ever-increasing license-renewal activities, and fewer resources were available for new applications.

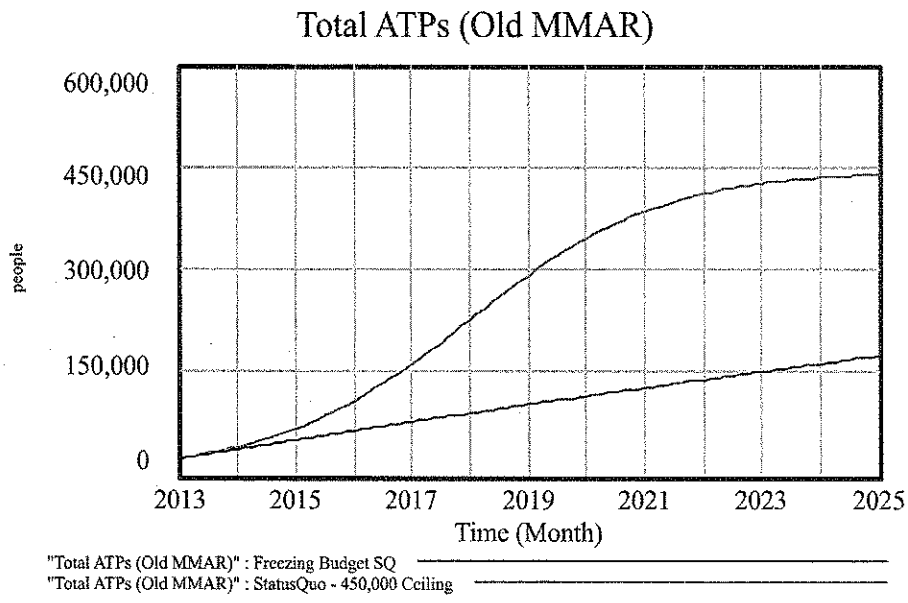
Figure 4.4 – Resource Constraint – System Dynamics Model
ATP Application Backlog (Weeks) Over Time



Source: Delsys Research

In this scenario, the System Dynamics model projected that the total number of ATPs would increase at a much slower rate compared to the unlimited resource status quo scenario, as shown in Figure 4.5, on the next page.

Figure 4.5 – Resource Constraint – System Dynamics Model
ATP Volume Over Time Showing a) No Resource Constraint and b) Effect of Resource Constraint and Backlog



Source: Delsys Research

Although the constrained-budget scenario is likely to result in practice (if the Status Quo were maintained), it was not used as the Status Quo scenario for a variety of reasons. First, there were a number of critical assumptions (e.g., the duration of the budget freeze, the decision on funding levels, alternate assumptions regarding program resource allocations) that change the results of the scenario for which there was no evidentiary basis. Second, to ensure consistency if budgetary constraint assumptions were applied to the Status Quo scenario they should also apply to the Policy scenario. Again, there was no evidentiary basis for applying specific assumptions. Accordingly, the Status Quo scenario incorporated an assumption that the government would scale resources sufficiently to meet emerging demand.

4.2 Program Administration Costs

Health Canada – Program Administration Costs are comprised of:

- Salary and Human Resources (HR)-related costs such as Employee Benefits Program (EPB) and staff accommodation costs;
- Operations & Maintenance (O&M) costs for travel, training, supplies and professional contracts;
- Corporate Cost to reflect departmental shared services and overhead; and
- Contract Cost for the Contracted Government Supply.

This latter cost is counted as part of Health Canada's MMAP Cost but is not included in the CBA as a Program Administration cost as it is related to the cost of supply for those persons

accessing the Government Supply. Contract costs are taken into account as part of the User Benefits and Costs.

Salary & HR-Related Costs

Health Canada administrative costs (human resource costs, accommodation, O&M costs) were documented for 2005-06 to 2009-10 as part of a Health Canada (2009) Supplemental Funding Request. The majority of the operational requirements under the Status Quo scenario arise from the administration of the ATP eligibility requirements and the administration and order processing related to the contract Government Supply. As there has been a fairly steady proportion (10%) of ATP persons who rely on the Government Supply for their access to marihuana for medical purposes, this analysis was able to model the Health Canada program administrative costs directly in relation to the total number of persons with ATPs.

The number of full-time equivalent persons (FTE) for FY2010-11 was reported as 33 FTEs and allowed the computation of an average salary cost per FTE ($68,060) based on the total salary cost for the fiscal year. It was assumed that salary costs per FTE were subject to a fixed salary escalator factor (e.g., 2% per year). This allowed the estimation of FTE for the same years for which salary costs were known (2005-06 to 2009-10).

As the activity volume is considered to be proportional to the average number of ATP persons in a fiscal year, a productivity measure was calculated as the ratio of ATP persons to estimated FTE. This showed an upward trend over time that was fitted with a logarithmic function in Figure 4.6.

The logarithmic equation allows for a prediction of the future number of FTEs required for Health Canada program administration in relation to the number of ATPs expected over time in the forecast period.

The MMAP ratio of ATP/FTE in the Status Quo is given by:

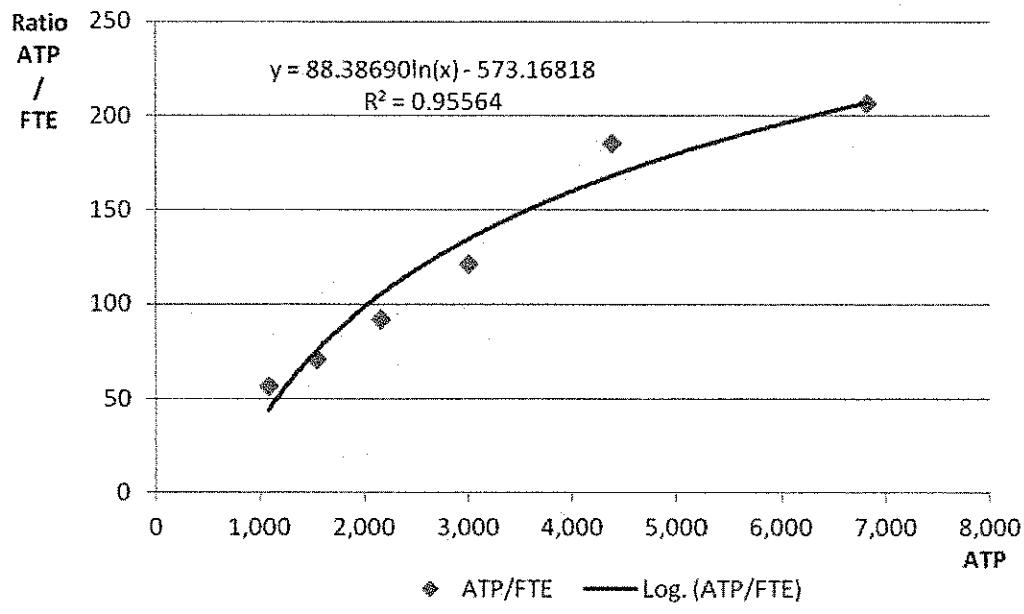
$$(07)\quad ATP/FTE(t) = -573 + 88.4 * LN[ATP(t)]$$

where:

ATP = the forecast number of persons with ATP in future years

LN[ATP] = the natural logarithm of the above.

Figure 4.6 – Status Quo - Productivity Measure
Ratio of ATP Persons per MMAP-FTE
and Fitted Logarithmic Function



Sources: Delsys Research using HC (2009) data and fitted logarithmic function

The number of required MMAP-FTE over time is then given in the Status Quo scenario by:

(08) FTE(t) = ATP(t) / [ATP/FTE(t)]

The average salary per FTE was benchmarked for $68,060 for 2010-11 and was adjusted annually based on a salary escalation factor, so that the salary per FTE over time is then given in the Status Quo scenario by:

(09) Salary/FTE(t) = Base Year Salary * (1 + Escalation Factor)^(t - base year)

where '^' means raised to the power.

The Salary Cost is then given in the Status Quo scenario by:

(10) Salary Cost(t) = FTE(t) * Salary/FTE(t)

Data in the benchmark period (2010-11) indicate that Employee Benefits Program (EBP) and Accommodation costs are proportional to Salary Cost at a fixed percentage (41%).

The EBP & Accommodation Cost is then given in the Status Quo scenario by:

(11) EBP & Accomm Cost(t) = Salary Cost(t) * 0.41

4.2.1 O&M Costs

Data in the benchmark period (2010-11) indicate that O&M costs are proportional to Total Administration Cost at a fixed percentage (20%). As Total Administration Costs = Salary Cost + EPB & Accommodation Cost + O&M Cost, this allows for the following equation for O&M Costs in the Status Quo scenario:

(12) O&M Cost(t) = [.2 / (1 - .2)] * [Salary Cost(t) + EBP & Accomm Cost(t)]

The Health Canada Administration Cost is then given in the Status Quo scenario by:

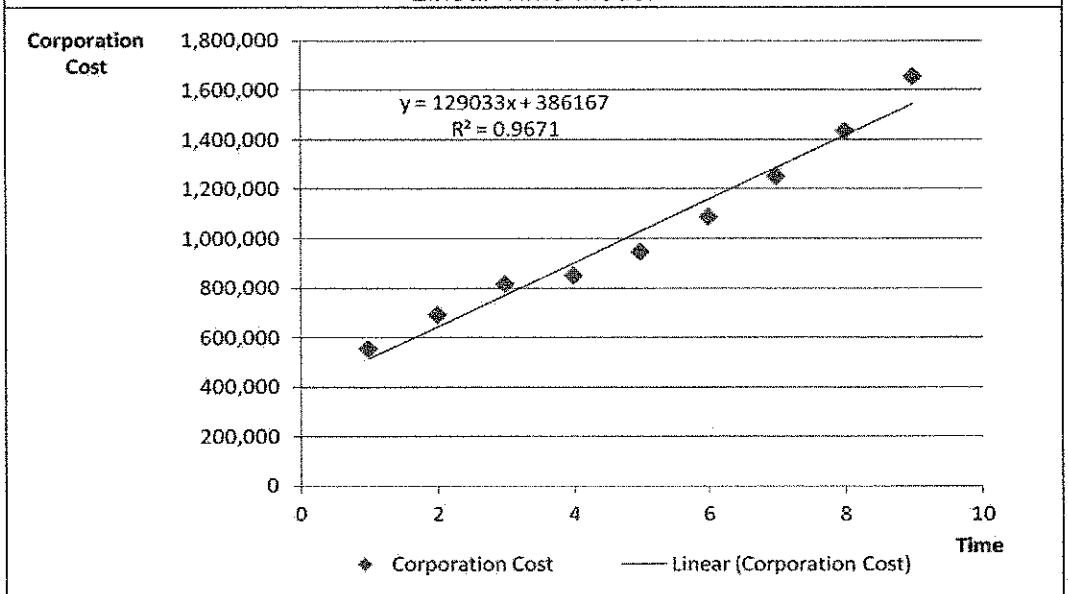
(13) HC-Admin Cost(t) = Salary Cost(t) + EBP & Accomm Cost(t) + O&M Cost(t)

4.2.2 Corporate Cost

Health Canada Corporate Cost includes Human Resources, Finance, Corporate Services and other departmental functional costs that are allocated to program activities such as MMAP.

For FY2005-06 to FY2013-14 (based on HC estimates), the Corporate Cost was a linear function of time as shown in Figure 4.7.

Figure 4.7 – Status Quo – Corporation Cost
Linear Time Model



Sources: Delsys Research

The linear equation allows a prediction of the future Corporate Cost over time in the Status Quo scenario as:

(14) Corporate Cost(t) = 386,167 + 129,033 * (t)

where:

t = a time trend which has values of 10 (FY2014-15) to 20 (FY2024-25).

The sum of Health Canada administrative cost (equation 13) and corporate cost (equation 14) equal the total Program Administration Costs for the Status Quo scenario:

(15) Program Administration Cost(t) = HC-Admin Cost(t) + Corporate Cost(t)

4.2.3 Contract Costs – Government Supply

Health Canada, through Public Works and Government Services Canada (PWGSC) has a contract to cultivate and distribute marihuana for medical purposes to persons authorized to access the Government Supply under the MMAP. The contract terms provide for payment related to a schedule of payments against certain deliverables, the most important of which is the Kilogram (KG) produced to meet the expected MMAP demand.

KG-Demand, Supplied and Produced

The model for KG-Demand for persons eligible to access the Government Supply was estimated based on actual data for KG-Supplied (for FY2005-06 to 2011-12) and an estimate of the Maximum KG-Demand based on the number of ATP persons who are:

- existing ATP-GS at the beginning of the FY (April of the year) who are eligible to access 12 months of Government Supply;
- new ATP-GS during the FY who are eligible (on average) to access 6 months of Government Supply; and
- new ATP-P/D during the FY who are eligible to access 4 months (on average) of 'interim' Government Supply.

From the Fiscal Year forecast of the Total ATP persons, a monthly time series was calculated that allowed, based on parameters for the proportion of Total ATP persons in different supply methods, an estimate of the number of persons in each category as described above.

The mean number of 'Proposed Daily Amount' from the ATP application form for each of the supply categories was obtained, which for 2010-11 showed that the proposed daily amount was significantly higher for DPPL supply (mean=9.0 grams) and PUPL supply (mean=7.6 grams) than for persons accessing the government supply (mean=3.6 grams). The mean across PUPL/DPPL supply was 8.0 grams.

For the years up to FY2009-10, during which ATP persons were able to access the Government Supply without prepayment, there was a significant rate of non-payment (around 20%) – and the 'effective utilization' rate[7] was around 17-20%. In other words, the actual KG-Demand was only 17-20% of what was theoretically possible to have been made available to persons eligible (and likely[8]) to access the Government Supply.

For the FYs after 2010-11 and including an estimate for FY2012-13 (based on one quarter's data[9]) the 'effective utilization' rate following the demand for full pre-payment was around 6%.

The Maximum KG-Demand (Government Supply) is given in the Status Quo scenario by:

(16) Max KG-GS(t) = {[Starting ATP-GS(t) * 12 * 30 * PDA-GS]

+ [New ATP-GS(t) * 6 * 30* PDA-GS]

+ [New ATP-P/D(t) * 4 * 30 * PDA-P/D]} / 1,000

where the first term in each of the three expressions on the right-hand side of the equation is the number of relevant ATP persons eligible to access the Government Supply, the first integer is the months of possible orders in the FY, the second integer is the mean days per month and the last term is the mean Proposed Daily Amount (a maximum) for each category of user.

The KG-Demand is given in the Status Quo scenario by:

(17) KG-Demand(t) = Max KG-GS(t) * Utilization Rate-GS(t)

where the effective utilization rate was assumed to be 6% for the beginning of the forecast period and allowed to rise towards the end of the forecast period as the growth of new ATP persons slows and there was expected to be higher utilization from the persons who start the year as ATP-GS.

It was assumed that the KG-Demand equalled the KG-Supply, as this is an actual transacted market with Health Canada as the intermediary between the consumer and the contracted producer.

The ratio of KG-Supply to KG-Produced was estimated to be 85% for FY2008-09. As a result of reduced demand as a result of pre-payment of orders, this ratio might have fallen to around 50% for FY2009-10. Access was only available for planned expenditures in additional FYs and the actual contracted amounts for KG-Produced were unknown. It was assumed, for the purpose of costing the Government Supply contract, that there was a constant 85% ratio between KG-Supply (and KG-Demand) and KG-Produced.

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[7] The effective utilization rate is the ratio of the KG actual supplied to persons from the Government Supply to this study's estimate of the Maximum KG-Demand, based on the number of persons eligible to access the Government Supply and the maximum amount they were eligible to obtain based on the application 'Proposed Daily Amount'.

[8] The theoretical maximum does not include the persons eligible for Government Supply who never place an order. It includes the existing and new ATP-GS who are expected to make use of the Government Supply and the new PUPL/DPPL persons who are eligible for interim Government Supply.

[9] There was little predictable seasonality in KG-Supply data by month for 2010 and 2011.

The KG-Produced is given in the Status Quo scenario by:

(18) KG-Produced(t) = KG-Supply(t) / 0.85

Government Supply - Contract Cost

Health Canada contracted Government Supply costs were documented for 2005-06 to 2009-10 as part of a HC (2009) Supplemental Funding Request. These costs were in addition to Health Canada administration costs.

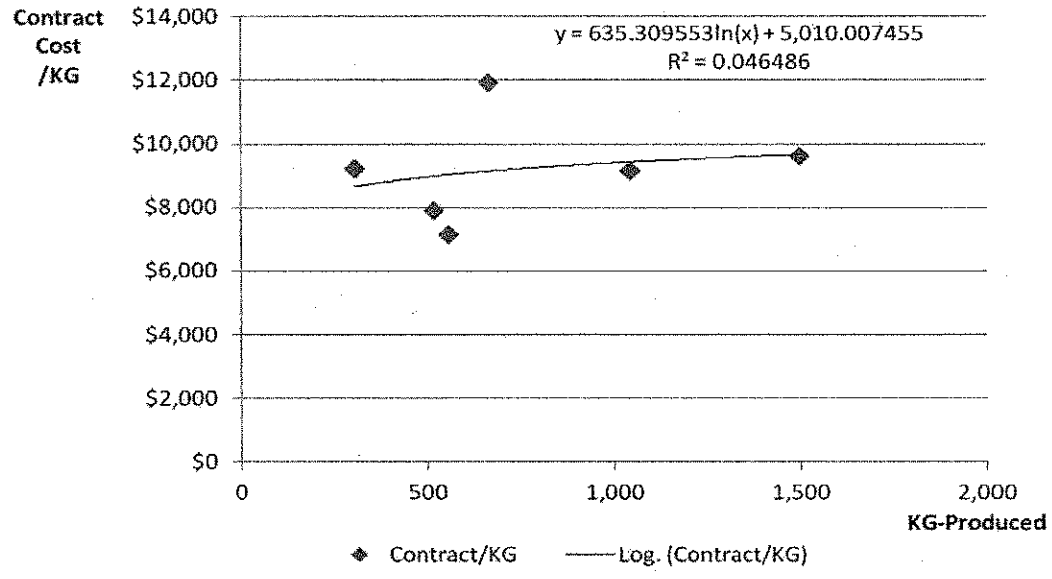
Contract Cost included dried marihuana supply, marihuana seed pouches, various reporting requirements and other miscellaneous work. Payment was made against a schedule of unit costs negotiated in a supply contract between the Government of Canada and the contract Government supplier.

The contracted KG supply costs were known for six fiscal years that spanned the two Supply Contracts signed in 2008 and 2010. There were two prices specified in the Contract: a) a price for 'base quantity' (referred to by Health Canada as 'firm deliverable'); and b) a price for 'optional quantity'. For the purposes of estimating a supply cost, a weighted average was selected, with 90% of the price of the 'base quantity' and 10% of the price for the 'optional quantity'.

These prices were plotted against actual and estimated KG produced for FY2008-09 to 2013-14 in Figure 4.8. There was a poor fit to the data as there was an increase for prices in the 2010 contract over the 2008 contract, but in each of these contracts there was (generally) declining prices over the three fiscal years of the contract. This produced a 'ratcheting' movement over time. Even though the estimated fit of a logarithmic function was poor, this model was used, as it made full use of available data[10].

[10] While the statistical 'fit' of the logarithmic regression is poor it still captures the (generally) upward movement over time (between successive Contracts) but at a declining rate that seems to be reflected by the decrease over time for the years of any particular Contract. Neither the slope not intercept parameter had much impact on the variation of the NPV results.

Figure 4.8 – Status Quo – KG Supply Cost
Relation of KG-Supply Cost and KG-Produced
and Fitted Logarithmic Function



Sources: Delsys Research

The logarithmic equation allowed a prediction of the future KG supply cost over time in the Status Quo scenario as:

(19) KG Supply Cost(t) = 5,010 + 635.3 * LN[KG(t)]

where:

LN[KG(t)] = is the natural logarithm of forecast KG-produced over time.

An estimated KG Cost was then calculated, based solely on the KG Supply Cost and the KG-Produced forecast. This value would not represent the full Contract Cost as it excludes the costs associated with seeds, reporting and miscellaneous work requirements for which the contract supplier is compensated under the contract. It does represent the bulk of the Contract Cost.

Estimated KG Cost over time in the Status Quo scenario is given by:

(20) Estimated KG Cost(t) = KG-Produced(t) * KG Supply Cost(t)

A comparison of the relationship for the observed and estimated period for FY2005-06 to FY2013-14 can be made between the Health Canada reported Contract Cost (for all items) and the Estimated KG Cost. This ratio has fluctuated from 67% to 92% over time. This study assumed that the Estimated KG Cost represented a fixed 90% ratio to Contract Cost over the forecast period.

Estimated Contract Cost over time in the Status Quo scenario is given by:

(21) Contract Cost(t) = Estimated KG Cost(t) / 0.90

4.2.4 Program Cost

The total Health Canada Program Cost for the MMAP is the sum of the Program Administrative Cost and the Contract Cost.

Total Program Cost over time in the Status Quo scenario is given by:

(22) Total Program Cost(t) = Contract Cost(t) + Program Administrative Cost(t)

For the purposes of the CBA it is important to note that the Administrative Cost component was treated as an economic cost of the program administration while the Contract Cost was treated as the supply cost associated with a market transaction in the estimation of Consumer Surplus and Producer Surplus.

4.2.5 Status Quo – Business Compliance Cost

It was assumed that Regulatory Compliance Cost was 10% of the Contract Cost. There was no available evidence to support this assumption but the best available information was that the new regulations governing LP supply security and reporting requirements would be less onerous than those embedded in the Government Supply contract.

Compliance Cost over time in the Status Quo scenario is given by:

(23) Compliance Cost(t) = Contract Cost(t) * 0.10

4.2.6 Status Quo – Government Supply Curve

The Government Supply Curve is the relationship between KG-Demand and Supply Price per KG over time. This differs from the Estimated Contract Cost as it: a) excludes the Compliance Cost component; and b) uses KG-Demand as the denominator (rather than KG-Produced).

Generally, the volume of seeds produced and supplied is a trivial component of the Supply Contract and is omitted from these calculations.

The Supply Price per KG-Demand over time in the Status Quo scenario is given by:

(24) Supply Price/KG-Demand(t) = [Contract Cost(t) * (1 - 0.10)] / KG-Demand(t)

When the Supply Price per KG-Demand and the KG-Demand are plotted over time for the forecast period, an upward sloping Government Supply Curve is obtained.

The linear equation for the Government Supply Curve over time in the Status Quo scenario is given by:

(25) Supply Price/KG-Demand(t) = 11,511 + 0.160595 * KG-Demand(t)

where

S-Intercept-GS = 11,511

S-Slope-GS = 0.160595 (times the quantity supplied in KG)

4.3 Status Quo– User Benefits & Costs

The existence of a market for transacted quantities of marihuana for medical purposes allows an inference, from observed and estimated market quantities and prices and parameters related to linear Demand and Supply curves, of measures of welfare in the form of Consumer Surplus and Producer Surplus. Before formulae for these welfare measures can be derived, intercept and slope parameters for the Supply and Demand curves must be developed. For the Demand curve, the single parameter assumed in this study will be the Price Elasticity of Demand.

4.3.1 Price Elasticity of Demand

Marihuana is a controlled substance and shares many of the demand characteristics of illegal drugs. Demand for illegal drugs has been found to be price inelastic, meaning that the percentage change in quantity demanded is less than the (absolute value) of the percentage change in price.

Mathematically, own-price elasticity of demand ε_p is defined in this study as:

ε_p = %Δ in quantity / %Δ in price = d(ln q) / d(ln p)

where d is the differential operator and ln is the natural logarithm function, q is quantity demanded and p is price.

A comprehensive assessment of US marihuana demand [Rhodes et al (2000)] found evidence that ε_p was in the inelastic range of -0.25 to -0.50 for young people and less frequent adult users. Marihuana price elasticity was:

- lower in the short term than the long term [Becker et al (2006) show that habits change slowly for products with physical and/or social addiction];

- lower for frequent versus first-time users than for regular users [Bretteville-Jensen (2006) shows higher price elasticity among heavy users of heroin]; and

- lower for young adults than for older users.

A comparable form of price responsiveness has been found for a 'participation' elasticity which measures the relationship between price changes and the number of users. A participation elasticity for marihuana of about -0.3 is reported [Kilmer et al (2010)].

The demand for marihuana for medical purposes from a legal source might differ from the demand for marihuana as an illicit substance and might be closer to that for prescription drugs. It is important to note that marihuana is not an approved therapeutic product in Canada.

Qualification – Marihuana for Medical Purposes is not an Approved Therapeutic Product
Marihuana for medical purposes is not an approved therapeutic product and the scientific studies of the safety and efficacy of marihuana for medical (therapeutic) purposes are generally inconclusive [Health Canada (2010)].
HC (2010) Marihuana (marijuana, cannabis) – (Information for Health Care Professionals)

With this qualification, it may still be that the demand for marihuana for medical purposes exhibits similarities (in terms of consumer preferences and price sensitivity) to demand for prescription drugs. At the very least, individual Canadians appear to perceive there to be anecdotal therapeutic benefit of marihuana consumption in relation to various disease conditions.

The price elasticity of demand for prescription drugs in Canada has been estimated at ε_p = -0.10 to -0.15 [Contoyannis et al (2005)] or very inelastic.

Prescription drug price elasticity was:

- lowest ($|\varepsilon_p| < 0.20$) for lowest income/lowest usage and for moderate income/highest usage;

- highest ($|\varepsilon_p| > 1.0$) for higher income/low-to-moderate usage.

Another study [Kapur-Basu (2005)] found a similar non-linear relationship between drug expenditures and household income with an overall (average) income elasticity for prescription drugs of ε_y approx = 0.

Empirical evidence for Canada does not indicate much price sensitivity (in terms of out-of-pocket costs) for prescription drug demand for changes in price. The low price elasticity of

demand for prescription drugs is a result of medical need and the generally low out-of-pocket cost for prescription medicines after insurance (public and private) plan coverage[11].

The combined evidence from both marihuana use (as an illegal substance) and from prescription drug use (as a legal substance) indicate that the price elasticity of demand for marihuana for medical purposes is likely to be low (inelastic) and in the range of ε_p = -0.10 to -0.50 (with a median value of ε_p = -0.25). It was therefore expected that the Marshallian demand curve for marihuana for medical purposes would be downward sloping with a steep slope indicating highly price inelastic.

For the purpose of the CBA study, linear demand and supply curves were assumed. These are the simplest economic specification and facilitate calculation of Consumer Surplus and Producer Surplus measures. They also require the fewest assumptions (e.g., intercept and slope) which must be inferred based on minimal empirical evidence.

The price elasticity of demand for a linear demand curve varies at different points along the curve, with high price elasticity at points near the y-axis intercept (i.e. zero demand) and low price elasticity at points near the x-axis (i.e. maximum demand) intercept point. The assumption that the Status Quo scenario supply markets all exhibit inelastic demand (at the observed positions of supply price and actual consumption) means that the observed market position is found towards the lower right-hand arc of the demand curve close to the x-axis.

Annex 1 contains a comprehensive discussion of the concepts of Consumer and Producer Surplus and the challenge of estimating the impacts of a policy change that involves:

- the existence of an effective consumer subsidy in the Status Quo scenario; and
- a Policy scenario that removes the effective subsidy and also allows for more efficient, lower cost supply.

For the case of the portion of the market that involves the Government Supply, this is effectively what occurs between the Status Quo and the Policy scenarios.

Measures of Consumer Surplus and Producer Surplus were estimated for three categories (i.e., separate markets) of persons with ATP:

1. Government Supply Market: persons who access marihuana for medical purposes from the Government Supply through Health Canada;
2. Personal Use Market: persons who supply their own marihuana for medical purposes from self-cultivation; and
3. Designated Person Market: persons who access a supply of marihuana for medical purposes from a designated person who grows it for them.

These categories were treated as separate markets for two main reasons: a) the supply price is estimated to be very different between these markets; and b) the product characteristics of the

[11] At present (2012), expenses to acquire marihuana for medical purposes are not eligible for reimbursement under Provincial/Territorial Drug/Health plans. For this reason the Status Quo scenario assumes that 100% of the cost of accessing a legal supply of marihuana for medical purposes is borne by the user.

marihuana may vary considerably between the Government Supply (i.e., a single strain of cannabis) and 'private production' (i.e. which may involve many strains of cannabis). The available literature on cannabis use suggested that certain users have a marked preference for certain strains of cannabis. There was no scientific evidence as to the actual or possible therapeutic properties of different strains of cannabis.

4.3.2 Government Supply Market

A Government Supply curve was estimated in equation 25. This involved a linear relationship between the KG-Demand and the Supply Price per KG-Demand. For the purpose of estimating Consumer Surplus and Producer Surplus, the Government Supply curve Slope was kept constant at the value (0.160595) in equation 25 and the Supply curve Intercept was allowed to vary slightly over time so as maintain the constant slope at the equilibrium values (Supply Price per KG-Demand, KG-Demand) determined from equations 24 and 17 above.

The slope of an upward-sloping line is given by the ratio:

Slope = Rise / Run = (Δvertical / Δhorizontal)

The Δvertical up the y-axis (price) is given by the difference between a point on the Supply Curve (i.e. Supply Price per KG-Demand) and the Supply Intercept.

The Δhorizontal along the x-axis (quantity) is given by the difference between KG-Demand and Zero (i.e. the quantity associated with the Supply Intercept).

Therefore:

Slope = (Supply Price per KG-Demand - Supply Intercept) / (KG-Demand - 0)

This equation can be rearranged to solve for the value of the Supply Intercept. The Government Supply curve Intercept over time in the Status Quo is given by:

(26) Intercept-GS(t) = Supply Price per KG-Demand(t) – [KG-Demand(t) * Slope-GS]

The definition of the price elasticity of demand is:

Price Elasticity ε_p = %Δ in quantity / %Δ in price

One point on the Demand curve (for the Government Supply) is known, as this is the point (observed or forecast) that results in quantity KG-Demand at the User Price ($5.00/gram * 1,000 grams = $5,000/KG).

In order to estimate the value of the Demand Intercept, the known point and the Price Elasticity of Demand can be utilized. By definition, the Demand Intercept is the point where the Demand curve intersects the y-axis and the quantity demanded is equal to zero. This corresponds to a -100% change in quantity. Therefore, the associated % change in price can be determined.

%Δ in price = %Δ in quantity / ε_p

The %Δ in price associated with the movement from the point (User Price, KG-Demand at User Price) to the Demand Intercept is given by:

$\%\Delta$ in price = (Price Intercept – User Price) / User Price

These two equations can be brought together to give the following value of the Demand Intercept. The Demand curve Intercept (for the Government Supply) over time in the Status Quo scenario is given by:

(27) Intercept-D(t) = User Price(t) [1 – (1.0 / ε_p)]

With two points of the Demand curve specified – the y-axis intercept and the observed transaction point (User Price, KG-Demand at User Price) – and the assumption that this curve is linear, it is possible to calculate the Demand curve Slope (which is negative as the curve is downward-sloping).

The Demand curve Slope (for the Government Supply) over time in the Status Quo scenario is given by:

(28) Slope-D(t) = [User Price(t) – Intercept-D(t)] / KG-Demand(t)

One characteristic of a constant Price Elasticity of Demand and a constant Demand Intercept is that the Demand Slope declines (in absolute value) as the scale of the market (i.e., KG-Demand) increases.

As shown in Figure 4.9, the Government Supply users (ATP-GS and those who are new ATP-P/D who access an interim supply) face an (effectively subsidized) User Price ($5,000/KG) when they consume KG-Demand. The actual cost associated with KG-Demand is the higher Supply Cost.

In the absence of an effective subsidy, users would face a price slightly less than the Supply Cost (associated with KG-Demand) and would consume at KG*-Equilibrium. Note that the Supply curve (while somewhat flat) is not horizontal, and has a positive slope.

Because the equations for the Supply and Demand curves are known and the equilibrium is determined by their intersection, it is possible to determine the value of KG*-Equilibrium.

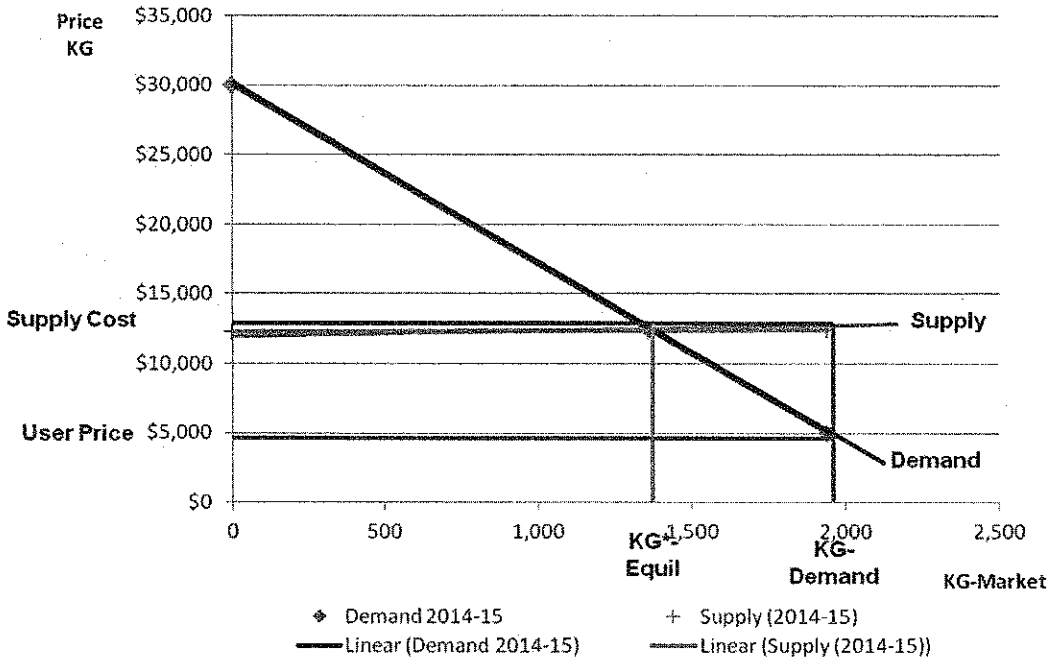
If the Demand and Supply curves are given by:

Supply Curve = Intercept-GS(t) + (Slope-GS * KG)
Demand Curve = Intercept-D - (Slope-D(t) * KG)

then it can be determined that the KG*-Equilibrium over time in the Status Quo scenario is given by:

(29) KG*-Equilibrium(t) = [Intercept-D – Intercept-GS(t)] / [Slope-GS + Slope-D(t)]

Figure 4.9 – Status Quo – Government Supply
Demand & Supply Curves Showing KG*-Equilibrium
and KG-Demand at (Effectively Subsidized) User Price



Sources: Delsys Research
NB: as supply curve is flat-ish it is not possible to show equilibrium price line.

The associated P*-Equilibrium can then be found using the above value for KG*-Equilibrium and either the Supply or Demand equations.

Using the Demand curve equation, P*-Equilibrium over time in the Status Quo scenario is then given by:

(30) P*-Equilibrium(t) = Intercept-D + [Slope-D(t) * KG*-Equilibrium(t)]

Consumer Surplus-GS

Consumer Surplus is a measure of the user benefit not captured in the market transaction. As the Demand curve represents the marginal willingness-to-pay for consumption, Consumer Surplus is the integral of marginal willingness-to-pay above the transacted value. This is (for an unsubsidized market) the area under the Demand curve and above the price line at the market equilibrium quantity.

For a situation of a subsidized market, as is the case here, the Consumer Surplus (Government Supply) is the area under the Demand curve and above the Supply Cost associated with the User Price at the KG-Demand[12]. While the Supply curve is very flat, it is not horizontal. In order

[12] See Annex 1 for a more detailed explanation of this point.

to correctly estimate the Consumer Surplus, it is necessary to find the KG'-Demand that is associated with the Supply Price per KG.

Using the Demand Curve equation, KG'-Demand over time in the Status Quo scenario can be determined by:

(31) KG'-Demand(t) = [Intercept-D - Supply Price per KG-Demand] / Slope-D(t)

Consumer Surplus can be estimated using a geometric formula which exploits the fact that, with linear Demand and Supply curves, the areas to be measured are triangles whose area is half that of the associated rectangles.

Consumer Surplus (Government Supply) over time in the Status Quo scenario is given by:

(32) CS(Govt Sup)(t) = 0.5 * [Intercept-D - Supply Price per KG-Demand(t)]

* KG'-Demand(t)

Producer Surplus-GS

For reasons explained in Annex 1, there is no Producer Surplus (Government Supply), as the market is subsidized and the marginal cost of production is always above the (effectively) subsidized price.

Deadweight Loss-GS

Deadweight Loss is the cost of producing at a quantity that exceeds KG*-Equilibrium such that the social value (i.e. willingness-to-pay) is less than the marginal cost of production. This occurs in markets where there is a subsidy or tax that creates a 'price wedge' between what users pay and what suppliers receive in a market transaction. The Deadweight Loss (Government Supply) over time in the Status Quo scenario is given by:

(33) DWL(Govt Sup)(t) = {0.5*[P*-Equil(t) - User Price(t)] * [KG-Dem(t) – KG*-Equil(t)]}

+ {0.5*[Supply Price(t) - P*-Equil(t)] * [KG-Dem(t) – KG*-Equil(t)]}

The Deadweight Loss calculation requires the area of two triangles to be calculated.

This completes the discussion of the Government Supply market in the Status Quo scenario.

4.3.3 **Personal-Use Supply Market**

Equation 2 gives the number of persons with a PUPL who self-supply their marihuana under the MMAR in the Status Quo scenario.

Personal Use – Supply Cost

The estimate for Supply Cost (Personal Use) used in the CBA model was based on an Activity-Based Costing (ABC) model which follows the analysis of small-scale indoor marihuana production [Kilmer et al (2010), Caulkin (2010)]. The model converted from US imperial/dollar units to Canadian metric/dollar units and replaced certain values (e.g. electricity cost per kwh)

with Canadian values. In addition, the opportunity cost for residential facility space and own time was included.

The maximum number of allowable plants for the mean Proposed Daily Amount (for ATP-P persons) was calculated using the Health Canada formula. For a mean PDA of 7.6 grams, this corresponded to 37 marihuana plants. The space requirement for this number of plants was based on 15 plants per square metre. The dried marihuana yield was 30 grams per plant per harvest and there was an assumed 3 harvests per year.

Variable labour cost was calculated using an assumption that each harvest (for this quantity of plants) required 60 labour hours and an opportunity cost of $10.00 per hour. Estimates of growing medium/supplies, electricity, space cost (for growing, drying and supplies) and equipment requirements were also used. There was also an estimate of fixed labour (equipment set-up) costs in addition to space usage cost based on a proportion of amortized housing cost.

The resulting Supply Cost (Reference case) was estimated at $1.80/gram (or $1,800/KG). In the CBA analysis, the sensitivity of the results was tested by allowing this parameter to vary over a range of values.

Table 4.1 – Status Quo – Personal-Use Supply Cost

Cost Summary per m^2 of Grow Area	Per Harvest	Per Year
Variable Consumables & Power	$222	$667
Variable Labour	$240	$720
Fixed Space & Equipment & Labour	$210	$631
Total Cost	$673	$2,018

Cost Using m^2 of Grow Area	Per Harvest	Per Year
Variable Consumables & Power	$555	$1,666
Variable Labour	$600	$1,800
Fixed Space & Equipment & Labour	$526	$1,579
Total Cost	$1,682	$5,045

Assumed Personal Use (Grams)	2,774

Cost per Gram of Use	Per Year
Variable Consumables & Power	$0.60
Variable Labour	$0.65
Fixed Space & Equipment & Labour	$0.57
Total Cost	$1.82

Sources: Delsys Research

Personal Use – KG-Demand

As with Government Supply users, a Maximum KG-Demand for Personal Use was calculated based on the mean PDA (7.6 grams) for ATP-P persons and the maximum number of days that persons could consume, allowing for persons who were ATP-P at the start of the Fiscal Year to consume for 12 months (at 30 days per month) and new ATP-P persons to consume for 3 months, on average (after they have successfully harvested their first crop, during which they are eligible to access the government supply for 4 months).

The Maximum KG-Demand (Personal Use) is given in the Status Quo scenario by:

(34) Max KG-PU(t) = {[Starting ATP-P(t) * 12 * 30 * PDA-P]

+ [New ATP-P(t) * 3 * 30* PDA-P] / 1,000

where the first term in each of the two expressions on the right-hand side of the equation is the number of relevant ATP persons eligible for Personal Use production, the first integer is the months of possible supply in the FY, the second integer is the mean days per month and the last term is the mean Proposed Daily Amount (a maximum) for each category of user.

In terms of actual use, it was assumed that this is less than the amount indicated in the PDA figure. For Personal-Use ATP persons, the PDA figure determines the maximum amount of marihuana plants legally allowed to be grown. This likely overstates actual usage. Data on MMAP users [Lucas (2009)] suggests that about 72% of users rely on inhalation methods of ingestion while 28% of users rely on oral methods of ingestion. Analysis [Kilmer-Pacula (2009)] suggests that heavy marihuana users (presumably smokers) consume about 1.2 grams per day +/- 0.4 grams. If this range is considered to represent a Standard Deviation (SD), then very heavy smokers might consume 2.0 grams per day (i.e. the mean of 1.2 plus two SD). Assuming that oral ingestion requires five times the amount of marihuana than that required for inhalation, 10.0 grams per day can be estimated as the oral ingestion mean. A weighted average of these would come to about 4.2 grams per day.

The ratio between the estimated mean daily consumption (4.2 grams) and the mean PDA for ATP-P (7.6 grams) provides the effective Utilization Rate (Personal Use), which is equal to 55%.

The KG-Demand (Personal Use) is given in the Status Quo scenario by:

(35) KG-Demand(t) = Max KG-PU(t) * Utilization Rate-PU(t)

Personal Use – Supply Curve

For the Personal-Use market segment it was assumed that the Supply Curve is horizontal at the Supply Cost (i.e., infinitely elastic supply which corresponds to Constant Returns to Scale production, based on the replication of small scale operations).

Personal Use – Demand Curve

Based on the estimate of the equilibrium quantity demand (equation 35) it is possible to infer, using the estimated Price Elasticity of Demand, the parameters of the Demand curve.

The Demand curve intercept (for Personal Use Supply) over time in the Status Quo scenario is given by:

(36) Intercept-D(t) = Supply Price(t) [1 – (1.0 / ε_p)]

As there were two known points of the linear Demand curve – the y-axis intercept and the estimated transaction point (Supply Price, KG-Demand at Supply Price) – it was possible to calculate the Demand curve slope (which is negative as the curve is downward-sloping).

The Demand curve slope (for Personal Use Supply) over time in the Status Quo scenario is given by:

(37) Slope-D(t) = [Supply Price(t) – Intercept-D)] / KG-Demand(t)

One characteristic of having a constant Price Elasticity of Demand and a constant Demand Intercept is that the Demand Slope declines (in absolute value) as the scale of the market (i.e. KG-Demand) increases.

Personal Use users have a lower Demand Intercept than those for the Government Supply market. This is a mathematical result of the assumption that the elasticity of demand is the same in the two markets. It implies that the initial (marginal) users of Personal Supply have a lower willingness-to-pay for the initial quantity units than those in the Government Supply market.

Consumer Surplus-PU

Consumer Surplus (Personal Use) over time in the Status Quo scenario is given by:

(38) CS(PU)(t) = 0.5 * [Intercept-D - Supply Price per KG-Demand(t)]

* KG-Demand(t)

Producer Surplus-PU

As the Personal-Use Supply Curve is horizontal, there is no Producer Surplus.

Deadweight Loss-PU

As there is no effective subsidy, there is no Deadweight Loss.

This completes the discussion of the Personal-Use supply market in the Status Quo scenario. In the next section, dealing with the Designated-Person supply market, this logic is replicated.

4.3.4 **Designated Person Supply Market**

Equation 3 gives the number of ATP persons associated with a DPPL who arrange for a Designated Person to supply their marihuana under MMAR in the Status Quo scenario.

Designated Person – Supply Cost

As noted above, the Supply Cost (Designated Person) was estimated based on an Activity-Based Costing (ABC) model (see description of Personal Use above). There was no information on the specific arrangements that are typically made between persons holding an ATP (the user) and the person with a DPPL (the supplier). Health Canada has no regulations related to the commercial arrangements between these parties. It is possible that a family member does the cultivation, for which the Supply Cost would be comparable to that for Personal Use production. However, the arrangement could involve a person undertaking marihuana production for up to two persons and expecting a commercial return for their efforts.

For the purpose of calibrating a model, the estimated mean PDA for ATP-D persons specified at a higher level (9.0 grams), which allows for a maximum of 44 marihuana plants. The production for a DPPL cultivating for two ATP-D users was scaled to allow for some economies of scale. With similar parameters (as for Personal Use), the estimated Supply Price was lower ($1.40/gram) when no profit and overhead were allowed. When an allowance was made for an overhead/profit factor of 50% of total cost, the CBA model generated a Supply Price of $2.80/gram. This result was very sensitive to the overhead/profit factor. If that value is higher (65%) the Supply Price becomes $4.00/gram.

As the generally accepted supply price from a compassion club is believed to be between $10.00-$12.00/gram, the estimated Supply Price would be more attractive than reliance on the 'grey market' illicit supply from those organizations.

The resulting Supply Cost (Reference case) is estimated at $2.80/gram (or $2,800/KG). The sensitivity of the results was assessed by allowing this parameter to vary over a range of values.

Table 4.2 – Status Quo – Designated Person Supply Cost

Cost Summary per m^2 of Grow Area	Per Harvest	Per Year
Variable Consumables & Power	$222	$667
Variable Labour	$105	$316
Fixed Space & Equipment & Labour	$203	$610
Total Cost	$531	$1,592
Cost Using m^2 of Grow Area	Per Harvest	Per Year
Variable Consumables & Power	$1,933	$5,799
Variable Labour	$915	$2,745
Fixed Space & Equipment & Labour	$1,770	$5,310
Overhead & Profit	$4,618	$13,854
Total Cost	$9,236	$27,708
Assumed Personal Use (Grams)		9,855
Cost per Gram of Use		Per Year
Variable Consumables & Power		$0.59
Variable Labour		$0.28
Fixed Space & Equipment & Labour		$0.54
Overhead & Profit		$1.41
Total Cost		$2.81

Sources: Delsys Research

Designated Person – KG Demand

As with Personal-Use users, an estimate was calculated for Maximum KG-Demand for Designated-Person Use based on the mean PDA (9.0 grams) for ATP-D persons and the maximum number of days that persons could consume. This calculation allowed for persons who were ATP-D at the start of the Fiscal Year to consume for 12 months (at 30 days per month) and new ATP-D persons to consume for 3 months, on average.

The Maximum KG-Demand (Designated Person Use) is given in the Status Quo scenario by:

(39) Max KG-DP(t) = {[Starting ATP-D(t) * 12 * 30 * PDA-D]

+ [New ATP-D(t) * 3 * 30* PDA-D] / 1,000

where the first term in each of the two expressions on the right-hand side of the equation is the number of relevant ATP persons eligible for Designated Person production, the first integer is the months of possible supply in the FY, the second integer is the mean days per month and the last term is the mean Proposed Daily Amount (a maximum) for each category of user.

The analysis assumed the same actual mean daily consumption (4.2 grams) as for Personal Use which, compared to the mean PDA for ATP-D (9.0 grams), provides an effective Utilization Rate (Designated Person) equal to 47%.

The KG-Demand (Designated Person) is given in the Status Quo scenario by:

(40) KG-Demand(t) = Max KG-DP(t) * Utilization Rate-DP(t)

Designated Person – Supply Curve

For the Designated Person market segment it was again assumed that the Supply Curve is horizontal at the Supply Cost (i.e., infinitely elastic supply which corresponds to Constant Returns to Scale production-based on the replication of small scale operations).

Designated Person – Demand Curve

Because the equilibrium quantity demand (equation 40) was already estimated, it was then possible to infer, using the assumed Price Elasticity of Demand, what were the parameters of the Demand curve.

The Demand curve Intercept (for Designated Person Use Supply) over time in the Status Quo is given by:

(41) Intercept-D(t) = Supply Price(t) [1 – (1.0 / ε_p)]

As there were two known points on the linear Demand curve, the y-axis intercept and the estimated transaction point (Supply Price, KG-Demand at Supply Price), it was possible to calculate the Demand curve Slope (which is negative as the curve is downward-sloping).

The Demand curve Slope (for Designated Person Supply) over time in the Status Quo is given by:

(42) Slope-D(t) = [Supply Price(t) – Intercept-D)] / KG-Demand(t)

Designated-Person users have a lower Demand Intercept than those for the Government Supply market. This is a mathematical result of the assumption that the elasticity of demand is the same in the two markets. It implies that the initial (marginal) users of Designated-Person Supply would have a lower willingness-to-pay for the initial quantity units than those in the Government Supply market.

Consumer Surplus-DP

Consumer Surplus (Designated Person) over time in the Status Quo is given by:

(43) CS(DP)(t) = 0.5 * [Intercept-D - Supply Price per KG-Demand(t)]

* KG-Demand(t)

Producer Surplus-DP

As the Supply Curve is horizontal there is no Producer Surplus.

Deadweight Loss-DP

As there is no effective subsidy there is no Deadweight Loss.

4.4 Status Quo – Safety Costs

The policy rationale for the proposed regulatory change involves a number of risks to public health and safety including: a) fire risk due to use of family residence for marihuana cultivation; and b) health risk for family members and public service officials as a result of the possible presence of mould, chemicals and other toxic materials related to the production of marihuana.

For the purposes of this CBA, only the safety costs associated with the risk of fire were quantified, as this is more tangible and has better data availability than the other risks. The broader safety risks are addressed in the qualitative analysis discussion.

4.4.1 Fire Risk Due to Faulty Electric Wiring/Use & Outcomes

One intended consequence of the proposed regulatory change is an improvement to public safety, by removing from residential areas the locus of legal marihuana cultivation under the MMAR (i.e. home cultivation under PUPL/DPPL).

Fire Causes Specific to Residential Marihuana Cultivation

The principal public safety risk relates to house fire caused by faulty electrical wiring, overloading of electrical circuits, tampering with electrical usage monitoring and other electrical system malfunctions.

Evidence has been offered in support of the existence of such fire risks associated with indoor marihuana cultivation (i.e., grow operations) although much of this evidence is not specific to misuse of PUPLs/DPPLs:

- [Ontario Fire Marshal/OPP (2009)] reported for a 6-month period that they had been called to fires involving either a marihuana grow operation or illegal drug lab approximately every 15 days (i.e. 24 times/yr)[13];

[13] An unknown proportion of these involved other 'drug labs' and were not specifically marihuana grow-op related.

- [Plecas et al (2005)] estimated that residences used for marihuana production have a 24x greater risk of residential fire than a regular home and that Surrey, BC (2003) attributed about 9% of house fires to electrical problems in residences used for marihuana production[14]; and

- [RCMP (2010)] reported that among MMAR 'misuse' cases (n=190) there were 23 cases (12%) where electrical hazard was mentioned, and 2 cases (1%) where a fire had occurred.

Health Canada regulatory analysis dealing with cigarette ignition propensity [Health Canada (2005)] used fire statistics from the Canadian Association of Fire Chiefs Annual Report – Fire Losses in Canada for various years to estimate probabilities of fires. This analysis followed that approach using available average Canadian data for a five-year period (1998-2002) that involves the most recent data available.

Fire Outcomes

The overall annual fire numbers (annual average over the five-year period 1998-2002) are shown in Table 4.3. The following information is provided: a) the number of total fires, b) the death rate per fire, c) the injury rate per fire, d) the average property damage per fire and information about the number of fires (by type) for residential occupancy (one- and two-family dwellings) compared to the number of Census (2001) family dwellings of a similar nature[15].

Table 4.3 – Canada Fire Data (Annual Average 1998-2002)	
Total Annual Fires	55,081
Total 1-2 Family Dwellings	8,273,535
Total 1-2 Family Dwelling Fires	11,279
Incidence of 1-2 Family Fire (per 100,000 family dwellings)	136
Rate of death per Fire	0.0062
Rate of injury per Fire	0.0448
Property Damage per Fire	$23,654
Source: CCFMFC Annual Report – Fire Losses in Canada for selected years.	

For the CBA, it was necessary to focus on risks associated with faulty wiring in residential homes. Data provided by the Canadian Association of Fire Chiefs data has several breakdowns of relevance to this analysis. The fire loss data provides the statistical breakdown for fires by:

- Property classification: which includes residential occupancy and further breakdown for 1- & 2-family dwellings (urban, rural) which is most relevant for MMAR misuse circumstances;

[14] As Surrey and British Columbia (more generally) are thought to be hotspots for marihuana grow-operations, these rates may not be representative of the average situation across Canada

[15] Census (2001) Dwelling count for single-detached, semi-detached, row house, detached duplex apartment and other single-attached house. This is said to correspond to the one- and two-family dwellings from CCFMFC data.

- Sources of ignition: which includes three categories relevant for MMAR misuse special electrical circumstances, i.e., 1) appliances and equipment (e.g. dryers, electrical appliances); 2) electrical distribution equipment (e.g. electrical wiring); and 3) other electrical equipment (e.g. lamps, electrical motors); and

- Act or omission causing fire: which includes two possible categories relevant for MMAR misuse special circumstances, i.e., 1) mechanical/electrical failure or malfunction (e.g. short circuit, part failure); and 2) construction design/installation deficiency (e.g. over-fusing).

As the death, injury and property damage profiles for all three relevant sources of ignition were similar, the CBA took an aggregate profile of their combination to represent the situation for special ignition sources specific to the marihuana production situation.

The analysis used the death, injury and property damage profiles for the latter act or omission causing fire to represent the situation for special acts/omissions specific to the marihuana production misuse associated with the MMAR, as it was more deadly and seemed to better relate to the main fire safety concern related to 'jimmy-rigged' electrical systems (e.g., electrical over-loading, poor electrical wiring, breaker-box bypass) involved in marihuana production situations.

Table 4.4 shows the fire data specific to these circumstances of interest.

Table 4.4 – Detailed Fire Data (Annual Average 1998-2002) for special circumstances relevant to marihuana production situations

	All	FRD	Electrical	Design/Install
Total Annual Fires	55,081	11,279	8,463	2,492
Probabilities	100%	20.5%	15.4%	4.5%
		Compound Factors		
Rate of death per Fire	0.0062	2.0815	0.3765	0.5872
Rate of injury per Fire	0.0448	1.7715	0.8382	0.6704
Property Damage per Fire	$23,654	1.2121	1.2074	1.0949

Source: CCFMFC Annual Report – Fire Losses in Canada for selected years.
FRD – Family residential dwelling
Electrical – all forms of electrical sources of ignition
Design/Install – construction design/installation act or omission

The row for total annual fires shows the annual average for the five-year period for each separate circumstance of interest relevant to the marihuana production misuse situation.

The row for probability shows the ratio of number of fires for a specific circumstance to the total number of fires.

The column for 'All' shows the actual rates (for all fires) for death and injury and the average property damage per fire.

The rows of rates (death and injury and property damage per fire) for the columns for 'Family Residential Dwelling' (FRD), 'Electrical' and 'Design/Install' show a compounding factor which,

when applied to the overall rates (of death and injury) or for property damage per fire, yield the appropriate values which can separately by derived from the data directly for those values.

The data was compiled in this way because the CBA model required the assumption that the probabilities and compound factors for the three circumstances of interest are statistically independent. This assumption allows them to be used multiplicatively (without adjusting for correlations which would be required if they were not independent) to develop compound probabilities and compound rates (for death/injury) and compound property damage per fire.

These values for the compound factors suggest that, for example:

- 1 & 2 family residential fires (FRD): have a higher (208%) death rate (than for all fires), a higher (177%) injury rate and higher (121%) property damage per fire;
- Electrical source of ignition fires (Electrical): have a lower (38%) death rate (than for all fires), a lower (84%) injury rate and higher (121%) property damage per fire; and
- Construction design/installation act or omission fires (Design/Install): have a lower (59%) death rate (than for all fires), a lower (67%) injury rate and higher (109%) property damage per fire.

All the above statements are relative to the same base (i.e. all fires).

Assuming that these three circumstances of interest are statistically independent, it is possible to compute the factors associated with a 'compound situation' having all three of these circumstances of interest. In other words, fire parameters can be estimated for 1- & 2- family residential dwellings where the ignition source is electrical and there is a construction design/installation deficiency. These are the circumstances of most concern for fire safety related to marihuana production misuse situations.

Table 4.5 shows the fire data specific to these circumstances of interest. The compound probability of 0.14% (i.e., a fire of this type given any kind of family dwelling fire), the specific rates of death per fire (0.0028) and injury per fire (0.0252) and average property damage per fire ($37,903) generate estimates that there would have been, nationally for Canada for an annual average over the five year period 1998-2002, 78 such fires corresponding to this compound set of circumstances and 0 deaths, 4 injuries and about $3.0M in cumulative property damage per year.

Table 4.5 – Residential Marihuana Cultivation
Relevant Fire Parameters

Estimated Annual Fires	78	
Probability	0.14%	Number
Rate of death per Fire	0.0028	0
Rate of injury per Fire	0.0252	4
		Total Damage
Property Damage per Fire	$37,903	$2.956M

Source: Delsys calculations based on CCFMFC data for selected years.

In the calculation of deaths, these estimates were rounded to the nearest integer value.

Although the estimates were rounded to the nearest integer, the calculation of injuries in the CBA model took into account the 'rounding difference' that arises from the death calculation. Therefore, if the estimate of deaths is 0.3 and this was rounded down to 0.0, the rounding error (i.e., 0.3 minus 0.0) was added to the estimate of injuries before rounding for injuries. In essence, this is equivalent to saying that 0.3 deaths means zero deaths, but means an extra 0.3 injuries. This was taken as an intuitively proper way for dealing with 'integer lumpiness' in this aspect of the CBA model.

The above data was used in the CBA to represent the probabilities of injury, death and property damage per fire caused by marihuana production "misuse-like" conditions.

4.4.2 Misuse of Residential Marihuana Cultivation

A review of alleged MMAR 'misuse' cases (n=190) shows that there were 23 cases (12%) where electrical hazard was mentioned [RCMP (2010)]. This suggests that the potential for a fire is present in 12% of MMAR 'misuse'. In the section of this report dealing with public security (below), an 80:20 'rule of thumb' was assumed in respect of MMAR 'misuse'. This assumption postulates that major misuse (i.e., closest to a grow operation) is 20% of all estimated misuse while 80% involves minor misuse (i.e., misuse of a smaller scale of criminality and involving minimal illegal activity, such as distribution of excess marihuana production to friends).

The alleged MMAR misuse data found that there were n=2 cases (1%) where a fire had occurred. As this probability is specific to MMAR misuse, which is a specific focus of concern in the CBA, this probability was used for the risk of fires associated with misuse of marihuana cultivation activities under MMAR production licenses.

How does this MMAR-misuse-related fire risk relate to the fire risk for all residences? Based on data from the Canadian Association of Fire Chiefs, it was estimated that the probability of a house fire among all Canadian residences (one- and two- family dwellings) associated with all causes was 0.14%. If the 1% probability of fire among known MMAR misuse cases is taken as a true measure, it suggests that the probability of fire for a MMAR misuse is about seven (7) times higher than for an average house. This estimate compares to a BC estimate [Plecas et al (2005)] that a residence used for marihuana production has a twenty-four (24) times greater risk of residential fire than a regular home. As MMAR misuse involves a family residence compared to marihuana production sites that are dedicated to marihuana cultivation, it would be reasonable to expect family members to engage in less risky makeshift electrical setups than is found in an average marihuana production site, so the lower risk assumed in the CBA may be more in keeping with this type of less risky and smaller scale operation than a full (average) marihuana production site.

The specific fire risk and outcome parameters (Table 4.5) were utilized in the CBA.

4.4.3 Residential Dwellings at Risk

The 78 fires (for simplicity the base period was assumed to be 2002) are related to specific circumstances relevant to marihuana production. However, it is known that they arise from all marihuana production sites, and not just those associated with the misuse of MMAR production licenses (PUPL/DPPL).

In the section (below) on public security risk, it was assumed that 36% of MMAR production licenses (PUPL/DPPL) were involved in some degree of possible 'misuse' but only 20% of that (i.e. 20% of 36%) was of a major misuse which would give rise to the type of elevated fire risk addressed in the CBA . Therefore, using probability compounding, the percentage of all MMAR production licenses giving rise to the elevated risk of house fires would be 2.6% (36% * 20%). This is the constant rate that is applied to a base year number of MMAR production licenses (e.g. 2012 value of 12,000) with growth over time in the Status Quo scenario. Therefore, for example, in 2012 there are an estimated 15,000 MMAR production licenses, of which 36% are assumed to be engaged in some degree of alleged misuse (5,400) and only 20% of these are assumed to engage in major misuse (1,080). Of these, 12% are likely to involve the presence of electrical hazards (130) and 1% will experience a house fire (11, rounding from 10.8).

The rate of growth of Census family dwelling has been 1.410% per year (based on the observed Census value for one- and two- family dwellings over the period 2001-05), so there would have been roughly 13,000 house fires in 2012. There were an estimated 13,000 indoor hydroponic marihuana cultivation (grow-op) sites in Quebec in 2000 [Bouchard 2007]. As Quebec accounted for 46% of Canadian police-reported cases of cannabis cultivation, this would imply that Canadian indoor grow operations were perhaps 28,000 in 2000. The estimated probability of fire for a grow-operation residence is 3.3% [Plecas et al (2005)], so one would expect about 925 house fires associated with grow-operation marihuana cultivation. This compares to an estimate of 11 house fires associated with MMAR misuse of production licenses. Accordingly, the MMAR-related contribution to fires in marihuana production sites would be only 1%.

4.4.4 **Misuse-Related Fires – Status Quo**

The CBA used the specific fire incidence as a parameter going forward in time as the scale of MMAR production and misuse activities was projected to increase.

The benchmark Pr_{fire} is 1%, which was taken to be specific to major misuse of MMAR production licenses. This is an increased probability above the baseline risk of fire for a 1 & 2 family residential home (which is estimated to be 0.14% for all of Canada). It was also assumed that there are elevated fire risks for minor misuse of MMAR production license (assumed to be 33% of that for major misuse) and for no misuse of MMAR production license (assumed to be 10% of that for major misuse). The rationale for these categories having some risk of residential fires (above the benchmark) is that, while there is a lesser (or no) level of misuse, there are inherent fire risks from the nature of indoor marihuana cultivation.

For purposes of the analysis it was not possible to lump ATP-P (PUPL) and ATP-D (DPPL) persons together, as there could be multiple DPPLs held by a single producer. In the case of DPPL production, the fire risk (from marihuana cultivation) is not borne by the person holding the ATP-D but the person engaged in marihuana cultivation under the DPPL. The analysis assumed, for production costs, that an average of 1.5 production licenses was held by the average DPPL producer which, in terms of fire risk, means that there is a lower fire risk for each ATP-D user than for each ATP-P user.

PUPL Licenses – Fire Events

The number of fires in the Status Quo scenario associated with MMAR-PUPL production is:

(44) House Fire-PU(t) = {ATP(t) * %PUPL * %Misuse * %Major * Pr_{fire}}

+ {ATP(t) * %PUPL * %Misuse * (1 - %Major) * Pr_{fire} * 0.33}

+ {ATP(t) * %PUPL * (1 - %Misuse) * Pr_{fire} * 0.10}

Where:

ATP-P(t) is the total number of ATP persons in time t

%PUPL (60%) is the proportion of ATPs with PUPL

%Misuse (36%) is the probability of misuse of PUPLs/DPPLs

%Major (20%) is the proportion of misuse that was assumed to be major misuse

Pr_{fire} (1%) is the probability of house fire (related to marihuana cultivation) given MMAR major misuse.

Pr_{fire} * 0.33 is the probability of house fire given MMAR minor misuse.

Pr_{fire} * 0.10 is the probability of house fire given normal MMAR use.

The number of fires is rounded to the nearest integer value.

DPPLs– Fire Events

The number of fires in the Status Quo associated with MMAR-DPPL production licenses is:

(45) House Fire-DP(t) = {[ATP(t) * %DPPL / Scale Factor] * %Misuse * %Major * Pr_{fire}}

+ {[ATP(t) * %DPPL / Scale Factor] * %Misuse * (1 - %Major) * Pr_{fire} * 0.33}

+ {[ATP(t) * %DPPL / Scale Factor] * (1 - %Misuse) * Pr_{fire} * 0.10}

where

%DPPL (20%) is the proportion of ATPs with DPPL

Scale Factor (1.5) is the assumed number of DPPL per Designated Person producer (or is otherwise a scaling factor for possible lower risk for DPPL producers versus PUPL producers).

4.4.5 Fire Outcome Social Cost – Status Quo

Three consequences of fire were assessed quantitatively:

A. Risk of Death from Fire

B. Risk of Injury from Fire

C. Property Damage from Fire

For 'risk of death from fire', the analysis used an estimate specific to fires that involved: a residential home, an electrical source of ignition, and faulty construction design or installation. This was estimated to be 0.28% (2000 data) [CCFMFC Annual Report – Fire Losses in Canada data]. The analysis used a Value of Statistical Life of $5.8M [Health Canada (2005)] in the event of a death being realized.

For 'risk of injury from fire', the analysis used an estimate specific to fires that involve: a residential home, an electrical source of ignition, and faulty construction design or installation. This was estimated to be 2.52% (2000 data) [CCFMFC Annual Report – Fire Losses in Canada data]. A willingness-to-pay (WTP) to avoid injury was estimated to be $13,300, based on healthcare costs associated with different forms of injury [as reported in Health Canada (2005)] with a scalar adjustment of 2.5 to adjust this health care cost to a WTP measure based on a rule-of-thumb used in some of the literature.

For 'property damage from fire', the analysis used an estimate specific to fires that involved: a residential home, an electrical source of ignition, and faulty construction design or installation. This was estimated to be $37,900 (2000 data) [CCFMFC Annual Report – Fire Losses in Canada data].

4.4.6 Status Quo - Fire Costs

For each of the fire events associated with PUPLs and DPPLs, the social costs associated with fires related to marihuana cultivation are given, in the Status Quo scenario over time, by:

$$(46)\quad \text{Fire Costs}(t) = [\text{House Fire}(t) * WTP_{damage}] + [\text{House Fire}(t) * Pr_{injury} * WTP_{injury}] + [\text{House Fire}(t) * Pr_{death} * WTP_{death}]$$

where:

WTP_{damage} = $37,903 i.e. the mean property damage per such fire

Pr_{injury} = 4.46%

WTP_{injury} = $13,300

Pr_{death} = 0.28%

WTP_{death} = $5.8M

The total fire costs for the Status Quo scenario are the sum of the Fire Cost for each of PUPL and DPPL.

The number of injuries and deaths for any year is rounded to the nearest integer value. A slight adjustment is made to the Pr_{injury} to reflect the non-integer part of the Pr_{death} so that, effectively, a 'partial death' is treated as an additional injury in the rounding related to the number of injuries.

4.5 Status Quo – Security Costs

The policy rationale for the proposed regulatory change involves a number of risks to public security, including: a) the threat of home invasion and violence to family members (including shooting) as a result of criminal 'grow-rip' from marihuana production activity under MMAR production license misuse; and b) the exposure to young children in the family to possible criminal activity which may have a lasting impact on such children.

For the purposes of the CBA, only the security costs associated with the risk of home invasion and violence to family members were quantified, as this is more tangible and has better data availability than the other risks. The broader security risks are addressed in the qualitative analysis section of this CBA (below).

4.5.1 Criminal Misuse of MMAR Production Licenses

One intended consequence of the proposed policy is to improve public security by removing from residential areas the locus of legal marihuana cultivation under MMAR (i.e., home cultivation under PUPL/DPPL). It is thought that some portion of PUPL/DPPL production licenses may be used as a 'cover' by persons who divert marihuana into the illicit market. This could take the form of:

a) growing an excess amount above what is legally permitted under the terms of the production license from Health Canada, which is subsequently sold or distributed illicitly; and/or

b) diverting some unconsumed amount of the marihuana grown within the permitted amount under the production license from Health Canada which is subsequently sold or distributed illicitly.

Health Canada Inspections

In 2010, Health Canada carried out inspections of PUPL/DPPL premises. Of 75 production sites identified: 27 persons answered the door (36%) and of these 15 allowed inspection (55%), while 12 did not allow inspection (45%). Therefore, based on this small sample (n=75), there were 16% of all residences that did not allow inspection and 45% of those residences for which a person was present at the time of the inspection.

Law Enforcement Review of Criminal Misuse

A consortium of 20 law enforcement agencies [RCMP (2010)], providing services to perhaps more than 75% of the Canadian population, reviewed 190 cases over a six- to seven-year

period in which police carried out an investigation of a residence for which a person held a valid MMAR production license (PUPL, DPPL)[16].

A review of the suspected 'misuse' cases (Figure 4.10) shows the number of cases reviewed by police. This is compared to the total number of PUPLs/DPPLs to show the 'observed' rate of MMAR misuse which varied from 1.5-3.0% over 2005-2010.

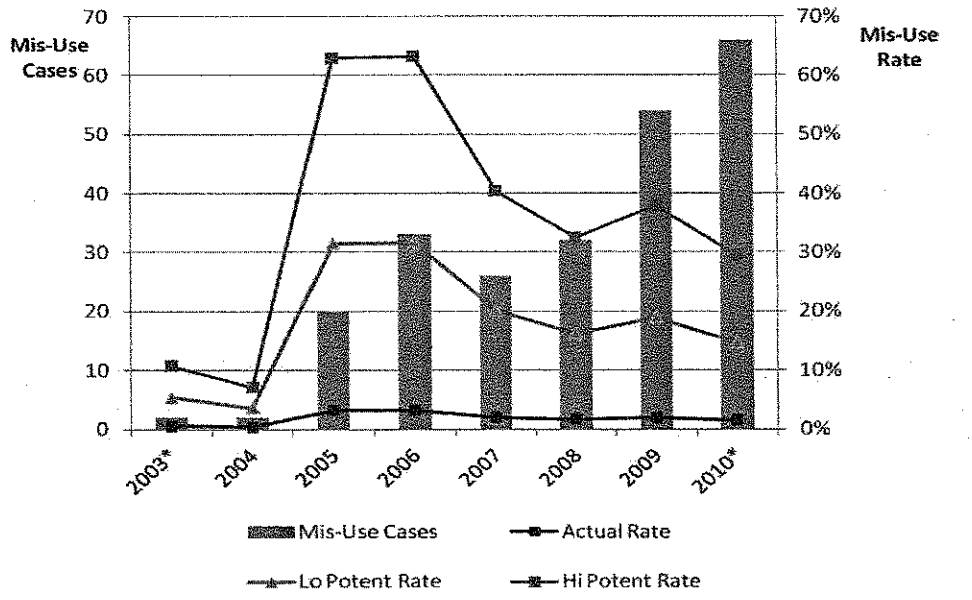
There is a low estimated rate of police detection for marihuana cultivation (i.e. grow operation). One BC study estimated this rate at 5% [Dandurand et al (2002)], while another study estimated the rate for Quebec at 2.5% [Bouchard (2007)]. If a higher (10%) rate of detection is assumed, this implies that the estimated rate of MMAR 'misuse' could be in the range of 15-30%. The lower rate of 5% detection would imply an estimated rate of MMAR 'misuse' in the range of 30-60%. When we use the average-per-year number of alleged misuse cases (29) and the average number of MMAR production licenses per year (1,653) for the 2003-2010 period and assume that there is a 5% probability of detection, it is estimated that about 36% of MMAR production licenses are 'likely' to be involved in misuse. The 36% 'misuse' rate reflects an average observed rate of 1.8% per year and an estimated 5% probability of detection. For purposes of sensitivity analysis, a misuse probability range from 25% to 45% was examined.

It was estimated [RCMP (2010)] that about 13% of Canadian adults have a criminal record. A police review of alleged MMAR misuse cases indicated that in about 50% of MMAR licenses involved in 'misuse' the person had a criminal record (n=67 of 134, with 1 ATP, 9 DPPL and 54 PUPL).

Some alleged MMAR misuse incidents involved the presence of weapons (n=16; 8%) or involved attacks and home invasion (n=16; 8%). There were 2 incidents (1%) where individuals were shot during a home invasion.

[16] The law enforcement agencies include: RCMP, OPP, SQ and municipal police in Toronto, Montreal, Vancouver, Ottawa, Calgary, Edmonton, etc.

Figure 4.10 – MMAR Misuse – Incidents Investigated By Police (2003-10)



Sources: RCMP (2010) and HC (website).
Data are adjusted for full year for 2003 and 2010.

The public security risks arising from 'misuse' under the MMAR relate to:

- Diversion of marihuana produced under PUPL/DPPL to the illicit market;

- Increased resources for law enforcement to address potential misuse – i.e., the need for additional evidence to support reasonable and probable grounds over and above the existence of a residential grow operation, since some operators are authorized and licensed to produce marihuana under the MMAR;

- The corrupting influence of illegal activity occurring in the residence on children residing there; and

- Threat of violence to family members from the potential targeting of the residence for armed robbery by other criminals who want to seize the drugs, profits or materials of crime.

With respect to the presence of children, the police reported that about 8% of MMAR 'misuse' involved the presence of children.

With respect to the threat of violence, the police reported that:

a) weapons were present in 8% of 'misuse' cases;

b) an attack or home invasion had occurred in 8% of 'misuse' cases; and

c) a person was shot during a home invasion in 1% of 'misuse' cases. It is not known whether these cases were all related (i.e., the weapons were necessarily related to the attack/home invasions).

Other data [Dandurand et al (2002)] found that a firearm was involved in about 3% of marihuana trafficking cases.

4.5.2 Social Costs Associated with Crime

Costs of Crime & Willingness-to-Pay to Avoid Crime

CBA techniques have been increasingly applied to crime reduction policy and evaluation of programs. The social cost of crime, or value per crime averted, is comprised of [Bowles (2010)]:

1) Victim costs: in terms of damage/replacement of property, health/care cost, loss of earnings, intangible quality-of-life aspects (i.e., WTP to avert pain and suffering);

2) Fear of crime costs: willingness to pay to avert possible crime in anticipation of future crimes (which may or may not be informed and rational); and

3) Criminal justice system costs: direct costs for police, courts, corrections etc.

Evidence from the United Kingdom (UK) suggests that (for all crime) the relative contribution of these three components is: 70% (victim costs), 5% (fear of crime) and 25% criminal justice system costs [UK-Home Office (2011)]. These components differ by type of specific crime.

There are various national level estimates of the overall 'cost of crime' that range from US$450-1,700B for the US (late 1990s), $40B for Canada (1993 estimate) and AU$35B for Australia (2005 data).

These estimates have been refined to the level of cost of crime by type of criminal offence. They generally rely on one of two types of methodologies:

a) 'Bottom-up' accounting of detailed cost (e.g., activity-based costing); or

b) 'Top-down' measures of individual (or social) willingness-to-pay be avert or avoid crime (or accept the harm caused by crime).

As in most fields where WTP approaches have been applied, the top-down estimates are often two (2) times higher (or more) than the bottom-up accounting estimates [Cohen (2010)].

Macro-econometric analysis [DiTella-MacCulloch (2008)] for the United States (US) found that an increase in the violent crime rate (from 242 to 388 assaults per 100,000 population) was equivalent to a 3.5% decrease in GDP per capita. This result, calibrated for US values for 2011, implied a WTP of US$1.15M to eliminate one violent crime.

4.5.3 Crime Prevention Costs - General

Out-of-pocket costs for the Canadian criminal justice system (1993) have been estimated at about $10 Billion [Federation of Canadian Municipalities (2000)] including the costs of police

services, the courts, legal aid and corrections. Evidence from the US and UK suggest that such costs represent perhaps 25% of the entire cost of crime when victim impacts and fear of crime are taken into account [National Crime Prevention Council (1996)].

4.5.4 Crime Prevention Benefits - General

Various United States studies have used stated preference methods to estimate the willingness to pay (WTP) to avoid crimes with estimates by specific types of crime. One study [Cohen et al (2004)] asked individuals to report their willingness to pay to reduce crime in their specific neighbourhood that implied marginal WTP to prevent crimes of about: US$25,000 per burglary, US$70,000 per serious assault, US$232,000 per armed robbery, US$237,000 per rape and sexual assault, and US$9.7 million per murder. As can be seen, these WTP measures have been estimated for serious crimes with clear victim impact.

Most drug crimes (especially drug possession and drug trafficking) are considered to have lesser victim impact. Drugs play into broader criminal activity when considering the criminal acts undertaken by certain drug addicts to meet their drug habit. One US estimate of the annual cost of crime attributable to each drug abuser is approximately US$60,000 [Miller et al (2006)]. Other US evidence [Cohen-Piquiero (2009)] indicates that the WTP to reduce drug-related crime among young adults is much lower (US$30,000 per crime) than for other types of crime such as aggravated assault (US$335,000 per crime), armed robbery (US$210,000 per crime) and murder (US$855,000 per crime) (2007 data).

The UK government produces standardized cost-of-crime estimates [UK-Home Office (2011)] for different types of crime. These vary from: GBP1.8 million per murder, GBP37,000 per sexual offence, GBP8,800 per robbery-personal, GBP3,900 per burglary in a dwelling to GBP1,750 for common assault.

4.5.5 Crime Costs - Drugs

One UK study [Dubourg-Pritchard (2007)] estimated that the social cost of illicit drug use was GBP15.4B (in 2003). The bulk (90%) of these costs was related to crime versus health costs (4%) and drug-related death (6%). The primary components of drug related crime costs were robbery/burglary (43%), fraud (32%) and shoplifting (12%). Drug arrests (in and of themselves) accounted for only 3.5% of all drug use costs (GBP540M). The UK analysis suggested a ratio of social costs of illicit drug use to street value of drug consumption of 3:1.

4.5.6 Security Cost Associated with Residential Cultivation Misuse

For the Status Quo scenario, two forms of MMAR 'misuse' were modeled:

- 20% was assumed to involve 'major' misuse in which production licensees grow more than the authorized amount and divert the excess to the illicit market; and

- 80% was assumed to involve 'minor' misuse in which operators act as retail traffickers for a small part of their marihuana cultivation.

This assumption was based on the 80:20 rule-of-thumb (i.e., 20% of inappropriate activity creates 80% of the social problem) and allowed the analysis to concentrate on the major

misuse, which, most importantly, is the activity that is assumed to increase the risk of home invasion and violence.

Four effects were examined that generate social welfare gains in the form of social willingness-to-pay to avoid the harm associated with crime related to the misuse of MMAR production licenses and the expected behavioural changes under the proposed Policy scenario.

a) Avoidance of Residential Misuse

b) Avoidance of Home Invasion

c) Avoidance of Non-Fatal Shooting

d) Avoidance of Fatal Shooting

In the analysis, event a) was applied to all 'major' and 'minor' misuse of MMAP production licenses. It was assumed that events b), c) and d) would apply only to the activity considered to be 'major' misuse of MMAR production licenses.

Data on social willingness to pay (WTP) (i.e., a 'top-down' measure) to avoid crimes has been estimated for the US [Cohen et al (2004)]. Similar data based on social costs (i.e. a 'bottom-up' measure) to avert crimes has been estimated for the UK [UK-Home Office (2011)]. To "convert" the social cost estimate to a WTP estimate[17] the analysis took an average of comparable estimates from the US and UK after adjusting for exchange rates[18]. Generally, in all cases the US and UK estimates were in the same order of magnitude.

a) Risk & Consequence of Residential Misuse

All MMAR misuse is considered to be residential misuse. There is no evidence in the literature as to a social WTP to avoid drug trafficking or to avoid marihuana cultivation in a residential area. Accordingly, the analysis did not include a value for this WTP in the absence of an estimate available in the literature.

b) Risk & Consequence of Home Invasion

Over the seven years of the police review of alleged MMAR misuse cases, there were 16 alleged cases of home invasion reported in relation to 190 police cases of alleged MMAR misuse. During those years, there was an average of about 1,650 MMAR production licenses and, based on the 36% misuse rate, about 595 estimated cases of misuse. On an annual basis, in terms of the probability of home invasion occurrence, this worked out to 0.38% per year per MMAR misuse. As all home invasion events were attributed in the CBA to major misuse, this worked out to a probability of 1.92% per major case of MMAR misuse.

[17] The analysis employed a rule of thumb adjustment factor of 2.0 so that the UK social cost estimates were multiplied by 2.0 to reflect WTP estimates.

[18] US$1.00 = CA$1.00 ; GBP1.00 = CA$1.30 (as of June 4, 2012).

For 'home invasion', the analysis used adjusted WTP estimates from the UK for 'robbery-personal' and the US for 'burglary' which averaged to $23,900 (US estimate of CA$25,000, UK adjusted estimate of CA$22,900).

c) Risk & Consequence of Non-Fatal Shooting

There were two (2) cases of shootings associated with home invasion reported in relation to the 190 police cases of alleged MMAR misuse. Represented as an annual probability, this is 0.048% per year per MMAR misuse. Since all shooting events were attributed in the analysis to major misuse, this worked out to a probability of 0.24% per year per major case of MMAR misuse. Data [Kleck (1991)] suggest that the probability of a fatality (given shooting) is 15%, so the probability of a non-fatal shooting would be 85% (given shooting).

For 'non-fatal shooting' the analysis used adjusted WTP estimates from the UK for 'serious wounding' and the US for 'serious assault', which averaged to $68,500 (US estimate of CA$70,000, UK adjusted estimate of CA$67,000).

d) Risk & Consequence of Fatal Shooting

For 'fatal shooting', the CBA used adjusted WTP estimates from the UK and US for 'murder' which averaged to $7.2M (US estimate of CA$9.7M, UK adjusted estimate of CA$4.7M). These WTP estimates for tragic, violent loss of life were much higher than the Canadian Statistical Value of Life, which is a WTP measure of death in normal circumstances.

4.5.7 Social Cost Associated with Residential Misuse – Status Quo

The social loss associated with residential misuse is given in the Status Quo scenario by:

(47) $\text{Social Loss}_{misuse}(t) = \text{ATP-P/D}(t) * Pr_{misuse} * WTP_{misuse}$

where:

ATP-P/D(t) = number of persons ATP-P and number of persons with ATP-D divided by a scale factor to allow for multiple DPPL.

Pr_{misuse} = 36%

WTP_{misuse} = $0

4.5.8 Social Cost Associated with Home Invasion – Status Quo

The social loss associated with home invasion is given in the Status Quo scenario by:

(48) $\text{Social Loss}_{invasion}(t) = \text{ATP-P/D}(t) * Pr_{misuse} * Pr_{major} * Pr_{invasion} * WTP_{invasion}$

where:

ATP-P/D(t) = number of persons ATP-P and number of persons with ATP-D divided by a scale factor to allow for multiple DPPLs.

Pr_{misuse} = 36%

Pr_{major} = 20% (conditional probability given misuse)

$Pr_{invasion}$ = 1.921% (conditional probability given major misuse)

$WTP_{invasion}$ = $23,900

4.5.9 Social Cost Associated with Non-Fatal Shooting – Status Quo

The social loss associated with non-fatal shooting is given in the Status Quo scenario by:

(49) $Social\ Loss_{non\text{-}fatal}(t) = ATP\text{-}P/D(t) * Pr_{misuse} * Pr_{major} * Pr_{shoot} * (1-Pr_{fatal}) * WTP_{non\text{-}fatal}$

where:

ATP-P/D(t) = number of persons ATP-P and number of persons with ATP-D divided by a scale factor to allow for multiple DPPLs.

Pr_{misuse} = 36%

Pr_{major} = 20% (conditional probability given misuse)

Pr_{shoot} = 0.240% (conditional probability given major misuse)

Pr_{fatal} = 15% (conditional probability given shooting)

$WTP_{non\text{-}fatal}$ = $68,000

Social Cost Associated with Fatal Shooting – Status Quo

The social loss associated with fatal shooting is given in the Status Quo scenario by:

(50) $Social\ Loss_{fatal}(t) = ATP\text{-}P/D(t) * Pr_{misuse} * Pr_{major} * Pr_{shoot} * Pr_{fatal} * WTP_{fatal}$

where:

ATP-P/D(t) = number of persons ATP-P and number of persons with ATP-D divided by a scale factor to allow for multiple DPPLs.

Pr_{misuse} = 36%

Pr_{major} = 20% (conditional probability given misuse)

Pr_{shoot} = 0.240% (conditional probability given major misuse)

Pr_{fatal} = 15% (conditional probability given shooting)

WTP_{fatal} = $7,190,000

4.5.10 Status Quo – Security Cost

For each of the security events associated with PUPL/DPPLs, the social costs associated with residential misuse, home invasions and non-fatal/fatal shootings are given in the Status Quo scenario over time, by:

$$(51)\quad \text{Security Cost}(t) = \text{Social Loss}_{misuse}(t) + \text{Social Loss}_{invasion}(t) + \text{Social Loss}_{non\text{-}fatal}(t) + \text{Social Loss}_{fatal}(t)$$

4.6 Status Quo – Summary of Benefits & Costs

Status Quo – Program Administration Costs

Health Canada – Program Administration Costs are from equation 22.

Compliance cost is given from equation 23.

Status Quo – User Benefits

User benefit is the sum of the Consumer Surplus measures for each of Government Supply (equation 32), Personal Use (equation 38) and Designated Person (equation 43) supply markets.

The Deadweight Loss (from the effective subsidy for the Government Supply) is given from equation 33.

There is no Producer Surplus in the Status Quo scenario.

Status Quo – Safety Costs

Safety cost is the sum of the Fire Costs (equation 46) for each of the PUPL and scaled DPPL supply.

Status Quo – Security Costs

Security cost is given from equation 51.

This concludes the discussion of the Status Quo scenario and measures to be calculated for the CBA. The next section addresses the Policy scenario that embodies the proposed Regulatory changes.

4.7 Policy – Transition Model (April 2014)

It is contemplated that, as of April 1, 2014, there will be a migration from the existing MMAP (Status Quo scenario) to the new (Policy scenario) regime for access to marihuana for medical purposes. This migration (transition) may take place in a number of ways.

The CBA model did not attempt to capture the complexity of the transition dynamics. Generally, the CBA focused on the 'steady state' of this transition process and the number of persons who will 'remain' in the regulated marihuana access regime and the number of persons who will choose an illegal supply source.

The reasons that persons who have been participating in the MMAP (prior to April 1, 2014) may choose to obtain marihuana from an illegal supply source are various and include:

- the supply cost of marihuana from LP may be too high;
- persons may prefer the control and quality of their own production; and
- persons may want to engage in illicit marihuana cultivation and distribution.

It has already been noted that some proportion (36%) of PUPL/DPPLs may involve misuse. Some 80% of ATP persons are associated with PUPL and DPPL production activities. The cost of legal supply through LPs will likely be higher than the supply cost for PUPL/DPPL production.

The CBA assessed the likely migration of persons from each of ATP-GS, ATP-O, ATP-P and ATP-D status to the new regime.

4.7.1 Policy Transition – Government Supply

In April 2014, the Status Quo scenario was forecast to have 1,823 KG-Demand for the Government Supply with an estimated 387 grams per year per full-time user[19]. One of the reasons for the relatively low usage rate for the Government Supply was the perceived quality of the cannabis strain used [Lucas (2009)]. In the Policy scenario, LP suppliers would be able to offer a variety of cannabis strains. It is therefore probable that, subject to affordability, the amount per person purchased could be different from this amount per year. The analysis, therefore, made an adjustment to the KG-demand that would be purchased at $5.00/gram (the Status Quo user price) before applying a model based on the operation of demand price elasticity.

Analysis [Kilmer-Pacula (2009)] suggests that heavy marihuana users consume about 1.2 grams per day +/- 0.4 grams. The analysis took 1.6 grams per day as the desired mean daily amount that a person would want to consume of marihuana. This would imply an annual

[19] This average is based on 1,823KG and 4,712 ATP-GS users. For this calculation, no consumption was attributed to persons on interim supply with new PUPL/DPPL production licenses.

consumption of 560 grams which, at $5.00/g, would cost $2,800 per year. This was felt to be affordable for the mean MMAP ATP person with a mean annual income of $30,000[20].

The base annual quantity of marihuana (in KG) that would be consumed in the Policy scenario, for the initial number of persons with ATP-GS in April 2014 and at the Status Quo user price of $5.00 per gram, is given by:

(52) Base KG-GS(User Price) = ATP-GS(April 2014) * 560 grams / 1,000

For the establishment of the benchmark transition to the Policy scenario, it was assumed that the LP market price of marihuana would be $7.50/g[21]. This represents a 50% increase in price (over the Status Quo user price per gram). With an assumed price elasticity ε_p of -0.25, the quantity demanded would be expected to fall by 12.5%.

$$\%\Delta\text{Quantity} = \varepsilon_p * \%\Delta\text{Price}$$

Therefore, the base annual quantity of marihuana (in KG) that would be consumed in the Policy scenario, for the initial number of persons with ATP-GS in April 2014 and at the higher LP market price of $7.50 per gram, would be:

(53) Base KG-GS(Market Price) = Base KG-GS(User Price) * (1 + %ΔQuantity-GS)

This equation captures the operation of the price elasticity, after a base adjustment for the different type of cannabis strains that will be supplied in the LP market. The operation of the price elasticity means that the quantity amount of marihuana has decreased as price rises. There are three ways in which, using a simple formula, this quantity reduction could be determined. The formula for the base quantity is:

Base KG-GS = User-GS * Days of Use * Quantity Per Day

The price elasticity effect could come about via some combination of changes in: a) the number of users; b) the number of days of use per year; and/or c) the mean quantity per day of use. For simplicity, the analysis assumed that there is no change in the number of days of use per year, so the above equation reduces to:

%ΔQuantity-GS = %ΔUser-GS + %ΔQuantity Per Day-GS

In order to assess the affordability of the quantity per day at the LP market price, the Proportion of Mean Annual Income (pre-tax) that would be comprised of marihuana purchases was computed. This proportion is:

%Annual Income = [Days-of-Use * Quantity-per-Day * Market Price] / Mean Income

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[20] Lucas (2009) reports an income distribution for a sample of MMAP users that implies a mean annual income of about $30,000, although 30% report earning less than $20,000 per year. At $5.00/gram, the expenditure of $2,800 per year would account for about 9% of pre-tax individual income.

[21] The reasonableness of this estimate was assessed in terms of an equilibrium model of Supply and Demand in the LP market for marihuana (see below). Effectively, the study assumed that ATP persons in the Transition face an *ex ante* expected user price of $7.50/gram which may be slightly more or less than the *ex post* realized price in LP market equilibrium when supply and demand interact.

In the CBA model, if the annual cost per user did not exceed $4,500 (i.e., 15% of mean annual income of $30,000), all of the price elasticity effect was ascribed to a reduction in the number of users. Conversely, if the annual cost per user did exceed $4,500, some proportion of the price elasticity was allowed to reduce the quantity per day so that the percentage of mean annual income required did not exceed 15%.

Various studies have shown that, with co-payment (usually 20% of private prescription drug costs), the annual amount spent on certain prescription drugs or treatment can be up to 17% of annual family income [Canadian Cancer Society (2009), Canadian Diabetes Association (2010)]. The out-of-pocket costs of new cancer drugs can be up to $13,000 per year and for Type I diabetes drugs and insulin pump up to $4,700 per year.

The Quantity per Day in the Policy scenario, for persons on Government Supply (as of April 2014), is calculated as:

(54) Quantity/Day-GS = MIN{1.6, [Mean Annual Income * Max % of Income / 350

/ $7.50]}

In the Reference case, the effective minimum of the right-hand side was 1.6 grams per day. This equation allows, in the sensitivity analysis for a lower assumption as to maximum percentage of income, for the amount to be less than 1.6 grams per day.

The %ΔQuantity Per Day can therefore be calculated as:

(55) %ΔQuantity/Day-GS = [Quantity/Day-GS - 1.6] / 1.6

The %ΔUser-GS can therefore be calculated as:

(56) %ΔUser-GS = %ΔQuantity-GS - %ΔQuantity/Day-GS

The number of users in the Policy scenario, for persons formerly on Government Supply (as of April 2014), is calculated as:

(57) Users-GS(Market Price) = ATP-GS(April 2014) * (1 + %ΔUsers-GS)

Equations 53 and 57, therefore, represent the KG-Demand and the number of users in the Policy scenario that would result from the transition from the Status Quo for persons formerly on the Government Supply.

4.7.2 Policy Transition – Other (Government Supply)

There was the same number of persons with ATP-G who did not access the Government Supply (i.e., ATP-O) as those who accessed the Government Supply (ATP-GS) in the Status Quo as of April 2014. The analysis did not count their consumption for the Consumer Surplus measure, as there was no indication as to where the marihuana was obtained.

In the Policy scenario, such persons might start to obtain marihuana from the LP supply, provided that the LP market price was at or below the price prevailing in the illicit market. The

rationale for this switch is that the cannabis strains and quality are likely to be diverse in the LP market and should be comparable to those currently available in the illicit market.

The analysis assumed that these persons would generally consume at the same level of daily usage, at the LP market price, as the persons formerly reliant on the Government Supply, provided that the LP market price was below that of the illicit market price. However, as they would likely experience a decrease in their supply price, they might be able to afford an increased amount per day.

The logic flow for this component of the transition is reversed from that for the above component. Provided that the LP market price is less than the illicit market price, it is possible to calculate the %ΔPrice experienced by these users as:

(58) %ΔPrice-O = [LP-Price – Illicit Price] / Illicit Price

The associated %ΔQuantity can therefore be calculated as:

(59) %ΔQuantity-O = ε_p * %ΔPrice-O

The additional quantity consumed is reflected in a higher Quantity/Day, while the number of users is kept constant:

(60) %ΔQuantity/Day-O = 1.60 + (1 + %ΔQuantity-O)

Therefore, the base annual quantity of marihuana (in KG) that would be consumed in the Policy scenario, for the expected number of persons with ATP-O who will transition to the LP market at the lower LP market price of $7.50 per gram, is expected to be:

(61) Base KG-O(Market Price) = ATP-O(April 2014) * * 350 * (1 + %ΔQuantity/Day-O).

The Number of Users in the Policy scenario, for persons formerly in Other Supply (as of April 2014) is calculated as:

(62) Users-O(Market Price) = ATP-O(April 2014)

Therefore, equations 61 and 62 represent the KG-Demand and Number of Users in the Policy scenario that result from the transition from the Status Quo for persons formerly on Other Supply.

4.7.3 **Policy Transition – Personal Use**

Persons with PUPL who are ATP-P in April 2014 must decide whether to switch their use to the legal supply from the LP market. This is the only option for these persons to access a legal supply of marihuana for medical purposes.

There are two aspects to the transition of persons who formerly held PUPLs (and DPPLs) that make this process more complicated:

- Some proportion (36%) of these persons is likely engaged in some form of misuse (based on police data) and may want to continue that activity in the future; and

- Some other proportion of these persons may feel 'entitled' to continue to cultivate own-use marihuana, even if not involved in misuse in terms of otherwise supplying the illicit market – such entitlement may arise from civil disobedience in reaction to a change in their previous legal authorization to produce.

In the first case, the 'economics of crime' must be considered in terms of the relative, risk-adjusted rewards and penalties associated with illicit behaviour. It is still necessary to differentiate between the scale of operation involved in this form of marihuana cultivation from the normal 'grow-op' because the locus of production is the family residence in the presence of family members.

In the second case, allowance is made for some proportion that may opt out, based on their perceived right to grow marihuana for their own use.

Economics of Residential Misuse

The analysis applied a model of rational criminal activity based on Canadian studies [Desroches (2005), Dandurand et al (2002), Bouchard (2007), Easton (2004)]. It is important to distinguish between residential misuse marihuana cultivation and 'grow-op' activity. While these share some similarities, what is different about residential misuse is the presence of family members. Grow-op houses are usually dedicated to marihuana cultivation and operated by paid employees or persons who share the criminal proceeds of the operation.

One study [Dandurand et al (2002)] of British Columbia marihuana trafficking over a four-year period found that there was a very low (5%) risk of a grow operation coming to the attention of police. In terms of the consequence of police detection, the biggest risk was seizure of plants and other assets for evidence (pr=100%), followed by charges laid (pr=85%), conviction of at least one suspect in the case (pr=63%), the payment of a fine (pr=25%) and prison sentence (pr=17%). The average prison term upon conviction was 2.5 months and the average fine was $1,000[22].

One study [Bouchard (2007)] of Quebec marihuana cultivation over a seven-year period found that there was a very low (2.5%) risk of arrest per offender at risk (for indoor hydroponic cultivation). The study estimated the number of marihuana cultivation operations in Quebec, which was extrapolated using a growth rate per year of 16% to derive an estimate of about 60,000 grow operations in 2012. There are probably less than 1,000 PUPLs/DPPLs in Quebec, so the contribution of MMAR 'misuse' to the overall marihuana cultivation activity level is minimal (less than 1%, assuming that perhaps 36% of PUPL/DPPL activity involves 'misuse').

There could be several reasons why marihuana cultivation under the MMAR is such a small share of overall activity:

a) It requires identifying a residence and producer to Health Canada (which police can access under certain conditions); and

[22] Note that probabilities and magnitude of both fines and prison sentences likely have changed as a result of recent amendments to the law. The magnitude of any such changes could not be assessed at this time and therefore historical values were used for the purposes of the analysis.

b) It generally involves a residence where people live, whereas commercial-scale illicit grow-ops involve much larger scale production than can be accommodated in a family residence also used for the benefit of the family.

Scale of Residential Misuse Marihuana Cultivation

This analysis assumed that the scale of marihuana cultivation for residential misuse is less than that for a grow-op.

The mean number of permitted plants under MMAR-PUPL, based on the mean Proposed Daily Amount of 7.6 grams, is 37 marihuana plants. These are expected to yield 30 grams of dried marihuana but also have a wastage factor of 1.2 so that the effective yield is actually 25 grams per plant per harvest. The yield is based on a 120-day harvest cycle and three (3) harvests per year. The mean PUPL producer, keeping to the maximum allowable number of plants and MMAR yield and harvest assumptions, would produce about 2.8KG of dried marihuana.

Yield per Year = Plants * Yield/Plant/Harvest * Harvest/Year

In terms of the expected actual marihuana consumption of such a person, the CBA used an estimate of about 4.2 grams per day, which comes, for 350 days per year of use, to about 1.5KG of consumption. It is possible that actual consumption accounts for the entire production or that production is scaled to meet consumption for own use.

For the 64% of persons who are not involved in any misuse, it was assumed that there is no illicit distribution of any excess production capacity. For the 36% of persons involved in MMAR misuse it was assumed that they are engaged in illicit marihuana distribution.

Minor Misuse (80%)

For 80% of misuse cases, it was assumed that that such misuse is minor in scale. As described below, some parameters were then applied to this activity to estimate the likely returns and risk associated with that activity.

Minor Misuse - Rewards

For minor misuse, this study assumed that the maximum number of plants would be kept at the legal limit (37) and that the yield would be higher (60 grams per plant per harvest) with a 90-day cultivation cycle and four (4) harvests per year. These parameters seem reasonable in relation to actual criminal evidence from grow-op activity [RCMP (2010)].

This would allow for the production of 8.9KG of dried marihuana against estimated personal consumption of 1.5KG, leaving 7.4KG of excess production available for illicit distribution. Data suggests that wholesale distribution [RCMP (2010)] by the pound generates about $2,800 (or $6.17/gram), so that the estimated sales value of the excess production is about $45,000.

This sales revenue is comparable to about half the sales revenue for a British Columbia grow operation [Easton (2004)]. Allowing the same supply cost per gram as for PUPL production generates an estimated gross margin (over costs) of about $40,000. This represents the 'reward' from criminal activity (for minor misuse).

The reference case reward for minor misuse (PUPL) is given in the Policy User Transition by:

(63) Reward-Minor = {[(Plants * Yield/Plant * Harvest/Yr) – Use/Yr]

* Wholesale Price/Gram} – Supply Cost/Yr

Minor Misuse - Risks

Probabilities [Dandurand et al (2002)] were available for the risk of detection, seizure, charges laid, conviction and receipt of fine or prison sentence. The analysis assumed various economic losses as a result of uncertain events occurring for the criminal activity. The study assumed the following values of economic loss: seizure ($50,000[23]), facing charges ($5,000[24]), fines ($1,000[25]) and prison ($9,000[26]).

An important parameter in the model is the aforementioned requirement for additional evidence as evidence of the mere presence of residential cultivation associated with an MMAR production license will generally be insufficient grounds for obtaining a warrant to search the premises. The result has been, according to law enforcement officials, that police resources are not as effective as they might be in terms of resulting law enforcement actions when there is suspected misuse of such MMAR licenses.

In the CBA model, this effect was introduced by assuming that cases of MMAR misuse faced a 2.5% probability of detection by police and that the probability of police action (given police detection) is reduced by a factor of 75% from its base probability value of 80% [Dandurand et al (2002)]. Therefore, the effectiveness of law enforcement to address MMAR misuse impacts on a lower probability of detection and a lower probability of police action, given police detection.

The analysis assumed that minor misuse does not attract home invasion and 'grow-rip' type robbery by other criminal elements as the scale of misuse is relatively minor. This risk was reserved for major MMAR misuse of residential cultivation.

Based on compound probabilities of law enforcement actions and consequences, an expected value of loss for minor misuse (PUPL) in the Policy User Transition was estimated as:

(64) $\text{Risk-Minor} = [\text{Minor-Misuse} * Pr_{detection} * Pr_{action} * (1 - \text{Enforcement Clarity}) * Pr_{found}]$

$* \{[Pr_{seizure} * \text{Loss-Seizure}] + [Pr_{report} * Pr_{charge} * \text{Loss-Charge}] +$

$[Pr_{convict} * \{(Pr_{fine} * \text{Loss-Fine}) + (Pr_{prison} * \text{Loss-Prison})\}]\}$

where

Minor-Misuse = ATP-P(Apr 2012) * 36% * 80%

[23] Based on the annual revenue * (1+.10) with an adjustment for the value of seized materials and supplies.
[24] Assumed as an inconvenience (value of time) factor with or without legal fees (which may be by a public defender).
[25] From Dandurand et al 2002.
[26] Based on 2.5 months sentence from Dandurand et al 2002 with hourly wage of $25 for 35 hours per week and 4.1 weeks per month.

$Pr_{detection}$ = probability of police detection (given misuse) = 2.5% (under MMAR)

Pr_{action} = probability of police action (given detection) = 80%

Enforcement Clarity = reduction in Pr_{action} as a result of MMAR = 75%

Pr_{found} = probability of case found (given action) = 95%

$Pr_{seizure}$ = probability of police seizure (given case found) = 100%

Loss-Seizure = expected economic loss from police seizure = $50,000

Pr_{report} = probability of report to Crown Prosecutor (given seizure) = 87%

Pr_{charge} = probability of charges laid (given report to Crown) = 98%

Loss-Charge = expected economic loss from facing charges = $5,000

$Pr_{convict}$ = probability of conviction (given charges laid) = 73%

Pr_{fine} = probability of fine imposed (given conviction) = 39%

Loss-Fine = expected economic loss from fine = $1,000

Pr_{prison} = probability of prison sentence (given conviction) = 42%

Loss-Prison = expected economic loss from fine = $9,000

In the Reference case, the expected loss from police action and criminal justice sanctions was about $270 and largely the result of police seizure.

Minor Misuse – Opportunity Cost

In addition to the supply cost of marihuana production, the analysis also accounted for the opportunity cost of time spent on criminal activity (in terms of additional cultivation time, transaction time and overhead for running of the illicit enterprise). A proportional value of this time relative to a target annual income ($60,000) for a work-year of 1,800 hours (i.e., $33.33/hour) was applied. For minor misuse this opportunity cost was roughly $4,700.

Minor Misuse – Net Expected Return

In the Reference case, the net expected return for minor misuse was about $35,800 and represents an expected rate of return of about 370% over the expected costs of activity (excluding loss from risks).

Minor Misuse – Compensation for Risk

The analysis also considered risk sensitivity, as people are generally risk-adverse. The analysis conceptualized risk sensitivity in terms of the ratio of the expected rate of return to some risk threshold rate of return, which reflects the expected value of loss from risks. The rationale is

that most people care about the absolute level of risk they bear and want a very high return to compensate them for such risk. For the purposes of the CBA, it was assumed that persons engaged in illicit activity want a minimum ten (10)-fold return to compensate them for illicit undertakings. In the reference scenario, the minimum expected return for minor misuse was estimated to be 28%.

Minor Misuse – Reward-to-Risk Multiple

In the Reference case, the expected rate of return (370%) was about thirteen (13) times higher than the minimum expected return for misuse (28%). This reward-to-risk multiple suggests that persons engaged in MMAR minor misuse would appear to be very comfortable in terms of the reward-to-risk profile (under the Status Quo scenario parameters).

If, with the Policy scenario, a marked change is seen in the reward-to-risk multiple, it would be reasonable to expect a reduction in illicit activity. This reflects a form of risk elasticity, for which it is possible to infer some value to generate behavioural change that should result from gaining more clarity under the MMAR (in terms of a higher probability of police detection of potential misuse and a higher probability of police action, given police detection).

The same calculations for major misuse, which also invites the risk of home invasion and 'grow-rip' theft by other criminal elements, are described below. The absolute dollar value of illicit reward was much higher for major misuse but the expected rate of return in the Reference case was lower (305%) and the minimum expected return for major misuse (based on the risk profile and losses) was estimated to be 128%. Therefore, the reward-to-risk multiple was much lower (2.4) for major misuse. However, this multiple is still economically attractive.

Deterrence Effect on Residential Misuse

In terms of the economically rational effect of crime prevention and deterrence on illicit activity, the analysis used a result for the US [Chang et al (2008)] which estimated that a 10% increase in the probability of criminal conviction for drug trafficking/production would decrease the number of active dealers by 0.26%. This implies a 'conviction elasticity' ($\varepsilon_{convict}$) of -0.026.

$$\varepsilon_{convict} = \%\Delta\text{persons involved in cultivation} / \%\Delta Pr_{convict}$$

Using Canadian parameters and the CBA effect of addressing the current need for additional evidence through the policy scenario (equation 62), the cumulative $Pr_{convict}$ for the Status Quo reference case is:

$$Pr^{SQ}_{convict} = Pr^{SQ}_{detect} * Pr_{action} * (1 - \text{Enforcement Clarity}) * Pr_{found} * Pr_{report} * Pr_{charge} * Pr_{convict}$$

$$= 0.296\% \text{ (for the Status Quo reference case)}$$

With the clarifying effect (removing the need for additional evidence), the Pr^{POL}_{detect} increases and results ina higher $Pr^{POL}_{convict}$:

$$Pr^{POL}_{convict} = Pr^{POL}_{detect} * Pr_{action} * Pr_{found} * Pr_{report} * Pr_{charge} * Pr_{convict}$$

$$= 2.365\% \text{ (for the Policy reference case)}$$

The impact in terms of the number of persons involved in illicit misuse (residential marihuana cultivation, formerly associated with MMAR production licenses) is given by:

(65) $\%\Delta$persons involved in cultivation = $\varepsilon_{convict} * \%\Delta Pr_{convict}$

where

$\varepsilon_{convict}$ = -0.026 * {[2.365% - 0.296%] / 0.296%}

= -0.026 * 700% = -18%

Therefore, one would expect there to be 18% fewer persons involved in residential marihuana cultivation as a result of the higher probability of detection and greater policy action effectiveness from the removal of valid MMAR residential production licenses (PUPL/DPPL).

The analysis assumed that this effect would be experienced for major misuse activity. As it is likely that persons involved in minor misuse are more risk adverse than persons involved in major misuse, the analysis assumed that the elasticity response for minor misuse would be twice (two times) that of major misuse.

Equation 62 is therefore estimated using $\varepsilon^{major}_{convict}$ = -0.026 and $\varepsilon^{minor}_{convict}$ = -0.052. These assumptions were tested in terms of the sensitivity of CBA results.

The number of persons who will cease their residential marihuana cultivation in the Policy transition (due to the clarifying effect of removing the need for additional evidence in enforcement) is given by:

(66) Cease = Misuse (major or minor) * $\%\Delta$persons involved (major or minor)

The number of persons who will continue their residential marihuana cultivation in the Policy transition (despite the 'enforcement clarity' effect) is given by:

(67) Continue = Misuse (major or minor) * [1 + $\%\Delta$persons involved (major or minor)]

Opting-Out for Residential Producers with No Misuse

The analysis also contemplated the possibility that persons who produce marihuana in the Status Quo scenario with no misuse (i.e., strictly for their own consumption) might opt out of the Policy scenario regime, and continue their own production illegally. These are people who were law-abiding in the Status Quo scenario (i.e., legal marihuana cultivation) but who might exercise civil disobedience in the Policy scenario through illegal marihuana cultivation at a small scale and without illegal marihuana distribution or sales.

In the Reference case, it was assumed that the Opt-Out Rate for such non-misuse PUPL users would be 0% (i.e. there is no civil disobedience). However, the sensitivity analysis allowed for a rate up to 20% of such persons.

The number of formerly ATP-P persons who are considered in terms of the Price Elasticity effect as still being in the market, ATP-P*, is given by:

(68) $\text{ATP-P}^* = \text{ATP-P(April 2014)} - \text{Cease}_{(minor)} - \text{Cease}_{(major)}$

$$- [\text{ATP-P(April 2014)} * (1 - .36) * \text{Opt-Out Rate}]$$

Once the persons who, despite the 'enforcement clarity' effect, will continue to engage in residential marihuana cultivation have been removed, the number of persons who are likely to be involved in the Transition to the new Policy regime can be calculated. It is then necessary to take into account the operation of the Price Elasticity of Demand as it affects these people.

The reference Price Elasticity of Demand $\varepsilon_p = -0.25$ and represents the %ΔQuantity in response to a %ΔPrice (ceteris paribus[27]). The situation of the regulatory change involves more than just an effective price change, as it represents a policy change and declaration of a formally legal activity as illegal. As discussed above, persons who were formally (and legally) cultivating marihuana for their own use (with no misuse) are expected to cease this activity as it is no longer considered legal. The analysis separately allowed for some Opt-Out Rate.

The %ΔPrice experienced by these users is given by:

(69) %ΔPrice-P = [LP-Price – Own Supply Cost] / Own Supply Cost

which, for an initial LP Price of $7.50 and an Own Supply Cost of $1.80, gives a %ΔPrice-P of 317%.

The operation of the price elasticity is given by:

(70) $\%\Delta\text{Quantity-P} = \varepsilon_p * \%\Delta\text{Price-P}$

The %ΔQuantity-P in the reference scenario is -79%. As the Status Quo scenario initial quantity demand (Personal Use) was 41,365KG, this means that the Policy Transition Quantity-P (after the price elasticity effect) will be 8,618KG (i.e. 41,365 * (1 + %ΔQuantity-P).

It is then necessary to assign this %ΔQuantity-P to either %ΔUser-P or %ΔQuantity/Day-P, and to again check to see if the Status Quo Quantity/Day is affordable in relation to Mean Annual Income (as in equation 54).

The Quantity per Day in the Policy scenario, for persons who were on Personal-Use Supply (as of April 2014) is calculated as:

(71) Quantity/Day-P = MIN{4.18, [Mean Annual Income * Max % of Income / 350

$$/ \$7.50]\}$$

In the Reference case, the effective minimum for Quantity/Day-P is 1.7 grams per day. This means that, relative to the Status Quo Quantity/Day-P (4.18 grams), the %ΔQuantity/Day-P is -59%.

[27] Ceterus paribus (roughly 'all other things unchanged') is the assumption used in partial equilibrium analysis.

The number of User-P is calculated as:

(72) User-P = MIN{(ATP-P*), [(Quantity-P * 1,000) / (350 * Quantity/Day-P)]

Where

ATP-P* from equation 68

Quantity-P is the resulting quantity demanded after the operation of the Price Elasticity of Demand; and

Quantity/Day-P is the result from equation 71.

It is then possible to calculate the %ΔUser-P as [(User-P – Base User-P) / Base User-P]. In the reference scenario, the %ΔUser-P is -49%.

Therefore, the base annual quantity of marihuana (in KG) that would be consumed in the Policy scenario, for the expected number of persons with ATP-P who will transition to the LP market at the higher LP market price of $7.50 per gram, would be expected to be:

(73) Base KG-P(Market Price) = ATP-P*(April 2014) * (1 + %ΔUser-P) * 350 * Quantity/Day-P

The number of users in the Policy scenario, for persons formerly in Personal-Use Supply (as of April 2014) is calculated as:

(74) Users-P(Market Price) = ATP-P*(April 2014) * (1 + %ΔUsers-P)

Equations 73 and 74, therefore, represent the KG-Demand and number of users in the Policy scenario that result from the transition from the Status Quo for persons formerly on Personal-Use Supply.

4.7.4 Policy Transition – Designated Person

The analysis considered a transition model for Designated-Person use in a similar manner. Here the situation differed slightly, as the persons consuming the marihuana are different from the persons producing the marihuana. The same reasoning (logic and equations) holds for such persons engaged in DPPL production. Here again it was assumed that the mean DPPL producer supplies for two ATP-D persons. The number of allowable marihuana plants is higher (44), as the Proposed Daily Amount mean is higher (9.0 grams).

Equations 63-67 apply for DPPL producers, resulting in an estimate of the number of persons who cease and continue producing marihuana. Although it not possible to know if the locus of production is a residence, for the purposes of the CBA of safety and security benefits this assumption is made for simplicity.

The number of persons who will cease their residential marihuana cultivation in the Policy transition (due to the law enforcement effect) is given by:

(75) Cease = Misuse (major or minor) * %Δpersons involved (major or minor)

The number of persons who will continue their residential marihuana cultivation in the Policy transition (despite the law enforcement effect) is given by:

(76) Continue = Misuse (major or minor) * [1 + %Δpersons involved (major or minor)]

When the shift is made from DPPL producers to ATP-D consumers, it is not possible to assume that the consumers whose producer is prepared to supply them illicitly will continue to source their marihuana requirements from these illicit producers. This is not an automatic result, as producers and consumers in the DPPL/ATP-D relationship may have different preferences, risk tolerances and other characteristics. The analysis assumed that all persons who held ATP-D authorizations would seek legal sources of supply.

The number of ATP-D persons who were considered as potential Policy scenario users (ATP-D*) was calculated as:

(77) ATP-D* = ATP-D(April 2014)

The price elasticity effect was then applied to these persons.

In the reference case, the %ΔPrice-D is 142% (from $3.10 to $7.50 per gram) and the operation of the Price Elasticity of Demand (ε_p = -.25) requires that the %ΔQuantity-D is -35%. This %ΔQuantity-D must then be assigned to either %ΔUser-D or %ΔQuantity/Day-D. Then, a check must be made to see if the Status Quo Quantity/Day is affordable in relation to Mean Annual Income (as in equation 71). Generally, the same result (as for Personal Use) will apply, so the Quantity/Day-D is 1.7 grams per day, which is a -59% change from the Status Quo scenario.

As the percentage change arising from the affordability condition (-59%) exceeds the required Price Elasticity of Demand required change in quantity demanded (-35%), there is no required change in the number of users (i.e. %ΔUsers-D = 0%). The affordability condition demands that the price response actually exceeds the ε_p = -.25 requirement. This is why the price elasticity in the Policy scenario often exceeds that for the Status Quo scenario.

As above (for ATP-P transition), the analysis estimated the base annual quantity of marihuana (in KG) that would be consumed in the Policy scenario, for the expected number of persons with ATP-D who will transition to the LP market at the higher LP market price of $7.50 per gram, to be:

(78) Base KG-D(Market Price) = ATP-D*(April 2014) * (1 + %ΔUser-D) * 350 * Quantity/Day-D

The Number of Users in the Policy scenario, for persons formerly in Designated-Person Supply (as of April 2014) is calculated as:

(79) Users-D(Market Price) = ATP-D*(April 2014) * (1 + %ΔUsers-D)

Equations 78 and 79, therefore, represent the KG-Demand and number of users in the Policy scenario that result from the transition from the Status Quo for persons formerly on Designated-Person Supply.

4.7.5 Policy Transition – All Users

It is possible to compute, based on the behavioural responses of producers and consumers, what the base level of demand (at an expected Market Price of $7.50/gram) would be across all users and taking into account the likely continued misuse/desire to continue illicit marihuana production and the likely operation of a price elasticity of demand. This gives a first look at the scale of the LP market demand (as of April 2014).

The base annual quantity of marihuana (in KG) that would be consumed in the Policy scenario, for all persons expected to transition to the LP market at the expected LP market price of $7.50 per gram is given by:

(90) Base KG(Market Price) = Base KG-GS + Base KG-O + Base KG-P + Base KG-D

The Number of Users in the LP market at the expected LP market price of $7.50 per gram is given by:

(91) Users(Market Price) = Users-GS + Users-O + Users-P + User-D

The scale of the expected LP market (as of April 2014) at an expected LP market price of $7.50 per gram is 19,385KG for 32,623 users, each consuming a mean of 594 grams per year (or 1.70 grams per day for 350 days per year) at an annual user cost of $4,460. This is the Reference case that was used to estimate the evolution of the LP market over time in the Policy scenario.

The analysis calculated an Implied Price Elasticity, based on the transition from the Status Quo to the Policy scenario and taking into account the options to 'opt-out' of the Policy Regime by illicitly cultivating marihuana for own use.

(92) Transition ε^{*}_{p} = {[KG(Market Price) - KG(User Cost)] / KG(User Cost)}

/ {[Market Price - User Cost] / User Cost}

where

KG(Market Price) = Base KG-Demand at LP Market Price (April 2014)

KG(User Cost) = Base KG-Demand at User Cost (as in Status Quo) (April 2014)

Market Price = $7.50/gram * 1,000 (this study's assumed estimated LP Market Price)

User Cost = $2.60/gram * 1,000 (from weighted average in Status Quo)

The last value is a weighted average of User Costs from ATP-GS, ATP-O, ATP-P, and ATP-D who all face different User Costs in the Status Quo scenario.

For the Reference case, the value of the Implied Price Elasticity is -0.36. This is higher than the initial Price Elasticity-Status Quo assumption (-0.25) as it explicitly allows for choosing to 'opt-out' of the Policy Regime. For the purposes of estimating Consumer Surplus in the Policy scenario, the analysis estimated the Intercept-D (Price Intercept of the Demand Curve) using the Price Elasticity of Demand which is computed in the Policy Transition model.

The Implied Grams Per Year-Policy is estimated using the KG (Market Price) and Users (Market Price) as:

(93) Grams/Year-POL = KG(Market Price) * 1,000 / Users(Market Price)

Implied Annual User Cost-POL is estimated as:

(94) Annual Cost-POL = Grams/Year-POL * Market Price

The Implied Grams Per Day-Policy is estimated using the Implied Grams Per Year-Policy as:

(95) Grams/Day-POL = Grams/Year-POL / 350

4.8 Policy – Demand Curve

The analysis again assumed that the Demand Curve is linear in the Policy scenario, the same assumption used in the Status Quo scenario. From the Transition Model (April 2014), an initial point on the Demand Curve-Policy was estimated, based on an expected LP Price of $7.50/gram.

The equilibrium LP Market Price is known when both a Demand and Supply curve estimate for the LP Market (Policy scenario) are obtained.

1. *Demand Curve – Intercept*

From equations 90 and 91 there is a point on the Demand curve (in April 2014) of (Market Price, KG(Market Price)) or ($7,500, 19,385) when expressed as a Price/KG and KG-Demand. The calculated Price Elasticity of Demand (Policy) is -0.36. As above (equations 27 and 28), it is therefore possible to estimate, for a linear Demand curve, the Intercept-D and Slope-D.

The Demand curve intercept in the Policy scenario is given by:

(96) Intercept-D = Market Price * [1 – (1.0 / ε^*_p)]

As there are now two points of the Demand curve (the y-axis intercept) and the estimated transaction point (Market Price, Base KG) the Demand curve slope (which is negative as the curve is downward-sloping) can be calculated.

2. *Demand Curve - Slope*

The Demand curve slope (for the Policy scenario at April 2014) is given by:

(97) Slope-D(April 2014) = [Market Price – Intercept-D] / KG(Market Price)

For the Reference case, these values are: Intercept-D = $28,335 and Slope-D = -1.07. It is known that, as the market expands in scale over time, the value of the Slope-D will fall (in absolute terms) in order to be linear with a constant Price Elasticity over time. This was the case for the Status Quo model.

The Demand curve for the LP Market assumed an instantaneous switch from the Status Quo to the Policy scenario as of April 2014. This is unrealistic, as the complexity of Policy Transition would likely occur over a 6- to 18-month period. As the CBA is intended to look at the long-term (10 year) 'steady state' impact of the Policy scenario, the complexity of the actual transition process is ignored for simplicity.

The model logic and results must now be applied from the Policy Transition to forecast the future evolution of Potential Demand Users over time.

From the Policy Transition, it was estimated that 15% of ATP-Persons in April 2014 would 'opt out' of the new Policy regime and access their marihuana from illicit sources, mostly from own-production that is now illegal (i.e., 6,844 Users 'Opt Out' from 47,123 assumed ATP-Persons).

From the Policy Transition, it was estimated that 16% of ATP-Persons in April 2014 would be 'priced-out' of the new Policy regime at the estimated LP Market Price of $7.50/gram (i.e., 7,656 User 'Priced Out' from 47,961 assumed ATP-Persons[28].

These probabilities were used as a constant over time to remove persons from the stream of Potential Policy User*, which is given by:

(98) $\text{Policy User}^{*}(t) = \text{Policy User}^{*}(t-1) + \{\text{New Entrants}(t) * [1 - Pr_{optout}] * [1 - Pr_{priceout}]\}$

where

New Entrants(t)	= ATP(April)(t+1) - ATP(April)(t) for April values of ATP numbers in the Status Quo over time between any two Fiscal Years.
Pr_{optout}	= the probability of Potential Policy Users to 'opt-out' of the Policy regime
$Pr_{priceout}$	= the probability of Potential Policy Users to be 'priced-out' of the Policy regime

[28] This study applies the 'price-out' effect against an estimated Market Price of $7.50 per gram. Subsequently, in a model of demand/supply equilibrium in the LP market, the study will determine an equilibrium price which may be greater than $7.50 per gram. The analysis does not estimate a further price elasticity effect should the equilibrium price be greater than $7.50 per gram. This was done to segment the analysis and provide simplicity.

In order to compute the Demand curve Slope over time, for the Policy scenario, it is necessary to estimate some position on the Demand curve over time. There is the constant Intercept-D which we calculated from the implied (constant) Price Elasticity of Demand. This analysis estimated a point associated with $7.50/gram LP Price, which was the Reference case price used in the Policy Transition Model. This will not necessarily be the Equilibrium Price when the LP Demand and Supply curves are allowed to intersect.

The KG-Demand in the LP Market, over time and at the estimated LP Market Price of $7.50/gram, is given by:

(99) KG-Demand*(t) = Policy User-FY*(t) * Grams/Day-POL / 1,000

where

Policy User-FY*(t) = FY average of monthly values determined over time based on April values for successive years.

The Demand curve slope (for the Policy scenario), over time, is given by:

(100) Slope-D(t) = [Market Price – Intercept-D] / KG-Demand*(t)

As for the Status Quo, the Slope-D(t) declines in absolute value over time as the market expands.

The parameters for the Demand curve (LP Market) over time are given in equation 96 (for constant Intercept-D) and in equation 100 (for time variant Slope-D(t)).

This analysis now turns to the LP Supply Model.

4.9 Policy – Supply Curve

A detailed activity-based costing (ABC) model was built for LP Supply production based on various parameters from the literature, and estimates that are comparable to the Government Supply (Status Quo) production, where these are appropriate.

It was assumed, except for the role of the Incumbent Supplier, that an LP entrant would have a beginning scale of operation of 500KG production. This can change in the actual Supply model and is used as a fixed target for the purposes of supply costing.

LP-Scale = 500KG

4.9.1 LP Production – Supply Cost Model

LP-Production Component

It was estimated that the number of production workers per KG produced is 0.072 FTE, based on reported data in the press (2006) about production at the Government Supply. The Scale = 500KG would require about 36 production workers.

LP-PROD = 0.072 FTE Production Workers / KG-Supplied

It was estimated that the production facility could support about 5 plants per m^2 of production space.

LP-PM2 = 5 Plants per m^2 of Production Space

It was estimated that a marihuana plant produces 33.6 grams/plant/harvest for 4 harvests per year, or 134 grams/plant/year.

LP-GPP = 134 grams / Plant / Year

The production space requirement to achieve the LP-Scale output, in terms of m^2 of production space, can be determined by:

(101) Production Space = LP-Scale / [LP-GPP * LP-PM2 / 1,000]

For the parameters assumed, this results in about 745m^2, or about 8,000ft^2 of production facility. In order to allow space for: a) storage and drying; b) worker change/toilets/day-use; c) secure delivery/pick-up; d) administration; e) maintenance/cleaning supplies; and f) miscellaneous needs, the production requirement was effectively doubled to get an overall estimate of the required facility size.

(102) Production Facility = Production Space * 2

It was estimated that a suitable production facility could be obtained for about \$9.00/ft^2, including Net Lease and TMI (taxes, maintenance and insurance)[29]. Therefore, the annual Production Facility Cost (LP-PFC) is given by:

(103) LP-PFC = Production Facility * \$9.00

which is about \$144,000 per year for the assumed LP-Scale.

It was estimated that production supplies are about \$85/m^2/harvest for growing medium and other sundry supplies (excluding electricity).

LP-SUPP = \$85/m^2/harvest

It was estimated that electricity requirements are 40 watts/ft^2, which, converting to metric for 24 hours per day for the LP-Scale, and converting to KWH, with electricity cost of \$0.04/KWH, gives:

LP-ELEC = \$146/m^2/year

Variable labour cost (production workers) was estimated at about \$35,000/year (based on \$15/hour for 1875 hours and EBP Cost Factor of 1.25).

[29] The \$9.00/ft^2 estimate was developed for Toronto Industrial locations (Canadian Property Management website). While these costs may be higher or lower by geographic area, this estimate is used for the reference scenario.

LP-LAB = $35,000/year

Production equipment costs are $120/m^2/year in relation to production space, based on amortized cost.

LP-EQUIP = $120/m^2/year

Production security costs are $20,000/year in relation, based on amortized costs for various security requirements and unit costs (e.g., entrance, fence, detection/alarm systems, IT security).

LP-SEC = $20,000/year

Total Production Costs, for the LP-Scale facility, is found by sum of various production cost items:

(104) Production Cost = LP-PFC + [LP-SUPP * Prod-Facility * Harvest]

+ [(LP-ELECT + LP-EQUIP) * Prod-Facility]

+ LP-LAB + LP-SEC

Production cost of about $1.9M is estimated for the LP-Scale production.

LP-Order Processing Component

Average shipment size is estimated to be 50 grams.

The number of annual shipments is given by:

(105) LP-SHIP = LP-SCALE * 1,000 / 50

which is 10,000 in the reference case. This would work out to about 40 shipments per working day (for 50 weeks/year and 5 working days per week). Some peak demand is allowed in the analysis so that the workforce is assumed to accommodate up to 1.5 * Average Orders/Day = 60 shipments/day.

It is estimated that an Order Clerk can process 10 Orders per day, so to accommodate the peak order there is a need for 6 FTE Order Clerks.

LP-ORD = [(LP-SHIP / 250) * 1.5] / 10

The same Annual Salary cost is assumed for Order Clerks ($35,000).

The Courier Cost per Shipment is estimated to be $50.

LP-COUR = $50

Order and Shipping Costs are therefore given by:

(106) Order/Ship = [LP-ORD * $35,000] + [LP-COUR * LP-SHIP]

An order/shipping cost of about $0.7M is estimated for the LP-Scale production.

LP – Corporate Component

There are a total of 36 production works and 6 order clerks. It was assumed that there is a Supervisor Span of Control of 12, so that the number of Supervisors is given by:

(107) LP-SUP = (LP-PROD + LP-ORD) / 12 (rounded to nearest integer)

It is assumed that Supervisors are paid 1.65 times the salary of Production/Order workers.

It is assumed that there are 1.35 Corporate Managers/Executives per $1M in sales revenue. For the LP-Scale that implies 5 Corporate Managers. It is assumed that these Managers earn $90,000 annually.

LP-EXEC = $450,000/yr

It was estimated for 12 Corporate Staff the requirement for Corporate Office space for about 4,600ft^2 at a commercial lease cost of $14.00/ft^2/yr.

The Corporate HQ Space Costs were estimated at $65,000/year.

LP-HQ = $65,000/yr

Corporate Security/IT and Equipment Costs were estimated at $30,000/year.

LP-IT&S = $30,000/yr

Corporate Costs are therefore given by:

(108) LP-CORP = [LP-SUP * $35,000 * 1.65] + LP-EXEC + LP-HQ + LP-IT&S

Corporate Costs were estimated at about $0.8M for the LP-Scale production.

LP – Total Operating Cost

LP-Total Operating Costs are the sum of Production, Order/Shipping and Corporate Costs.

(109) LP-OPER = [LP-SUP * $35,000 * 1.65] + LP-EXEC + LP-HQ + LP-IT&S

It was estimated that Total Operating Costs, for the LP-Scale production, would be $3.4M per year.

LP – Net Margin (EBIDT)

LP-Net Margin (Earnings Before Interest, Debt and Taxes) is given by:

(110) LP-NET = [LP-SCALE * $7.50 * 1,000] - LP-OPER

and the % Net Margin is LP-NET / LP-REVENUE (first part of right-hand side of above equation). In the reference scenario, this results in LP-NET = $390,000 and %Net of 10%.

LP – After Tax Profit

It was estimated that LP interest costs and taxes would be about $105,000, so that after-tax profit is about $285,000, or 8% of Revenue.

By definition, as the analysis has fully exhausted the revenue, the total cost (per gram or KG) is the same as the sales revenue (per gram or KG).

Table 4.6 summarizes the LP Supply Cost model. This is not presented as a reliable guide to LP costing, but as an order-of-magnitude cost estimate that corresponds reasonably well to Health Canada expectation that the LP Market Price could be in the vicinity of $7.50/gram.

In Table 4.6, the LP supply cost works out to $6.72/gram, which, in a market after HST is applied (at 13%), would give a user price of roughly $7.60/gram.

Table 4.6 – Policy – LP Supply Cost		
Model 2.20 LP Parameters (Initial Scale for LP)		
LP-Small Scale (KG)	500	
Target Revenue - Small	$3,750,000	
Production Site Workers	36.0	
Production Space Requirements		
Plants / m^2	5	
Yield / Plant / Year (grams)	134	
Yield / m^2 / Year (grams)	672	
Grow Space Requirement m^2	744	
Grow Space ft^2	8,000	
Storage / Drying ft^2	1,600	20%
Worker Facility ft^2	800	10%
Secure Delivery Space ft^2	1,200	15%
Administration ft^2	1,600	20%
Maintenance/Cleaning ft^2	1,200	15%
Other/Misc. ft^2	1,600	20%
Total Production Facility ft^2	16,000	
Ratio of Grow / Total Space	50%	
Production Facility Cost/Year	$144,000	
Cost per m^2 Grow Area	$194	
Production Facility Value	$1,920,000	
Variable Cost Parameters		
Supplies per m^2 / harvest	$85	
Supplies per m^2 / year	$340	
Supplies per / year	$252,976	
Electricity KwH per m^2 / year	3,650	
Electricity KwH / year	2,715,774	
Electricity Cost / year	$108,631	
Electricity Cost per m^2 / year	$146	
Labour Hours per KG	135	
Labour Hours / year	67,500	
Labour Cost / year	$1,260,000	
Labour Cost per m^2 / year	$1,693	
Equipment Cost / year	$89,286	
Equipment Cost per m^2 / year	$120	
Physical Security Requirements		
Security Cost / year	$20,000	
Security Cost per m^2 / year	$27	
Production Cost Sub-Total		
Total Production Costs / year	$1,874,893	
Total Production Costs / m^2 / year	$2,520	
Total Production Costs / KG	$3,750	
Order Processing		
Average Shipment Size (gram)	50	
No. Shipments / Year	10,000	

Table 4.6 – Policy – LP Supply Cost	
No. Shipments / Day	40
Peak Shipments / Day	60
Shipments / FTE / Day	10
Peak FTE Requirement	6
Order Proc Labour Cost / year	$210,000
Labour Cost / Shipment	$21
Courier Cost / Shipment	$50
Courier Cost / year	$500,000
Management & Overhead	
Operational Staff FTE	42
Supervisors FTE	4
Supervisors Cost	$231,000
Corporate FTE	5
Corporate Staff Cost	$450,000
Corporate Space m^2 per FTE	28
Corporate Staff	12
Corporate Overhead Space m^2	93
Corporate Space m^2	429
Corporate Space ft^2	4,618
Corporate Space Cost/Year	$64,648
Corporate Security Cost/Year	$10,000
IT/Equipment Costs	$20,000
Order/HQ Cost Sub-Total	
Total Order/HQ Costs / year	$1,485,648
Total Order/HQ Costs / KG	$2,971
Operating Cost Sub-Total	
Total Costs / year	$3,360,541
Total Costs / KG	$6,721
Operating Margin	$1,644,107
% Operating Margin	44%
EBIDT	$389,459
% Net Margin	10%
Working Capital Requirement	$616,438
Debt Load	$750,000
Interest Cost	$42,329
EBT	$347,130
Taxes	$62,483
Profit After Tax	
Earning After Tax	$284,647
% After-Tax Profit on Revenue	8%
Sources: Delsys Research	

This LP costing model provides some support for believing that an LP Market could be operative in FY2014-15 at around $7.50/gram.

4.9.2 LP – Compliance Cost

The TBS Regulatory Cost Calculator was used with an activity-costing model for specific policy regulatory requirements to derive an estimated Business Compliance Cost of $20M on an annualized basis for the LP market entrants. This was estimated to involve Fixed Compliance Costs (per year) of $322,160 per LP and Variable Compliance Costs of $62,476 per LP based on the scale of the LP operation.

This study developed a Scale Factor(t) over time based on the KG-Supply in the LP market over time and made adjustments to the Fixed Compliance Cost as additional LPs entered the market.

The LP Compliance Cost was estimated in the Policy scenario to be:

(111) LP-COMP = {Fixed Cost * #LP(t)} + {Variable Cost * Scale Factor(t)}

where

#LP(t) = the number of LP entrants at time t

Fixed Cost = $332,160 per LP

Variable Cost = $62,476 per LP (when Scale Factor = 1.00)

Scale Factor(t) = KG-Supply(t) / KG-Supply(2014-15) which is a value between 1.0 and 6.44 over time

In the reference case, the LP compliance costs represent about 11% of Revenue (FY2014-15) and fall to 3% of revenue (FY2013-14).

4.9.3 LP – Supply Curve

It was not possible to derive the Supply curve Intercept or Slope directly from the LP costing model (above). The Supply curve represents the impact of a (possibly) lower marginal cost Incumbent, and the introduction of LP Entrants with higher marginal costs. It was expected that the Supply curve would have an upward slope, reflecting the fact that market expansion draws in LP entrants, at the margin, who may be less efficient and have higher marginal costs.

The following heuristic rationale was posited for the Supply curve parameters.

It is not anticipated that there would be any LP Market supply at a price (per KG) below $6,000. Effectively, it is believed that the Incumbent's marginal cost is at least $6,000/KG.

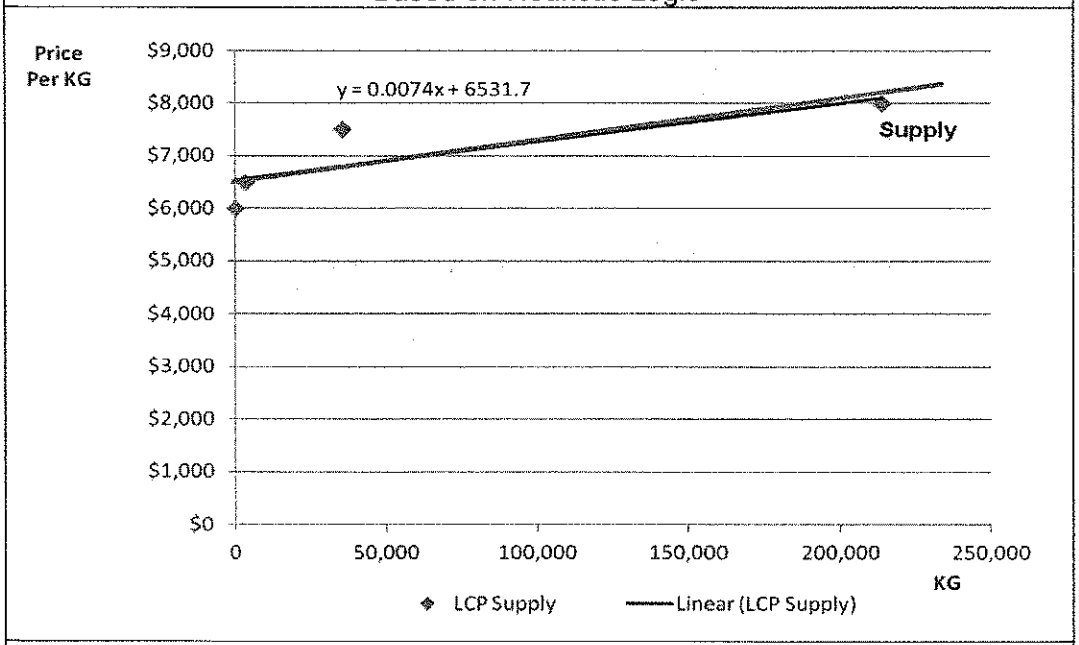
It is estimated that the Incumbent could supply, perhaps, 3,500KG, at a marginal cost (Price) of $6,500.

It is estimated that a scaled Incumbent and about 50 LP Entrants (at the LP-Scale used in the Costing Model) could supply 35,500KG at a Market Price of $7,500/KG.

It is estimated that a scaled Incumbent and, perhaps, 400 LP Entrants could supply 200,000KG at a Market Price of $8,000/KG.

These are heuristic estimates. When these points are graphed and used to estimate a Linear Regression line in the supply space (Figure 4.11), an estimate of the Supply curve is obtained.

Figure 4.11 – Supply Curve - LP Market
Based on Heuristic Logic



Sources: Delsys Research

Supply – Intercept & Slope

Based on this heuristic reasoning, an Intercept-S of $6,500 and a Slope-S of 0.0074 are estimated. These will be fixed over time in the model.

Intercept-S = 6,500

Slope-S = 0.0074

This study will analyze the sensitivity of the CBA results to these parameters. When analyzing this sensitivity, the Intercept-S is allowed to vary and the Slope-S is calculated so that there is always a fixed point at (P=$6,722, Q=30,000). Effectively, there is allowance for the Supply curve to 'swivel' around that fixed point, which establishes the April 2014 position in the LP Market.

Now that the Demand and Supply curve parameters are obtained and are linear in form, it is straightforward to determine the Market Equilibrium (Price, KG) at any point in time in the model.

One additional factor taken into account is the 'tax wedge' that HST introduces between the Market Price (User) and Market Price (Supplier). The existence of HST means that, at any point in time in the Policy scenario,

(112) Market Price(User)(t) = Market Price(Supplier)(t) * (1 + HST)

where it was assumed, for simplicity, a single HST rate for all provinces/territories of 13%.

4.10 Policy – LP Market Equilibrium

The two equations for Supply and Demand in this analysis are:

Supply-P = A + B * KG (i.e. A=Intercept-S, B=Slope-S)

Demand-P = C + D(t) * KG (i.e. C= Intercept-D, D(t)=Slope-D)

In equilibrium, the KG are the same in the two equations and Demand-P = (Supply-P * 1.13). Rearranging and solving for KG-Equilibrium:

(113) KG-EQ(t) = [C - 1.13A] / [1.13B - D(t)]

This equation is used to determine KG-EQ(t) over time. The Supply equation is then used to determine Supply-P(t) over time.

In the FY2014-15, the reference scenario gives:

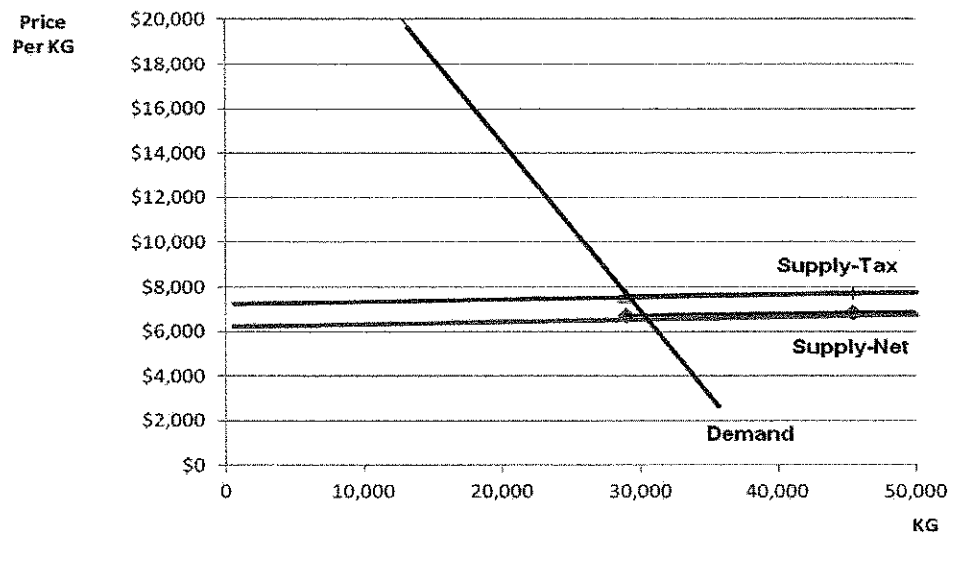
KG-EQ = 26,731 KG

P-EQ-Supply = $6,698/KG

P-EQ-Demand = $7,569/KG

These are shown in Figure 4.12.

Figure 4.12 – Equilibrium - LP Market (2014-15)



Sources: Delsys Research

Initially, in the Reference case, it was anticipated that the LP Market could be supplied by a Scaled Incumbent and 50 New LP Entrants. The analysis allows additional LP Entrants to enter the market in FY2016-17 and in FY2018-19 if the market capacity utilization ratio is sufficiently close to 85% over the average of the next four years. It is assumed that once LP Entrants join the market they scale their production from the Base-Scale of 500KG annually to about 4,000KG annually by 2024-25.

4.11 Policy – User Benefits & Costs

Consumer Surplus – LP Market

Consumer Surplus is estimated in a similar manner to equation 32 (for Government Supply).

The existence of the HST tax wedge means there is a Deadweight Loss associated with the LP market and it is necessary to separately track the Supply Price (P*S-EQ) and Demand Price (P*D-EQ) as well as the Equilibrium Quantity (with Tax) (KG*-EQ) for various calculations. It is also necessary, for the Deadweight Loss calculation, to calculate the Price ($P^{\#}$-EQ) and Equilibrium Quantity (no Tax) ($KG^{\#}$-EQ).

Consumer Surplus (LP Market) over time in the Policy scenario is given by:

(114) CS(LP)(t) = 0.5 * [Intercept-D - Demand Price(t)] * KG*-Demand(t)

Producer Surplus – LP Market

Producer Surplus (LP Market) over time in the Policy scenario is given by:

(115) PS(LP)(t) = 0.5 * [Supply Price(t) - Intercept-S] * KG*-Demand(t)

Deadweight Loss – LP Market

Deadweight Loss is estimated in a similar manner to equation 33 (for Government Supply).

Deadweight Loss (LP Market) over time in the Policy scenario is given by:

(116) $DWL(LP)(t) = \{0.5*[P^{\#}\text{-EQ}(t) - \text{Supply Price}(t)] * [KG^{*}\text{-EQ}(t) - KG^{\#}\text{-EQ}(t)]\}$

$+ \{0.5*[\text{Demand Price}(t) - P^{\#}\text{-EQ}(t)] * [KG^{*}\text{-EQ}(t) - KG^{\#}\text{-EQ}(t)]\}$

The Deadweight Loss calculation requires the area of two triangles to be calculated.

4.12 Policy – Safety Costs

It was estimated in the Reference case of the Policy Transition Model (for April 2014), that 8,000 producers (PUPL/DPPL) might 'opt out' of the Policy regime and continue cultivation, illicitly and principally in their family residence. This was modelled in equation 63-67. This was a reduction of 33% in misuse by persons who held production licenses.

It was also known that about 60% of persons who are interested in accessing marihuana for medical purposes are prepared to undertake own-production. This is a historical fact in the MMAP experience.

It was also estimated, in equation 98, that the number of persons that would enter the new Policy regime, based on the number of persons who would have participated in the MMAP in the Status Quo scenario. The analysis used the number of persons who would have participated in the MMAP as the base against which to estimate the continued stream of persons who will continue to engage in misuse in the Policy scenario.

4.12.1 Policy – Residential Misuse

The number of persons who will continue to grow marihuana in their family residence in the Policy scenario who were, counterfactually, related to MMAP in the Status Quo scenario, is given by:

(117) Misuse(Policy)(t) = 7,605 (for April 2014)

(118) Misuse(Policy)(t) = Misuse(Policy)(t-1) + [MMAP-New Entrant(t) * 0.6 * (1 - .33)]

where

MMAP New Entrant(t)		= the number of persons who would enter MMAP in the Status Quo
Pr(PUPL)	=	0.6
%Misuse Reduction	=	0.33

It is important to highlight that this study does not assume that all residential cannabis/marihuana cultivation would cease as a result of the Policy changes. Effectively, the operation of the crime prevention/deterrent effect of clarification (through the removal of the need for additional evidence) is only assumed to reduce such activity by 33%. It may be that the actual impact will be higher, but this study modelled the response based on evidence in the literature dealing with drug crime prevention.

The analysis assumed, as for the Status Quo scenario, the same parameters for minor and major misuse, fire risk, injury and death rates, economic loss from injury, death and property damage. Therefore, equations 44 to 46 are effectively used to estimate the same losses associated with fire to obtain Fire Costs for the Policy scenario.

4.12.2 Policy – Fire Costs

For each of the fire events associated with misuse, the social costs associated with fires related to marihuana cultivation are given, in the Policy scenario over time, by:

$$(119)\ \text{Fire Costs}(t) = [\text{House Fire}(t) * WTP_{damage}] + [\text{House Fire}(t) * Pr_{injury} * WTP_{injury}] + [\text{House Fire}(t) * Pr_{death} * WTP_{death}]$$

as in equation 46.

4.13 Policy – Security Costs

The misuse stream, over time, in the Policy scenario, as given in equation 118, is also used as the primary input into the Security model which otherwise uses the same parameters and logic as equations 47 to 51 for the Status Quo.

Crime Prevention Benefits & Costs

One intended consequence of the proposed Policy is to improve public security by removing from residential areas the locus of licensed marihuana cultivation.

Attribution of crime prevention benefits is made difficult by the presence of the 'displacement effect'. This is defined as the unintended increase in targeted crimes in other locations following from the introduction of a crime reduction scheme. Five different forms of displacement have been identified [Reppetto (1976)]: a) temporal (change in time), b) tactical (change in method), c) target (change in victim), d) territorial (change in place), and e) functional (change in type of crime).

Effectively, the attribution of benefits to crime reduction must be able to document logically (and with evidence, preferably) that the reduction of crime is not localized in time, space, location or type of crime and merely displaced elsewhere. If such displacement occurs there is no (or less) social welfare gain.

Crime reduction/control benefits arise from:

a) savings of resources for law enforcement activity; and

b) reduced societal harm (i.e. willingness-to-pay (WTP) to avoid harm or willingness-to-accept' (WTA) harm).

The elimination of the option to personally produce marihuana for medical purposes under Health Canada regulation is a main feature of the intended improvement in public security outcomes. Such a policy will only have an impact to the extent that the underlying activity is stopped or reduced in level. To the extent that this activity remains (at the same level) and becomes illicit (without cover of the MMAR), there would be no social welfare change. This is an example of what is called the 'displacement effect,' which must be taken into account in CBA related to crime prevention.

There are two main mechanisms by which the proposed Policy could, theoretically, reduce the level of criminal activity related to marihuana cultivation in residences:

a) Signal effect: declaration of the activity as illicit may result in some people ceasing their activities; and

b) Deterrence effect: increasing the risk of detection, arrest, seizure and punishment without the legal cover of MMAR production licenses may reduce the marginal return of the illicit activity.

The first effect would appear to be naïve. The second effect is based on rational criminal activity and the altering of the risk/reward trade-off. The economic/rational theory of criminal activity [Becker (1968)] treats crime as a rational activity and postulates that crime prevention/control should also be demonstrated to be rational (and effective).

Crime Prevention Impacts of the Proposed Policy

The proposed Policy will no longer allow (following a phasing-out transition period) the cultivation of marihuana for medical purposes under what are now MMAR production licenses (that mostly involve family residences). This will eliminate the legal ability to cultivate marihuana in a family residence.

As such, it will logically eliminate the threat of violence against families in their residence who cultivate marihuana for medical purposes in their residence. This is not to say that some persons may not continue to do so, but this activity will now be illegal. Therefore, the expected magnitude of this impact depends crucially on the degree to which people desist from future illegal marihuana cultivation in their residence.

Crime Prevention Benefits - Policy

By explicitly developing a model (Policy Transition Model) to look at the rewards and risk of marihuana cultivation misuse (under MMAR in the Status Quo) and the economic returns to crime, this study can more accurately estimate, with the assistance of a behavioural parameter found in the 'economics of crime' literature, the possible impact (net of displacement) on the underlying residential marihuana cultivation. As this CBA has explicitly modelled the continuation of some crime (estimated at 67%) in the Policy scenario, the analysis has appropriately ascribed a reasonable estimate for the benefits arising from crime prevention as a result of the intended Policy impact.

4.13.1 **Policy – Security Cost**

For each of the security events associated with misuse in the Policy scenario, the social costs associated with residential misuse, home invasions and non-fatal/fatal shootings are given in the Policy scenario over time, by:

$$(120)\quad \text{Security Cost}(t) = \text{Social Loss}_{misuse}(t) + \text{Social Loss}_{invasion}(t) + \text{Social Loss}_{non\text{-}fatal}(t) + \text{Social Loss}_{fatal}(t)$$

as in equation 51.

4.14 Policy – Program Administration Costs

As above for the Status Quo scenario, Health Canada Program Administration Costs are comprised of:

- Salary and Human Resources (HR)-related costs such as Employee Benefits Program (EBP) and staff accommodation costs;
- Operations & Maintenance (O&M) costs for travel, training, supplies and professional contracts; and
- Corporate Cost to reflect Departmental shared services and overhead.

4.14.1 Policy – Salary & HR-Related & O&M Costs

Health Canada administrative costs (human resource costs, accommodation, O&M costs) were estimated to be about $1.4 Million in the first year, presumably FY2014-15, for the Policy scenario. These estimates did not include Employee Benefit Program (EBP) costs or HC Corporate functional overhead (which were embedded in the Status Quo MMAP Costs). To ensure consistency between the Status Quo and Policy scenarios, these adjustments were made and base year costs were associated with activity volumes to allow a basis for forecasting changes in HC Program Administration Cost over time as the volume of activity grows.

The assumptions used by Health Canada to underpin the administration cost estimate was that there would be 60 LPs requiring licensing as producers, and that there was a need for two (2) inspections per license, or 120 field inspections. In addition, there were 100 files to be reviewed, although it was unclear how this related to the licenses issued or inspection volume.

HR salary cost, 'grossed-up' by 41% for EBP costs, results in an estimate of $1.89 Million in the first year. About 79% of this cost is HR-Related and 21% is O&M-Related (travel, training, police accompaniment, office supplies, publishing etc). Certain line item costs appeared to be of a fixed nature, so this study estimated that $132,000 (O&M) and $346,675 (HR) were of a fixed nature and the remainder were variable with the volume of activity which is largely related to the number of LP producers.

Based on the assumed number of 60 LPs, these variable cost elements were $4,258 (O&M) per LP and $19,185 (HR) per LP. There were 13.25 FTEs in this base-year estimate.

In the LP Supply Model, the analysis estimated the number of producers that were expected to be in the LP Market, over time, based on a model of LP New Entrants and a scaling growth path over time as they expand along with the overall market scale. Allowance was also made for a Salary Escalation factor (2%) to increase HR costs over time in real terms.

The Health Canada Administration Cost over time, in the Policy scenario is given by:

$$(121)\ \text{HC-Admin Cost}(t) = \{\text{Fixed-HR} + [\text{Variable-HR} * \#\text{LP}(t) * (1 + \text{Salary Escalation})^t]\}$$

$$+ \{\text{Fixed-O\&M} + [\text{Variable-O\&M} * \#\text{LP}(t)]\}$$

This is the counterpart to equation 13 for the Status Quo scenario.

4.14.2 Policy – Corporate Cost

In the Status Quo scenario, there was a fixed component and a variable component of these costs which meant that the Corporate Cost increased at a fixed amount per year.

It was estimated that the HC Corporate Cost represented about 14% of the HC-Administration Cost (FY2013-14), so this ratio was used to benchmark an initial year value of ($1.89 Million * 0.14 = $257,092) for the initial year. Based on the ratio of fixed/total cost in the Status Quo for FY2013-14, it was estimated that about $100,000 is fixed Corporate Cost and about $150,000 is variable Corporate Cost. It was estimated that the step-function increase, per year, would be about $15,000.

The linear equation to predict the future Corporate Cost over time in the Policy scenario is given by:

$$(122)\ \text{Corporate Cost}(t) = 100{,}000 + 15{,}000 * (t)$$

This is the counterpart to equation 12 for the Status Quo scenario. The value for t (FY2014-15) is 10, which is the continuation of the time trend from the Status Quo.

4.14.3 Policy – Program Administration Costs

The sum of Health Canada administrative cost (equation 121) and corporate cost (equation 122) equal the total Program Administration Costs for the Policy scenario:

$$(123)\ \text{Program Administration Cost}(t) = \text{HC-Admin Cost}(t) + \text{Corporate Cost}(t)$$

This is the counterpart to equation 15 for the Status Quo scenario.

4.15 Policy – Summary of Benefits & Costs

Policy – Program Administration Costs

Total HC Program Administration Costs are from equation 123.

Compliance cost is given from equation 111.

Policy – User Benefits

User benefit is the Consumer Surplus measure from equation 114.

Producer Surplus is from equation 115.

The Deadweight Loss (from the HST tax) is given in equation 116.

Policy – Safety Costs

Safety cost is the sum of the Fire Costs from equation 119.

Policy – Security Costs

Security cost is given from equation 120.

4.16 Net Present Value (Policy vs Status Quo)

The Net Present Value is – with the use of a Social Discount Rate (SDR) – the discounted sum over time of the difference between the streams of benefits and costs in the Policy scenario and benefits and costs in the Status Quo scenario.

The Net Present Value is given by:

(123) $NPV = \sum_t [Policy(t) - Status\ Quo(t)] / [(1+SDR)^t]$

where

Policy(t)	= the sum of the Policy scenario benefit (if positive) or cost (if negative) estimates for each of the components of the CBA;
Status Quo(t)	= the sum of the Status Quo scenario benefit (if positive) or cost (if negative) estimates for each of the components of the CBA;
SDR	= the Social Discount Rate (8%);
t	= time index from 1 (FY2014-15) to 10 (FY2023-24)

This completes the discussion of the CBA methodology. The report now turns to the CBA Model results.

CHAPTER FIVE

5.0 CBA - Results

This section reports the CBA results from the model described in the previous section on methodology. It presents the CBA results in four sections and provides detailed tables, including the two Accounting Table summaries required by Treasury Board Secretariat.

The CBA results are presented in terms of:

1. Program Usage & Outcomes: resulting from the proposed regulation changes in terms of authorized users and authorized consumption, residential producers, marihuana cultivation misuse and resulting safety and security impacts;

2. Monetized Cost and Benefit Measures: related to users, producers, deadweight loss (from taxes and effective subsidies) and safety and security benefits resulting from lower social costs;

3. Net Present Value Measure: the Discounted Net Present Value (NPV) based on the difference between the Policy scenario and Status Quo scenario streams of costs and benefits over time; and

4. Sensitivity Analysis: the sensitivity of the NPV measure to different reasonable parameter values.

In a CBA, the key measure is the NPV for the Reference Case, supplemented by Sensitivity Analysis of the CBA results based on Monte Carlo analysis of changes to parameter values that underpin the model dynamics (behavioural responses to changes) and monetization of events (in terms of willingness-to-pay measures).

5.1 Program Usage & Outcomes

Tables 5.1 and 5.2 show the forecast results over the 10 year period (FY2014-15 to FY2023-24) for the Reference case for each of the Status Quo and Policy scenarios. These tables show forecast values for:

Program Usage Indicators:

- Authorized marihuana users under the MMAR (Status Quo) and the proposed Policy regime;

- Licensed marihuana producers under the MMAR (DPPL/PUPL) and as LPs;

- KG quantity of marihuana consumed from legal sources of supply; and

- Average supply cost (per KG) from legal sources of supply.

Safety Indicators:

- Number of residential misuse cases for marihuana production (i.e., misuse of PUPL/DPPL production licenses under the MMAR; and persons who are forecast to 'opt out' of the Policy regime and continue home cultivation that is expected to involve supply to the illicit market);

- Number of residential fires predicted to occur as a result of residential misuse marihuana cultivation;

- Number of predicted fire injuries resulting from the residential fires resulting from misuse marihuana cultivation; and

- Number of predicted fire deaths resulting from the residential fires resulting from misuse marihuana cultivation.

Security Indicators:

- Number of potentially violent home invasions that are predicted to arise from residential misuse cases for marihuana production;

- Number of non-fatal shootings that are predicted to arise in relation to home invasions and residential misuse cases for marihuana production; and

- Number of fatal shootings that are predicted to arise in relation to home invasions and residential misuse cases for marihuana production.

A discussion follows (below) on the impact of the Policy in terms of changes between the two cases. The change in outcomes is summarized in Table 5.3 as the difference between the Policy and Status Quo scenarios.

TABLE 5.1 - STATUS QUO – PROGRAM OUTCOMES & INDICATORS								
	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	202
Usage Indicators								
Authorized Marihuana Users	57,799	93,338	141,461	201,426	267,769	330,345	378,943	409
Licensed Marihuana Producers	38,532	62,226	94,308	134,284	178,512	220,230	252,629	273
Marihuana KG Consumed	67,573	107,841	163,853	233,748	312,556	388,859	450,964	493
Value of Consumption ($M)	$156	$248	$373	$526	$702	$869	$1,001	$1,
Supply Value Per KG	$2,310	$2,300	$2,277	$2,251	$2,247	$2,235	$2,220	$2,
Safety Indicators								
Residential Misuse	15,259	24,641	37,346	53,177	70,691	87,212	100,041	108
Fires	96	158	237	340	451	557	638	6
Fire-Injuries	5	7	10	15	20	26	29	3
Fire-Deaths	0	0	1	1	1	1	1	
Security Indicators								
Home Invasions	53	86	130	186	247	305	349	3
Non-Fatal Shootings	6	9	14	20	26	32	37	4
Fatal Shootings	1	2	2	3	5	6	7	

TABLE 5.2 - POLICY – PROGRAM OUTCOMES & INDICATORS								
	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	202
Usage Indicators								
Registered Marihuana Users	41,384	66,435	100,814	143,138	189,486	233,131	267,559	290
Licensed Marihuana Producers	51	51	51	51	61	61	61	6
Marihuana KG Consumed	26,734	41,681	61,462	84,809	109,458	132,216	150,204	162
Value of Consumption ($M)	$179	$284	$427	$604	$800	$989	$1,143	$1
Supply Value Per KG	$6,698	$6,808	$6,955	$7,128	$7,310	$7,478	$7,612	$7
Safety Indicators								
Residential Misuse	11,102	17,276	25,248	34,539	43,957	51,976	57,598	60
Fires	66	104	152	207	264	312	345	3
Fire-Injuries	3	5	7	9	12	14	15	
Fire-Deaths	0	0	0	1	1	1	1	
Security Indicators								
Home Invasions	43	66	97	133	169	200	221	2
Non-Fatal Shootings	4	7	10	14	18	21	24	2
Fatal Shootings	1	1	2	3	3	4	4	

TABLE 5.3 – CHANGE/POLICY IMPACT – PROGRAM OUTCOMES & INDICATOR								
	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	202
Usage Indicators								
Registered Marihuana Users	-16,415	-26,903	-40,647	-58,288	-78,283	-97,214	-111,384	119
Licensed Marihuana Producers	-38,481	-62,175	-94,257	-134,233	-178,451	-220,169	-252,568	273
Marihuana KG Consumed	-40,838	-66,160	-102,392	-148,939	-203,098	-256,643	-300,760	330
Value of Consumption ($M)	$23	$36	$54	$78	$98	$120	$142	$1
Supply Value Per KG	$4,387	$4,509	$4,678	$4,877	$5,063	$5,243	$5,391	$5
Safety Indicators								
Residential Misuse	-4,157	-7,365	-12,098	-18,638	-26,734	-35,236	-42,443	-47
Fires	-30	-54	-85	-133	-187	-245	-293	-3
Fire-Injuries	-2	-2	-3	-6	-8	-12	-14	-
Fire-Deaths	0	0	-1	0	0	0	0	
Security Indicators								
Home Invasions	-10	-20	-33	-53	-78	-105	-128	-1
Non-Fatal Shootings	-2	-2	-4	-6	-8	-11	-13	-
Fatal Shootings	0	-1	0	0	-2	-2	-3	

Authorized Users of Marihuana for Medical Purposes

The number of authorized users of marihuana for medical purposes decreases by about 30% over the period as a result of potential users: a) 'opting out' to undertake illegal residential marihuana cultivation; and b) being 'priced out' of the market through higher prices and the operation of the price elasticity of demand. This is shown in Figure 5.1.

Consumption of Marihuana from Legal Sources

The quantity of marihuana consumption from legal sources decreases by over 65% as a result of the reduction in the number of users and the quantity consumed per user. The latter effect results from the higher price, the operation of price elasticity of demand, and an affordability effect that spending on marihuana from legal sources does not exceed more than 15% of the mean annual income of users. This is shown in Figure 5.2.

Figures 5.1 & 5.2 – Program Usage Indicators

Figure 5.1 Legal Users

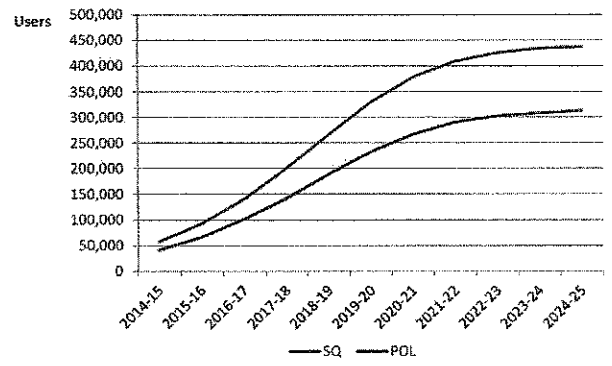
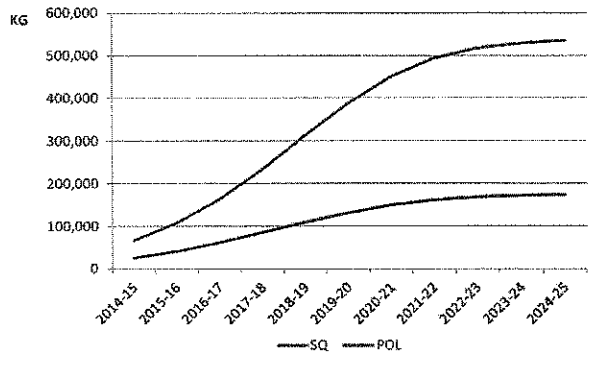


Figure 5.2 Legal Consumption KG



Source: Delsys Research

Value of Marihuana Consumed by Authorized Users

The value of marihuana consumed by authorized users increases by almost 15% as a result of the interplay between lower marihuana consumption and higher marihuana supply price. This value is the product of the quantity of authorized marihuana consumption (KG) times the supply price of the marihuana obtained from a legal source consumed. This is shown in Figure 5.3. The Policy change to create a regulated marihuana supply market comprised of Licensed Producers could, over time, grow to be a $1.3 Billion per year industry.

Price of Marihuana Produced by LPs

The average supply price for marihuana produced by licensed producers increases by about 250% over time as a result of the elimination of low-cost legal own-cultivation (and designated person production) and the transition to LP supply with security, quality control and other regulatory requirements. This is shown in Figure 5.4.

Figures 5.3 & 5.4 – Program Usage Indicators

Figure 5.3 Legal Value $M

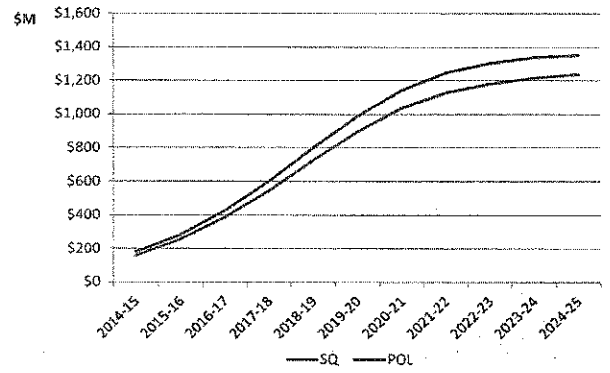
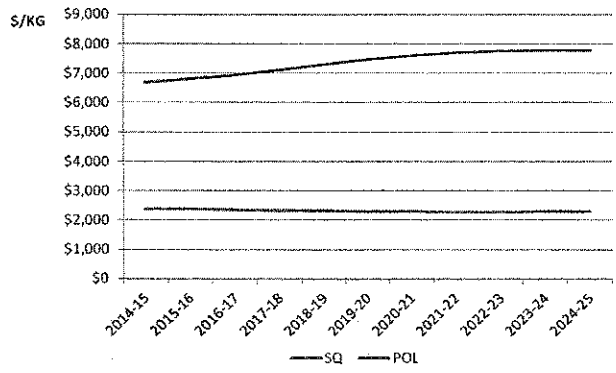


Figure 5.4 Supply Price $/KG



Source: Delsys Research

Safety Indicators

The number of cases of potential misuse in terms of residential marihuana cultivation for the purpose of supplying the illicit market decreases by 45% over the forecast period as a result of: a) more effective law enforcement activity through the elimination of MMAR production licenses by removing the need to obtain additional evidence (above that normally required to obtain reasonable and probable grounds to investigate potential misuse); and b) a deterrent effect as the probability of conviction increases.

The number of residential fires caused by faulty/misused electrical devices and systems that arise from indoor marihuana cultivation decreases by almost 50%. This is shown in Figure 5.5.

The number of fire-related injuries is reduced by a similar percentage – close to 50%. There is a cumulative reduction of 92 injuries over the forecast period. This is shown in Figure 5.6.

There are four (4) fire-related deaths averted over the forecast period as a result of the policy to eliminate legal residential marihuana cultivation.

Figures 5.5 & 5.6 – Safety Indicators

Figure 5.5 Fires Related to Misuse

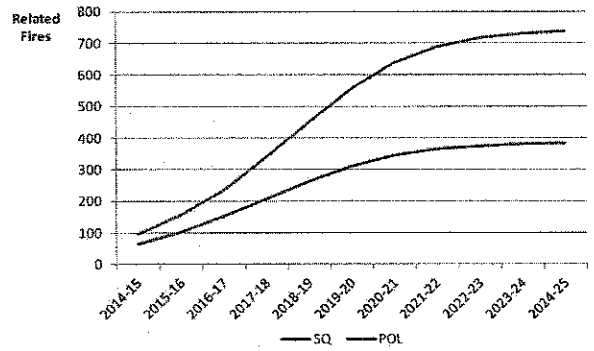
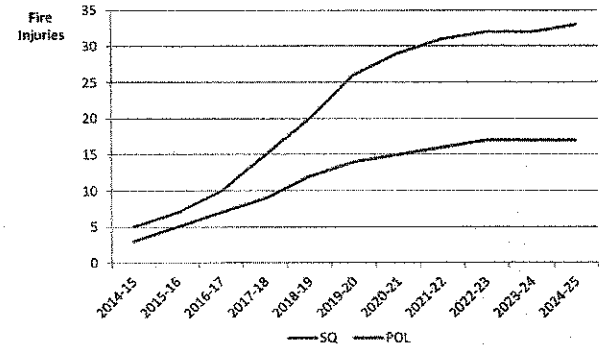


Figure 5.6 Fire-Related Injuries



Source: Delsys Research

Security Indicators

The number of potentially violent home invasions that arise because of misuse in terms of residential marihuana cultivation for the purpose of supplying the illicit market decreases by 40% over the forecast period as a result of: a) more effective law enforcement activity due to the increased clarity as a result of the elimination of MMAR production licenses; and b) a deterrent effect as the probability of conviction increases. This is shown in Figure 5.7.

The number of cases of home invasions with non-fatal shootings decreases by over 40%. There is a cumulative reduction of 94 non-fatal shootings over the forecast period. This is shown in Figure 5.8.

There is a cumulative reduction of 16 fatal shootings over the forecast period.

Figures 5.7 & 5.8 – Security Indicators

Figure 5.7 Home Invasion Related to Misuse

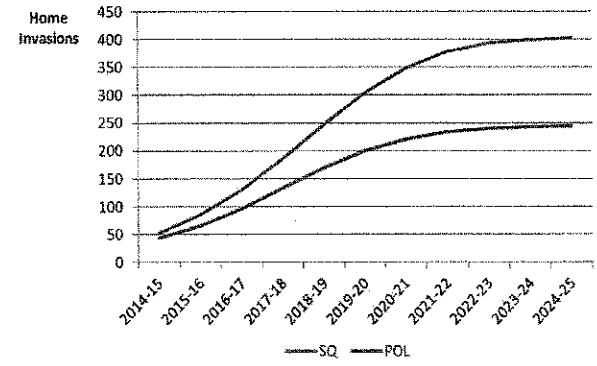
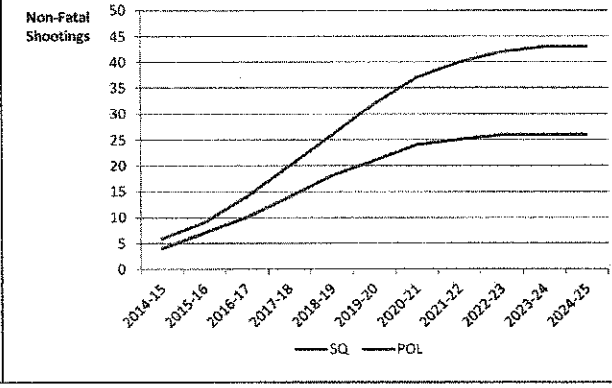


Figure 5.8 Non-Fatal Shootings



Source: Delsys Research

5.2 Monetized Cost & Benefits Measures

Tables 5.4 and 5.5 show the forecast results over the 10-year period (FY2014-15 to FY2023-24) for the Reference case for each of the Status Quo and Policy scenarios. These tables show forecast values for monetized Costs and Benefits including:

1. Consumer Surplus: a measure of user benefit;
2. Producer Surplus: a measure of supplier benefit;
3. Deadweight Loss: a measure of economic loss resulting from tax/subsidy distortions from the market equilibrium most efficient use of resources;
4. Program Administration Costs: Health Canada program administration costs to oversee the Marihuana Medical Access Program;
5. Safety Costs: a measure of the economic loss associated with fires resulting from residential marihuana cultivation;
6. Security Costs: a measure of the economic loss associated with home invasion and shootings resulting from the misuse of residential marihuana cultivation; and
7. Business Compliance Costs: a measure of the incremental costs that business must bear as a result of regulatory requirements that are beyond normal business practice[30].

For the purposes of these Tables, CBA costs are those variables with negative values (implying a social cost) and CBA benefits are those variables with positive values (implying a social benefit).

A discussion follows of the impact of the proposed Policy in terms of changes between the two cases. The change in outcomes is summarized in Table 5.6 as the difference between the Policy and Status Quo scenarios. These are the values that are discounted, using a Social Discount Rate of 8% in the Reference case, to produce the estimate of the Net Present Value (NPV).

[30] Business Compliance Costs are shown in the CBA as they form a part of the RIAS analysis. As Business Compliance Costs are already included in the cost of supply, these are not additional in terms of the CBA result.

TABLE 5.4 – STATUS QUO – MONETIZED CBA RESULTS

	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	
CBA - Costs (Negative)								
HC - Program Administration	-20,630,103	-30,008,114	-42,160,070	-56,881,976	-73,004,828	-88,422,448	-101,019,733	-1
Deadweight Loss	-1,971,263	-3,171,138	-4,526,278	-5,830,658	-7,820,031	-9,236,870	-9,893,372	-
Safety - Social Cost	-3,705,188	-6,081,774	-14,916,011	-18,886,520	-23,160,253	-27,257,771	-30,367,814	-
Security - Social Cost	-8,864,700	-17,047,400	-18,439,000	-27,375,400	-43,621,300	-52,605,500	-61,187,100	-
Sub-Total CBA Costs	-35,171,254	-56,308,426	-80,041,359	-108,974,554	-147,606,412	-177,522,589	-202,468,019	-2
CBA - Benefits (Positive)								
User - Consumer Surplus	278,021,823	443,096,890	672,631,011	959,070,572	1,281,745,711	1,594,297,577	1,848,899,513	2,
Producer Surplus	0	0	0	0	0	0	0	
Sub-Total CBA Benefits	278,021,823	443,096,890	672,631,011	959,070,572	1,281,745,711	1,594,297,577	1,848,899,513	2,
Other (Non-CBA) Costs								
Business Compliance	-2,354,664	-3,584,649	-4,927,424	-6,193,331	-8,095,245	-9,437,517	-10,057,428	-

TABLE 5.5 – POLICY – MONETIZED CBA RESULTS

	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	
CBA - Costs (Negative)								
HC - Program Administration	-1,924,268	-1,965,770	-2,007,272	-2,048,775	-2,340,055	-2,385,394	-2,430,733	-
Deadweight Loss	-464,119	-748,188	-1,152,209	-1,671,596	-2,271,736	-2,874,843	-3,385,975	-
Safety - Social Cost	-2,541,498	-4,008,412	-5,854,356	-13,765,621	-15,965,992	-17,811,936	-19,076,035	-
Security - Social Cost	-8,489,700	-9,243,400	-17,378,300	-25,700,700	-26,833,100	-34,968,000	-35,673,900	-
Sub-Total CBA Costs	-13,419,585	-15,965,771	-26,392,137	-43,186,691	-47,410,883	-58,040,173	-60,566,643	-
CBA - Benefits (Positive)								
User - Consumer Surplus	289,235,420	448,337,593	656,021,931	896,947,174	1,146,355,466	1,372,117,274	1,547,502,175	1,
Producer Surplus	2,644,475	6,428,038	13,976,839	26,612,531	44,329,865	64,679,652	83,476,731	
Sub-Total CBA Benefits	291,879,895	454,765,631	669,998,770	923,559,704	1,190,685,331	1,436,796,926	1,630,978,906	1,
Other (Non-CBA) Costs								
Business Compliance	-20,126,430	-21,907,819	-24,265,316	-27,047,930	-33,307,251	-36,019,576	-38,163,485	-

TABLE 5.6 – CHANGE/POLICY IMPACT – MONETIZED CBA RESULTS

	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	20
CBA - Costs (Negative)								
HC - Program Administration	18,705,835	28,042,344	40,152,798	54,833,201	70,664,773	86,037,054	98,589,000	107,
Deadweight Loss	1,507,145	2,422,949	3,374,069	4,159,063	5,548,296	6,362,027	6,507,397	6,4
Safety - Social Cost	1,163,690	2,073,362	9,061,655	5,120,899	7,194,261	9,445,835	11,291,779	18,2
Security - Social Cost	375,000	7,804,000	1,060,700	1,674,700	16,788,200	17,637,500	25,513,200	26,0
Sub-Total CBA Costs	21,751,670	40,342,656	53,649,222	65,787,863	100,195,529	119,482,416	141,901,375	158,
CBA - Benefits (Positive)								
User - Consumer Surplus	11,213,597	5,240,702	-16,609,079	-62,123,399	-135,390,245	-222,180,303	-301,397,337	-358,
Producer Surplus	2,644,475	6,428,038	13,976,839	26,612,531	44,329,865	64,679,652	83,476,731	97,3
Sub-Total CBA Benefits	13,858,072	11,668,741	-2,632,240	-35,510,868	-91,060,380	-157,500,652	-217,920,606	-261,
Total CBA Net Benefits	35,609,742	52,011,396	51,016,982	30,276,995	9,135,149	-38,018,236	-76,019,231	-102,
Other (Non-CBA) Costs								
Business Compliance	-17,771,766	-18,323,170	-19,337,892	-20,854,599	-25,212,005	-26,582,059	-28,106,057	-29,2

5.2.1 Consumer Surplus Measure of User Benefit

Consumer Surplus is a measure of user benefit over and above what is reflected in the user price paid for acquiring the good (i.e., marihuana for medical purposes produced by an authorized LP). It reflects the willingness-to-pay by users and is captured as the area under the Demand curve and above the price either paid by consumers or reflecting the supply cost of producing the good.

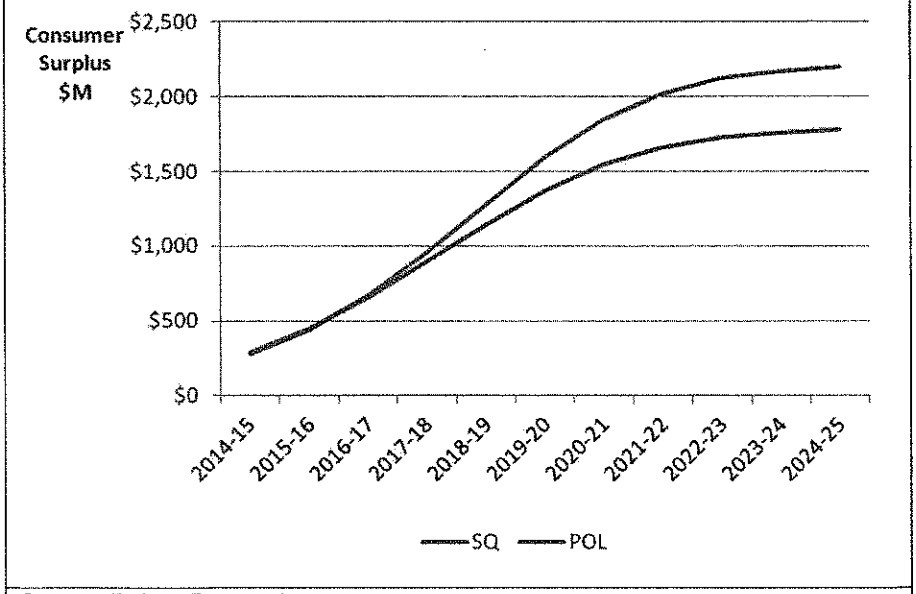
As is shown in Table 5.3 and Figures 5.1, 5.2 and 5.4, the Policy scenario projects a reduction in the number of individuals accessing marihuana under the MMAP, and KG consumed, and an increase in the user price of marihuana consumed. These changes indicate that there would be a loss of Consumer Surplus under the Policy scenario.

The valuation of Consumer Surplus depends on the Slope and Intercept of the Demand curve, which was inferred from a single assumption related to the Price Elasticity of Demand for a linear Demand curve. For the Status Quo scenario, separate measures were taken for each of the distinct 'supply markets' pertaining to Government Supply, Personal-Use supply and Designated-Person supply options. These were then summed to give an overall Consumer Surplus.

The Policy scenario has a single legal LP Market for supply and similar reasoning can be applied for the Price Elasticity of Demand and a linear Demand curve to estimate Consumer Surplus.

The Consumer Surplus decreases in the Policy scenario by almost 20% over the forecast period. This is shown in Figure 5.9. That Consumer Surplus decreases by about 20% when the marihuana KG consumed for medical purposes under the MMAP decreases by 65% requires some explanation.

Figure 5.9 Consumer Surplus – Measure of User Benefit



Source: Delsys Research

The estimation of Consumer Surplus is influenced by the willingness-to-pay valuation of consumers as reflected in the Demand curve and determined (in part) by the Demand Intercept, which captures the marginal willingness-to-pay for the first user in the market. With linear Demand and this study's estimation of the Demand Intercept based on the Price Elasticity of Demand, the Demand Intercept is much higher when the known (observed) transacted market price is higher.

The Policy scenario involves market transactions in the range of $7.60 to $8.80 per gram over time, reflecting the higher cost of marihuana from the LP market. The higher cost also reflects higher product quality in terms of multiple strains of cannabis and production quality control to limit contaminants and toxic substances and ensure a consistently high quality of product over time. In the Reference case, the Demand Intercept in the LP market is equivalent to $29.20 per gram.

The Status Quo scenario involves three separate supply markets, each with their own supply price. The Demand intercepts for these separate markets are: $25.00 per gram (Government Supply), $14.00 per gram (Designated Person) and $9.00 per gram (Personal Use).

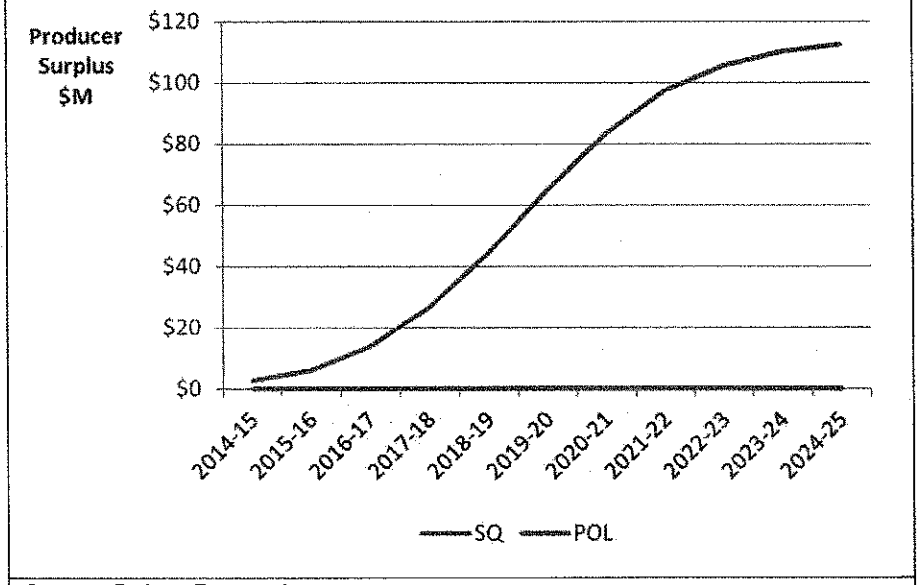
Therefore, the Consumer Surplus measure in the Policy scenario is much higher (for a given level of marihuana consumption) than in the Status Quo scenario. This is a direct result of the mathematical logic of the study's model and is generally reflective of higher product quality and costs associated with marihuana cultivation by LPs operating under rigorous quality control standards.

5.2.2 Producer Surplus Measure of Supplier Benefit

Producer Surplus is a measure of supplier benefit over and above what is reflected in the user price paid for acquiring the good (i.e. marihuana for medical purposes produced by an authorized LP). It reflects lower marginal cost for units below the equilibrium quantity. There was no Producer Surplus in the Status Quo scenario as the social valuation of the marihuana produced in the Government Supply was below the supply (and marginal cost) of production as a result of the effective subsidy to production. There also was no Producer Surplus in the Personal-Use or Designated-Person supply markets as these have perfectly elastic (i.e., flat) Supply curves.

There was Producer Surplus in the Policy scenario as the LP Supply curve is upward sloping. The value of Producer Surplus, however, was quite small in comparison with Consumer Surplus, as can be seen in Figure 5.10 (when compared to the scale in Figure 5.9). This result was attributable to the relatively inelastic (i.e., relatively flat) Supply curve in the Policy scenario.

Figure 5.10 Producer Surplus – Measure of Supplier Benefit



Source: Deloitte Research

Consumer and Producer Surplus are the two measures of social benefit in the CBA. The analysis of the Policy scenario involves a projected reduction in Consumer Surplus and an increase in Producer Surplus. However, because the former overshadows the latter, the overall result is a projected reduction in social benefit, which contributed negatively to the NPV overall result.

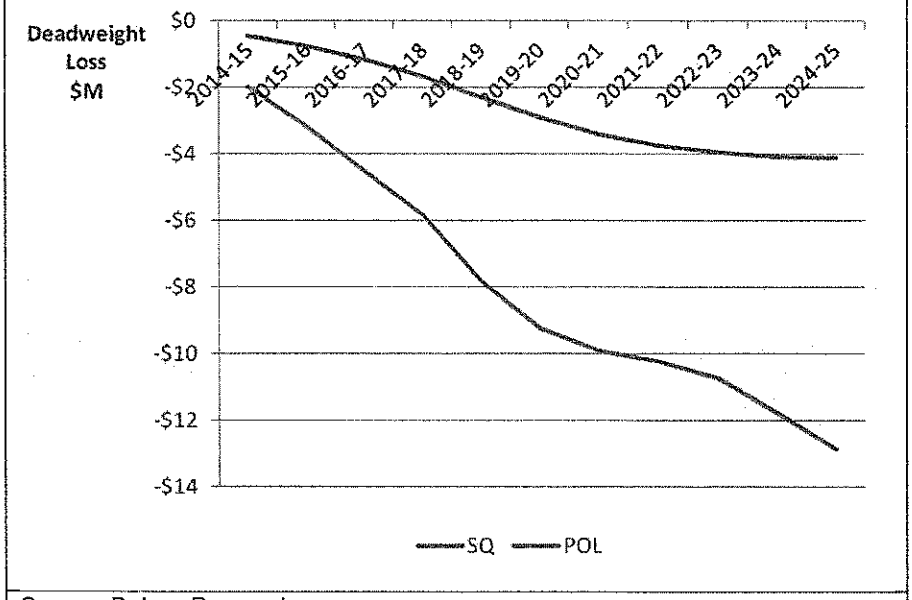
5.2.3 Deadweight Loss from Market Distortion (Tax/Subsidy)

Deadweight Loss arises in the Status Quo scenario from the effective subsidy to production that results in excess demand relative to the market equilibrium without such subsidy. The value of this loss is relatively small as the Government Supply component in the CBA model was comparatively small.

Deadweight Loss arises in the Policy scenario from the projected application of HST tax on marihuana which creates a 'tax wedge' between the price users would pay and the supply price that would be received by suppliers. The value of this loss is also relatively small.

The estimated Deadweight Loss in both cases, as shown in Figure 5.11, plays no significant role in the overall CBA results and findings. The analysis projects a small Deadweight Loss as a result of the Policy change. The loss is shown as a negative value compared to the benefit measures related to Consumer and Producer Surplus.

Figure 5.11 Deadweight Loss – Economic Cost of Tax/Subsidy



Source: Delsys Research

As the Policy scenario involves a lesser loss (i.e., smaller negative value), this outcome constitutes a reduction in social cost which contributes positively to the NPV overall result.

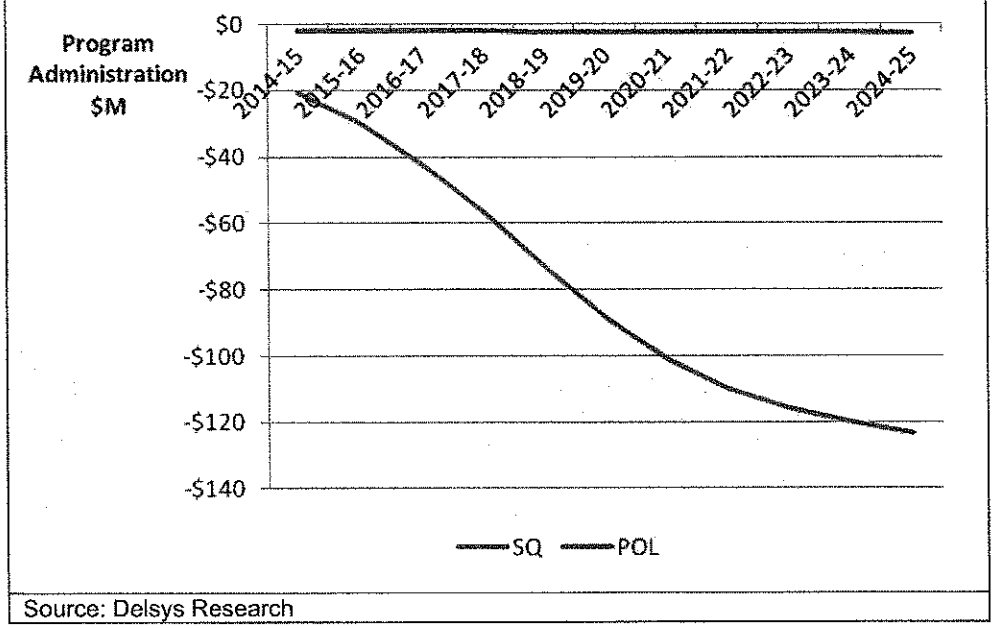
5.2.4 Health Canada - Program Administration Costs

In both the Status Quo and Policy scenarios, Health Canada is responsible for Program Administration in terms of employee salaries, benefits and accommodation as well as travel and supply (e.g., specialized equipment) costs associated with inspections and office work. These are costs and are represented as negative values in the analysis.

The 'contract value' associated with the Government Supply in the Policy scenario is not included in this section, as it forms part of the cost of supply that was taken into account in the estimation of Consumer and Producer Surplus measures.

As Health Canada will eliminate the role it plays in determining eligibility of persons to access the legal supply of marihuana for medical purposes, the Program Administration cost is lower in the Policy scenario than in the Status Quo scenario. This is shown in Figure 5.12.

Figure 5.12 HC Program Administrative Cost



Source: Delsys Research

The Policy scenario reduction of over 95% of Program Administration costs is a relatively modest source of savings (and benefits) in the context of the overall NPV result.

This graphic highlights an important point about the Status Quo scenario. The Status Quo scenario is modeled on the assumption that government resources required to administer the MMAP will continue to grow over time to fully accommodate the required program uptake in terms of numbers of persons wanting to access a legal source of marihuana for medical purposes. The Program Administration cost is projected to increase from $13.8M (FY2013-14) to over $120M (FY2023-24). In reality, the Government of Canada is, and will likely continue to be for some time, operating under a fiscal restraint. It is, therefore, highly unlikely that such additional resources would be available (over time) to fully accommodate the forecast increase in the MMAP participation in the status quo.

Consequently, achievement of the Status Quo scenario benefits, in terms of increasing Consumer Surplus, is at considerable risk of not being realized. Rather than impose a specific government resource constraint on the Status Quo, the analysis of the Status Quo scenario adopted an assumption of continued ATP growth and growing Health Canada program administration costs (and contract costs) – even though it is acknowledged that such growth might well not be realized in reality due to fiscal restraint.

This qualification to the achievement of the Status Quo results is very important when interpreting the overall NPV result. This analysis compares a Policy scenario – whose rationale is partially based on the requirement to reduce administrative costs – to a Status Quo scenario in which it is assumed that sufficient resources would be made available to scale program delivery capacity in response to service demands growing at an exponential rate up to some limit – even though there is substantial risk that this would not be realized in reality.

Figure 5.12 shows the large resource 'gap' (the difference between the Status Quo and Policy scenarios) which represents the Health Canada savings that would be required to respect overall departmental and Government of Canada fiscal restraint objectives.

The impact of a resource constraint was analyzed (Figure 4.5 above) using a System Dynamics simulation model. The simulation results indicated that the number of ATPs in a constrained Status Quo scenario might be only about 1/3rd of the unconstrained case (i.e. perhaps only 150,000 ATPs could be accommodated in the program over the forecast period in the constrained Reference case compared to the ceiling value of 450,000 in the unconstrained Reference case). The practical implication of a resource constraint is that there would be substantial backlogs and lengthy time delays for processing new applications and renewals of ATPs.

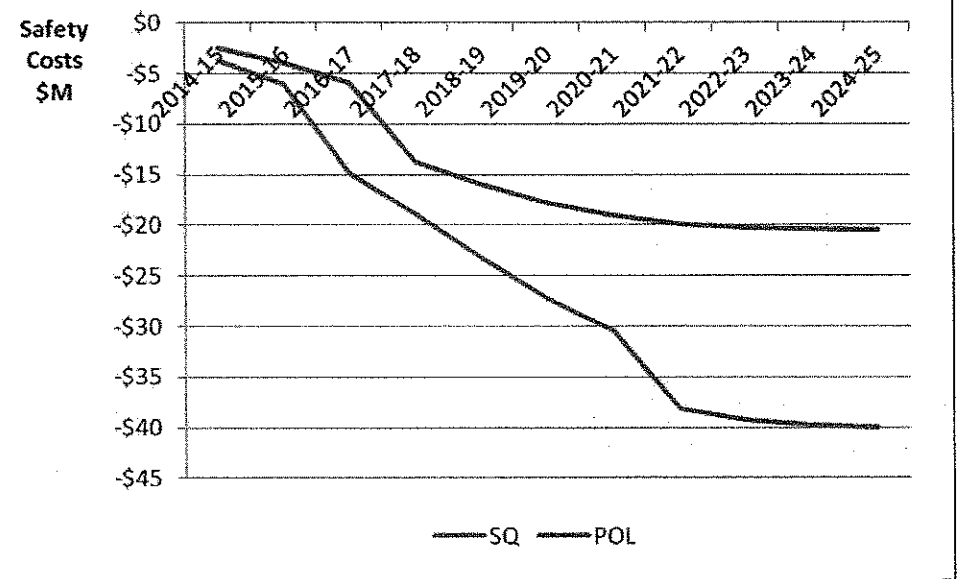
5.2.5 **Monetized Safety Costs**

Monetized Safety Costs relate to residential fire events and the estimated property damage and willingness to pay to avoid fire-related injuries and deaths. Canadian data for fires specific to electrical causes have been used to estimate fire risks and outcomes in terms of damage, injury and deaths. The property damage estimate (from insurance claims) provides a direct estimate for that cost. The values for willingness to pay to avoid injury and death has been were derived from other Canadian and international studies.

It is known (Table 5.11 and Figure 5.5) that the Policy scenario involves a reduction in the number of residential cases of misuse and fire events related to marihuana cultivation and residential misuse. It would therefore be expected that the Safety Costs would decrease in the Policy scenario. As costs are treated in the CBA analysis as negative values, the reduction in negative values is a positive benefit.

The Policy scenario involves a decrease in Safety Costs of almost 50% over the forecast period. This is shown in Figure 5.13. The scale of the Safety Costs is small in relation to the Consumer Surplus change so these represent a modest source of savings (and benefits).

Figure 5.13 Safety Costs



Source: Delsys Research

The step-function nature of the curves in the above figure is a result of the large monetary value attributable to fire deaths which change in a discontinuous manner as the number of fire deaths is restricted to integer values.

The reduction of adverse safety and security outcomes is, perhaps, the most important aspect of the Health Canada proposed changes to the regulatory regime. Figure 5.13 (safety) and Figure 5.14 (security) demonstrate that the model of behavioural response and valuation of outcomes resulting from the Policy change achieve a substantial reduction in the social costs arising from adverse public safety and public security outcomes.

5.2.6 **Monetized Security Costs**

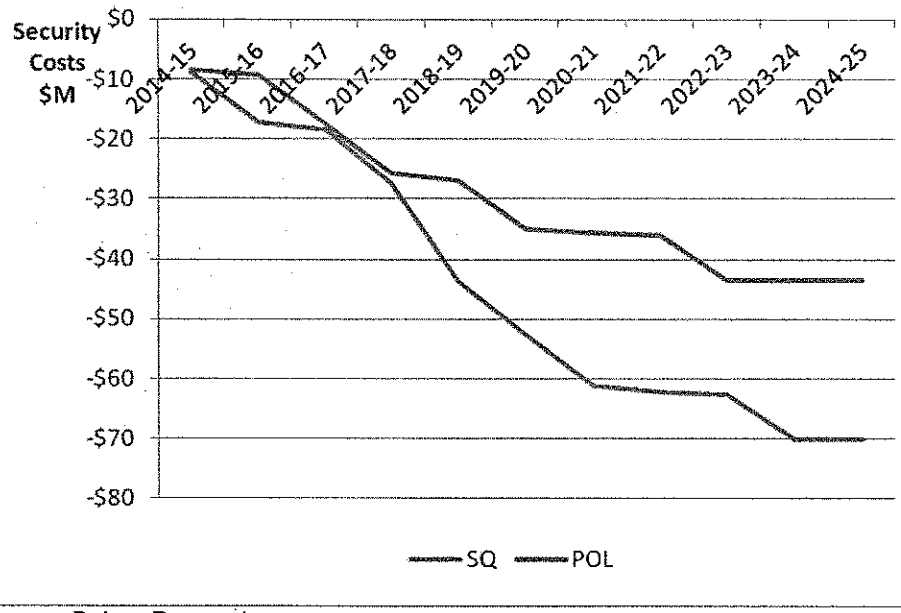
Monetized Security Costs relate to violent home invasions and shootings (non-fatal and fatal) that arise from criminal attempts to seize the asset value associated with marihuana cultivation and misuse. Law enforcement authorities refer to such crime, directed at 'grow-op' type operations, as 'grow-rip' robberies. The presence of handguns by perpetrators of home invasions, as well as possibly handgun possession by persons engaged in marihuana cultivation misuse, can (and have, in the past) led to shootings.

Canadian data on home invasions and shooting related to marihuana cultivation under the MMAR are available and have been used to estimate security risks and outcomes in terms of home invasions, shootings and deaths. Willingness to pay to avoid home invasion, non-fatal shooting and fatal shootings have been adapted from US and UK social-cost data specific to comparable types of crime.

It is known (Table 5.11 and Figure 5.7) that the Policy scenario involves a reduction in the number of residential cases of misuse. Security Costs are therefore expected to decrease in the Policy scenario. As costs are treated in the CBA as negative values, the reduction in negative values is a positive benefit.

The Policy scenario involves a decrease in Security Costs by roughly 40% over the forecast period. This is shown in Figure 5.14. The scale of the Security Costs is small in relation to the Consumer Surplus change, so these represent a modest source of savings (and benefits).

Figure 5.14 Security Costs



Source: Delsys Research

Security Costs are estimated to be about twice the scale of Safety Costs and contribute proportionally the same to the NPV benefit gain of the Policy scenario over time.

The Deadweight Loss, Program Administration Costs, Safety Costs and Security Costs are the four measures of social cost in the CBA. As the Policy scenario involves a reduction in all these costs the overall result is a reduction in social cost, which contributes positively to the NPV overall result.

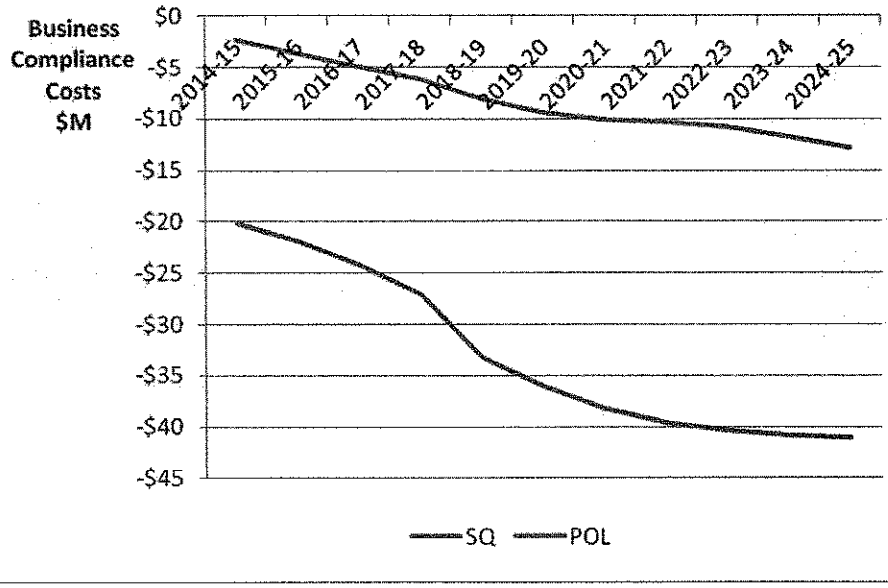
5.2.7 Business Compliance Costs

Business Compliance Costs are estimated in both the Status Quo and Policy scenarios. The assumption used in the Status Quo scenario is that a fixed share of overall Supply Cost (10%) is comprised of Business Compliance Costs. This is a fairly high value as a result of the nature of the contractual relationship between Health Canada and the contracted Government Supplier. It is generally perceived by Health Canada that the regulatory burden faced by LPs in the Policy scenario will be considerably less per unit of production (i.e., reduced red tape per supplier).

However, Government Supply represents a small share (about 10% in terms of people, about 3% in terms of KG consumed) of marihuana supply in the Status Quo scenario, whereas Licensed Producers will account for all (100%) of the marihuana supply in the Policy scenario. Therefore, while the regulatory compliance burden per unit of activity will be substantially less, it will apply to a much larger volume of activity. Business Compliance Costs are anticipated to fall from 10% of revenue in the Status Quo scenario to about 3% of revenue in the Policy scenario (by FY2020-21).

The overall result, as shown in Figure 5.15, is that the Business Compliance Costs will be about two to three times greater in the Policy scenario.

Figure 5.15 Business Compliance Costs



Source: Delsys Research

As Business Compliance Costs are incorporated in the Supply Cost for both the Status Quo and Policy scenarios, they do not form part of the CBA result and are used, instead, in the RIAS and other TBS regulatory assessment processes[31].

The Business Compliance Costs mostly fall on Medium and Large Business (as opposed to Small Business) as the scale of LP activity (in terms of employees and sales revenue) is expected to grow beyond that of a Small Business after two years.

[31] TBS 'One for One' and 'Small Business Lens' requirements.

5.3 Net Present Value

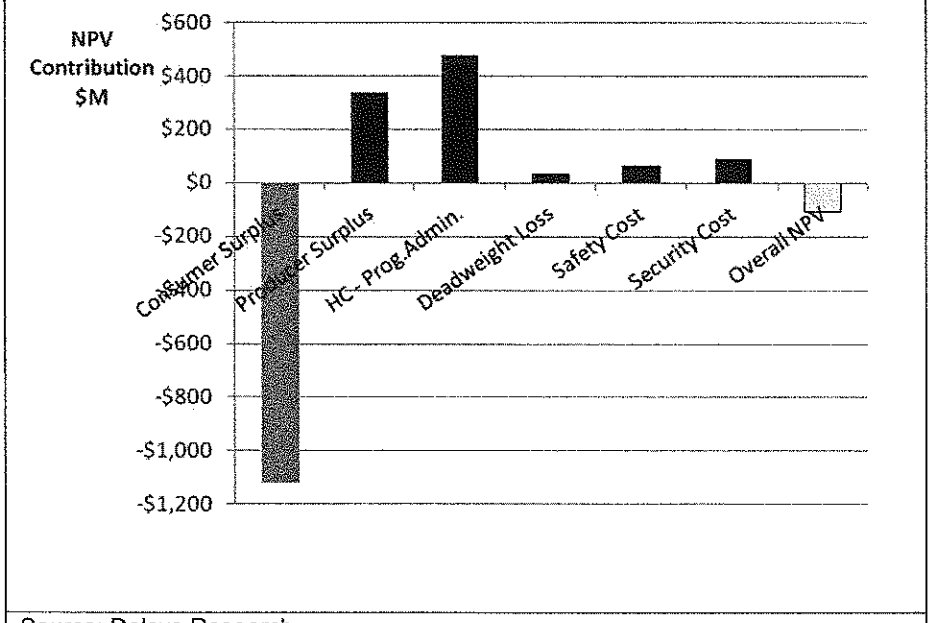
The main focus of the CBA results is on the Reference case (i.e., most likely) estimate of the Net Present Value. This sums the various cost and benefit measure differences between the Policy and Status Quo scenarios, over time, after discounting by a social discount rate that values future year results as less valuable than more current year results. The purpose of social discounting is to reflect the social opportunity cost of resources which are values higher the closer they are in time to the present period.

5.3.1 Reference Case

The Reference case NPV is -$109.72 Million, with an annualized NPV of -$16.35 Million. This result is shown in Table 1 of the CBA Accounting Statement (as per TBS guidelines).

As discussed in the previous section, the bulk of the NPV result arises from the loss of Consumer Surplus resulting from reduced consumption and a higher supply price for persons consuming marihuana for medical purposes under the MMAP. Figure 5.16 shows the contribution to the overall NPV result from each of the CBA cost and benefit components. In terms of the offsetting positive contributions the largest contributors are the reduction in Health Canada Program Administration costs and the Producer Surplus. While the contribution to the NPV result from reduced safety and security costs is small in comparison to the overall NPV result, these are still large in absolute value.

Figure 5.16 Composition of Reference Scenario NPV
By Benefit-Cost Component



Source: Delsys Research

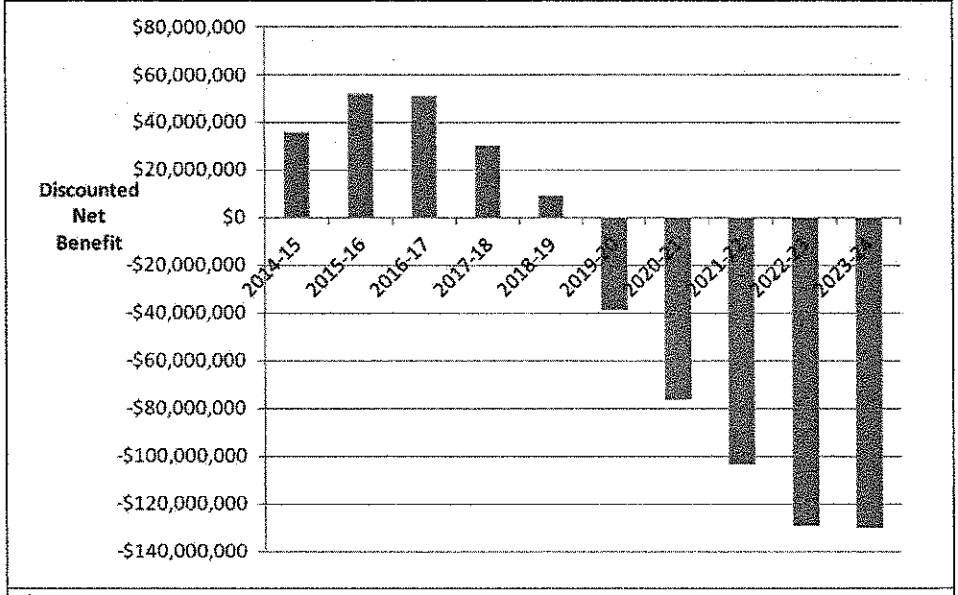
The relative magnitude of the net benefit contributions to the overall NPV result can also be seen, in undiscounted flows by year, in Table 5.6.

5.3.2 Time Profile of Discounted Net Benefits

The Reference case NPV of -$109.72 Million results from the sum of a discounted stream of net benefits (i.e., benefits less costs) for each year. This is shown in Figure 5.17.

The net benefits start off positive for the first five years (i.e., discounted benefits exceed discounted costs), then turn sharply negative for the remaining five years of the time horizon. The sum of positive discounted net benefits for the first five years (+$158 Million) is more than offset by the sum of negative discounted net benefits for the last five years (-$268 Million), which generates the negative NPV result in the Reference case.

Figure 5.17 Time Profile of Contribution to NPV Result



Source: Delsys Research

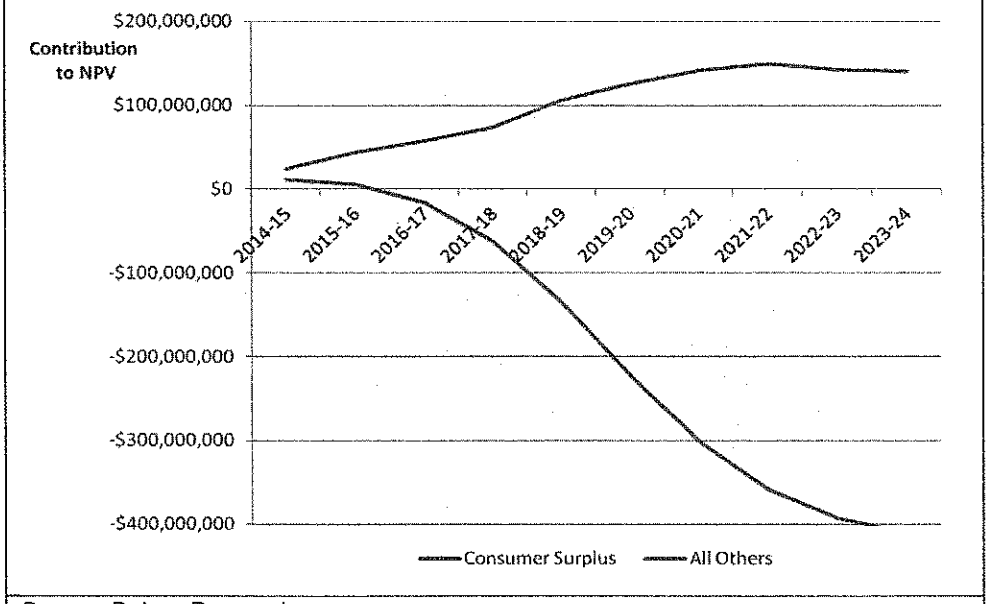
In the first five years, with positive discounted net benefits, there are a number of circumstances that produce greater benefits (with positive discounted net benefit) than costs (with negative discounted net benefit):

a) The change in Consumer Surplus (Policy scenario minus Status Quo scenario) starts off as positive and becomes negative by year 3 – up until that point, all components of NPV are positive; and

b) With the Consumer Surplus contribution negative in year 3, it is not sufficiently negative for another three years (until year 6), at which time the negative value for the change in Consumer Surplus fully offsets the other positive components of NPV.

This can be seen in Figure 5.18, which shows the time paths for Consumer Surplus (in red) and for the sum of 'Other' components (in blue). Consumer Surplus grows more rapidly (i.e., negatively) than the Other components grow (positively). It is between the fifth and sixth years that the vertical distance between the blue line and the x-axis is the same as the vertical distance between the red line and the x-axis. This is where the contribution to NPV becomes zero and the negative contribution to NPV from Consumer Surplus is exactly offset by the positive contribution to NPV from Other components.

Figure 5.18 Time Profile of Consumer Surplus and Other Components: Contribution to NPV Result



Source: Delsys Research

Rationale for Positive Initial Consumer Surplus Contribution

This study now turns to the rationale for the change in Consumer Surplus starting off positive for the first two years of the time horizon. The change in Consumer Surplus is broken down as a function of: a) lower KG-Demand moving towards the higher priced Policy scenario; and b) a higher valuation of Consumer Surplus in the higher priced Policy scenario (as seen in Figure 5.19):

A. Less KG-Demand: If this is valued at the Consumer Surplus value (per KG) in the Status Quo scenario, the impact of reducing KG-Demand in the Policy scenario is negative (in terms of contribution to NPV) – as seen in the blue data points – and its slope, in terms of KG-Demand, is -$2,668/KG; and

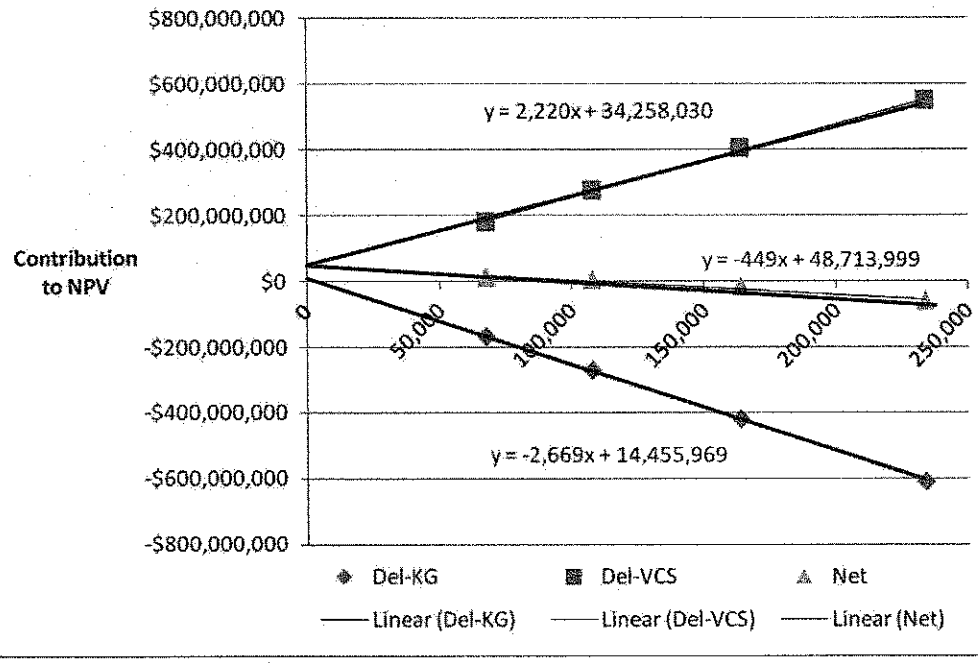
B. Greater CS-Value per KG: In the Policy scenario, each KG-Demand adds to Consumer Surplus at a higher value (per KG) – roughly $10,500/KG – than each KG-Demand in the Status Quo scenario – roughly $4,100/KG. This is a consequence of the higher exchange value (i.e., price) and the higher price intercept for the Demand curve. When this contribution is valued at the KG-Demand in the Policy scenario, its contribution is positive (in terms of NPV) – as seen in the red data points – and its slope, in terms of KG-Demand, is $2,220/KG.

As the combined effect (i.e., slope) is the sum of these separate effects (i.e., slopes), the overall slope of the relationship (i.e., the marginal effect on Consumer Surplus per KG-Demand) is negative ($2,220 + - $2,668 = -$449).

However, the intercept of the net relationship is positive ($34.3 Million + $14.5 Million = $48.7 Million). Therefore, the overall contribution of Consumer Surplus is positive up to the value of

KG-Demand = 109,000KG (where this is KG-Demand under the Status Quo scenario) – which is not reached until year 3.

Figure 5.19 Consumer Surplus Contribution to NPV
as a Function of KG-Demand (Status Quo) showing
a) Impact of Lower KG-Demand;
b) Impact of Higher Consumer Surplus Value per KG; and
c) Net (combined) Impact



Source: Delsys Research

5.3.3 Discussion of Results

This CBA has undertaken a careful, informed approach to the monetization of some of the major (but by no means exhaustive) anticipated outcomes of the proposed regulatory change for access to marihuana for medical purposes. This has attempted to capture meaningful and realistic behavioural reactions to the removal of licensed marihuana cultivation by individuals for their personal or designated-person use. This study thus documents a likely reduction in the number of adverse safety (i.e. fires) and security (e.g. misuse and home invasion) incidents that can be monetized in terms of social and security costs to society.

The CBA documents significant reductions in Health Canada Program Administration costs that are likely to arise as Health Canada ceases to be the principal medium of individual access to a legal supply of marihuana for medical purposes and focuses its regulatory effort on licensing and inspection of the commercial (legal) producers. These savings are significant, as the scale of the MMAP is expected to expand by about 750% in the ten year forecast period (for ATP persons in the Status Quo).

The impact on individuals authorized to access marihuana under the MMAR on the elimination of legal personal-production and designated-person production and its replacement by commercial supply will make the legal supply price higher, although this analysis does not

presently observe the transacted market price for Designated Person supply and only the supply price for Personal Use supply can be estimated. Also, only the likely LP Market price can be forecast. However, the Reference case, reflecting the best information and data available, indicates a relatively large supply price increase in the Policy scenario.

There is some possibility that the LP Market price could be lower than what is estimated in this analysis. This will only become known once the market is established in FY2014-15. Competitive market pressure between LP suppliers and greater production efficiencies, if supported by the Regulatory regime, may drive the supply price in the Policy scenario lower than this study's Reference case.

The impact of higher LP market price is a reduction in the KG consumed in the market. The effect of the elimination of legal own-production is not expected to result in the cessation of that activity but its curtailment, as a result of a higher expected probability of police action, arrest and conviction.

The reduction in the KG consumed in the market is reflected in the reduction in the Consumer Surplus measure that tends to dominate the overall NPV result. While the sensitivity analysis (in the next section of this report) demonstrates that there are realistic parameter estimates that generate a positive NPV, this analysis suggests that the Reference case result with a negative NPV is the single most likely CBA result.

The TBS Guidelines for Cost-Benefit Analysis direct the results to be summarized (primarily) in terms of the Reference case. This report presents them as such. These Guidelines also require a sensitivity analysis of the CBA results to investigate the range of NPV results that can arise from alternative, realistic parameter values. This is undertaken below. It is important to highlight that the results show considerable variability and that the Reference case finding of a negative NPV is not, in fact, statistically significantly different from zero in light of the standard deviation of the resulting NPV distribution[32].

[32] The mean and standard deviation of the NPV distribution, based on 10,000 Monte Carlo trials, are: μ (mean) = $-1,476M; σ (standard deviation) = $2,799M. As a rule of thumb, there is a 95% probability that this study's estimate of the mean lies within a bound of +/- (2*Std Dev) of the 'true' mean. As that range includes the value zero and this study's Reference case estimate of -$728M this analysis can not say that a Null Hypothesis that this study's estimate is equal to zero can be rejected (at the 95% confidence interval).

CBA Accounting Statement (Table 1)

PART 1: Deterministic Case — NPV Results & Sensitivity Analysis

Category of Impact	NPV	Annualized NPV	Year 1	Year 2	Year 3	Year 4	Year 10
1. Monetized							
Benefits			13,858,072	11,668,741	-2,632,240	-35,510,868	-300,334,092
Costs			21,751,670	40,342,656	53,649,222	65,787,863	170,944,178
Net Benefits (All)	-109,723,604	-16,352,053	35,609,742	52,011,396	51,016,982	30,276,995	-129,389,915
Net Benefits (Exc. Users)	1,004,940,153	149,765,717					
2. Quantified / Non-Monetized							
Benefits							
Reduction-Legal Users			-16,415	-26,903	-40,647	-58,288	-124,933
Reduction- Legal KG-Consumed			-40,838	-66,160	-102,392	-148,939	-357,221
Costs							
Reduction-Misuse (Residential)			-4,157	-7,365	-12,098	-18,638	-51,225
Reduction-Residential Fires			-30	-54	-85	-133	-350
Reduction-Fire-Injuries			-2	-2	-3	-6	-15
Reduction-Fire-Deaths			0	0	-1	0	-1
Reduction-Home Invasions			-10	-20	-33	-53	-157
Reduction-Non-Fatal Shootings			-2	-2	-4	-6	-17
Reduction-Fatal Shootings			0	-1	0	0	-3
3. Unquantified							
Benefits	There are additional benefits in terms of reduced health risks to family members as a result of mould/chemical exposure resulting from residential marihuana cultivation in the home. There are also other general benefits from removing marihuana cultivation from homes, e.g., reduced fear, reduced policing costs, higher property values, and reduced environmental impacts from chemical waste).						
B. Cost-Effectiveness Analysis	Not Applicable						

PART 2: Risk/Uncertainty

Category of Impact	Values of Risk Variables (Low-High Range)			Type of Probability Distribution (Distribution Parameters)	
1. Key Risk Parameters	Lo	Mean	Hi	Type of Distribution	Parameters
Designated Person - Supply Cost	$1.40	$2.80	$5.00	Uniform	Minimum - Maximum
Max % of Mean Annual Income	10%	15%	20%	Uniform	Minimum - Maximum
Price Elasticity of Demand	-0.50	-0.25	-0.10	Triangular	Minimum - Likeliest - Maximum
Personal Use - Supply Cost	$1.00	$1.80	$2.50	Uniform	Minimum – Maximum
Utilization Rate - Personal Use	40%	55%	65%	Uniform	Minimum - Maximum
Utilization Rate - Designated Person	35%	47%	55%	Uniform	Minimum - Maximum

2. Monte Carlo Simulation	Project Outcome Values (NPV)	
	Mean Value	-1,687,872,721
	Median Value	-1,342,604,699
Sensitivity Analysis Results	Standard Deviation	2,855,961,358
	Low	-26,289,518,277
	High	10,010,797,264

Source: Delsys Research – as per TBS (2007) p.42

5.3.4 Stakeholder Analysis

The reference scenario NPV of -$109.72 Million can be broken down by results attributable to different stakeholders. This is summarized in Table 2 of the CBA Accounting Summary (as per TBS guidelines) and shown in Figure 5.20.

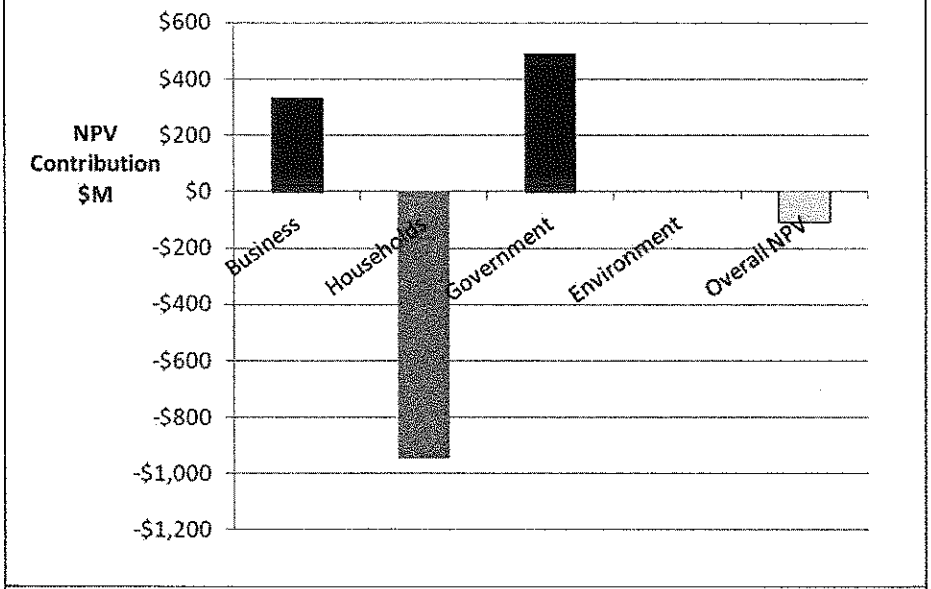
a) By Type of Stakeholder

Government (Federal Government) is the main beneficiary of benefits resulting from the Policy scenario through the reduction in Health Canada's Program Administration Costs.

Households, especially MMAP users, are the main stakeholder group impacted in terms of reduced Consumer Surplus benefits.

Businesses, especially Medium-Sized Businesses, are also a main beneficiary of the Policy scenario in terms of Producer Surplus benefits. It is important to note that Producer Surplus is not related to profitability and should not be taken as an indicator of such.

Figure 5.20 Composition of Reference Scenario NPV
By Stakeholder Type



Source: Delsys Research

CBA Accounting Statement (Table 2)

Stakeholder Impacts

Category of Impact	NPV	Annualized NPV	Year 1	Year 2	Year 3	Year 4	Year 10
Cumulative Net Impact	-109,723,604	-16,352,053	35,609,742	52,011,396	51,016,982	30,276,995	-129,389,915
1. Impact on Business							
Small Firms	7,622,719	1,136,010	2,368,944	5,674,077	0	0	0
Medium Firms	293,793,341	43,783,871	275,531	753,961	13,976,839	23,491,078	98,517,365
Large Firms	34,377,298	5,123,231	0	0	0	3,121,453	11,517,494
2. Impact on Households							
Participants in MMAP	-1,000,602,469	-149,119,274	12,002,322	13,110,613	-8,565,862	-58,585,004	-375,552,827
Non-Participants in MMAP	58,312,807	8,690,328	2,075,690	3,446,330	4,984,947	6,679,612	14,335,706
3. Impact on Government							
Federal Government	481,637,405	71,778,176	18,749,528	28,286,699	40,267,369	55,012,377	118,558,853
Other Government	11,081,795	1,651,514	137,728	739,715	353,689	557,479	3,233,494
4. Impact on Environment							
Not Relevant in Context	NA	NA	NA	NA	NA	NA	NA
5. Impact by Region							
Atlantic	-93,371,867	-13,915,162	2,222,267	3,051,185	970,316	-4,364,215	-38,001,962
Quebec	11,183,903	1,666,731	1,008,401	1,716,715	1,962,993	1,796,741	1,193,257
Ontario	199,063,164	29,666,281	24,567,758	35,888,291	41,784,033	41,018,600	6,015,633
Prairies / Territories	35,464,319	5,285,229	2,208,915	3,828,505	4,611,755	4,709,199	6,389,183
British Columbia	-260,950,029	-38,889,249	5,585,289	7,505,651	1,691,620	-12,821,928	-104,557,718

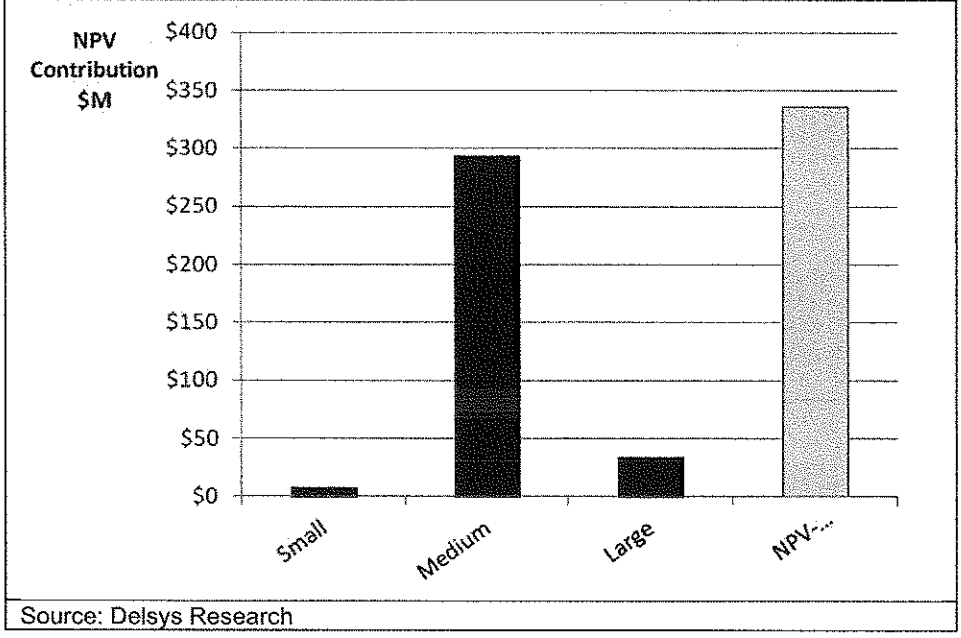
Source: Delsys Research – as per TBS (2007) p.43

b) By Size of Business

The Federal Government's regulatory streamlining initiatives place considerable focus on the elimination of business compliance costs and administrative burden on business, especially on Small Business[33].

The distinction between results in terms of size of business requires careful interpretation. Basically, all new LP entrants start as Small Businesses and grow to become Medium Businesses during the forecast period. Therefore, there is no real result specific to Small Business, as this is a transitory impact in the first two years, which is then overwhelmed by gains achieved – by the same businesses – over the balance of the forecast period as Medium-sized Businesses. This is shown in Figure 5.21.

Figure 5.21 Composition of Reference Scenario NPV By Size of Business



Source: Delsys Research

[33] Small Business is defined as less than 100 employees and/or less than $5M in Sales Revenue. In the CBA model for this regulatory proposal, New Entrant LPs are all Small Businesses during the initial two years of their operation and grow to become Medium businesses after two years.

c) By Household Type

The CBA considered two types of households: a) those associated with a family member who accessed marihuana for medical purposes or with a family member who is a Designated Producer; and b) members of the general public. These are shown in Figure 5.22.

i. Households – Family Member Participating in the MMAP

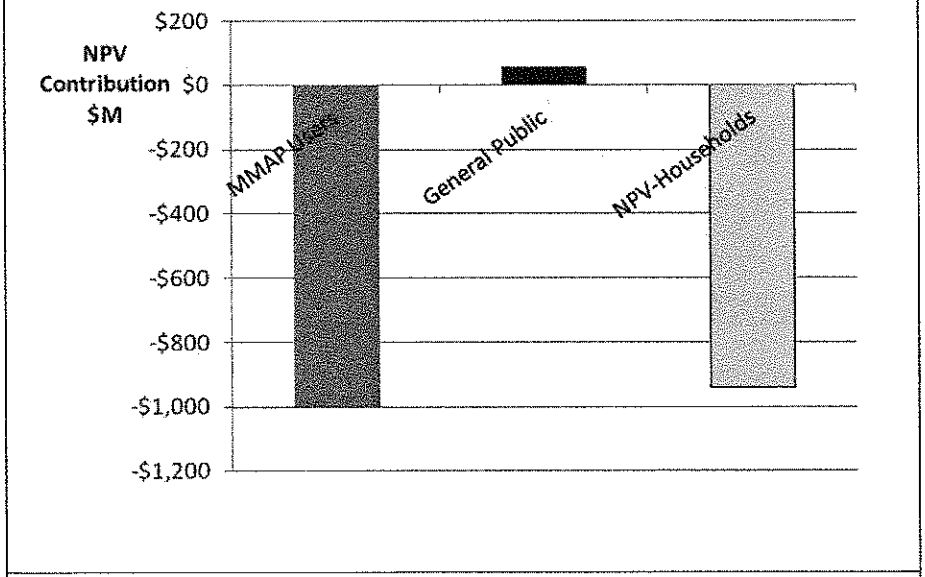
These households experience the loss of Consumer Surplus associated with more expensive marihuana and less quantity of marihuana consumed, the non-insured portion of fire property damage and the consequences of fire death and fire injury not attributed to firefighters, as well as the majority of home invasion consequences that are not attributed to the criminal justice system. Of these impacts, the monetary value associated with Consumer Surplus is the largest.

ii. Households – General Public

The General Public bears the Deadweight Loss associated with the market distortion arising from the effective subsidy or tax impact on regulated commercial marihuana supply, as well as the insured component of the property damage associated with fire events attributable to misuse of residential marihuana cultivation related to the MMAP.

It should be noted that, ultimately, the impacts on Governments (Federal and other) are also borne by these households as taxpayers. This value is not included, as Government is a separate Stakeholder in the analysis.

Figure 5.22 Composition of Reference Scenario NPV
By Household Type



Source: Delsys Research

If we attribute the Government NPV benefit to the General Public i.e., as taxpayers, the bar in Figure 5.22 for the general public NPV would be almost $500M higher.

d) By Level of Government

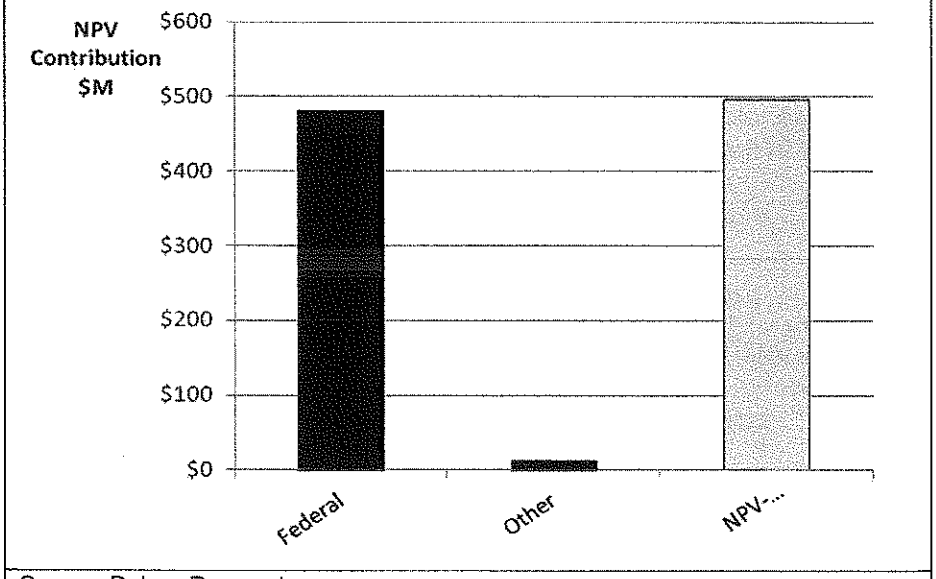
The Federal Government receives benefits from: a) the reduction in Health Canada – Program Administration Costs and b) a share of the costs of the criminal justice system as it pertains to Security social costs that are not borne by victims of Home Invasion crime.

Other Government receives benefits from: a) fire injuries sustained by firefighters associated with misuse of residential marihuana cultivation and b) a share of the costs of the criminal justice system as it pertains to security social costs that are not borne by victims of home invasion crime.

The bulk of Government benefits are related to the reduction in Program Administration cost and accrue to the Federal Government. This is shown in Figure 5.23.

It should be noted that, ultimately, the impacts on Governments (Federal and other) are also borne by the general public as taxpayers.

Figure 5.23 Composition of Reference Scenario NPV
By Level of Government



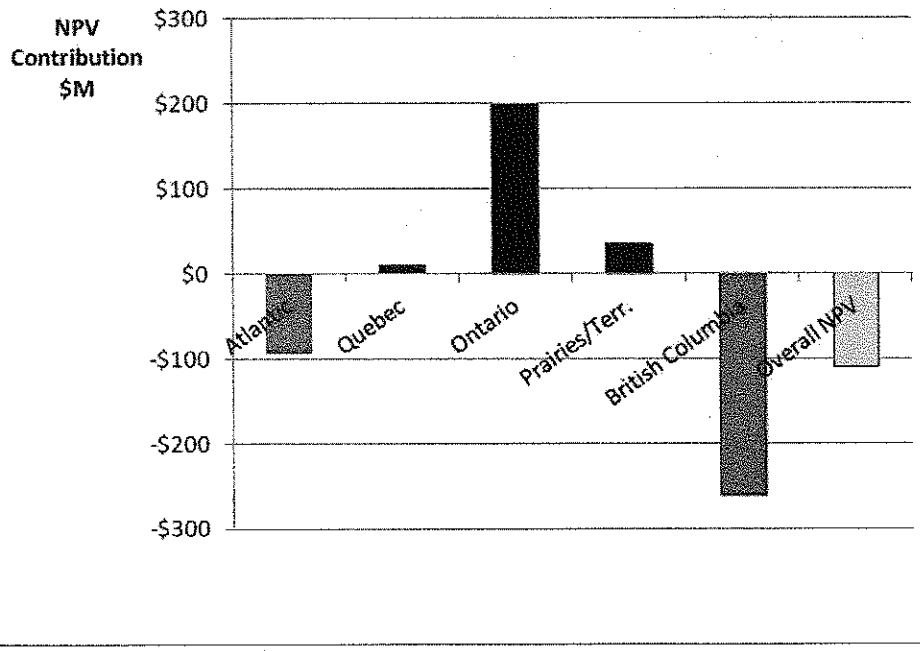
Source: Delsys Research

e) By Geographic Region

The CBA costs and benefits were allocated by geographic region of Canada according to known distributions of MMAP participation (which determines the bulk of the allocation) and an assumption about the expected locus of LP market production.

The large negative NPV attributable to British Columbia and the Atlantic[34] region result from their disproportionate share of MMAP participation in terms of persons authorized to possess marihuana for medical purposes. This is shown in Figure 5.24.

Figure 5.24 Composition of Reference Scenario NPV
By Geographic Region



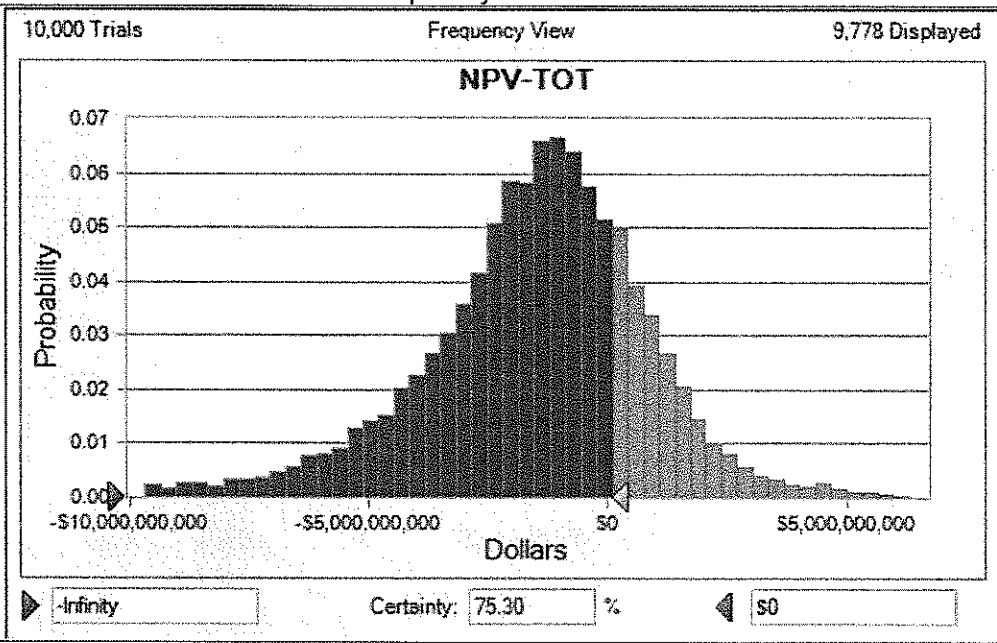
Source: Delsys Research

[34] The Atlantic region concentration of MMAP participation is largely driven by the high MMAP participation rates in Nova Scotia.

5.4 Sensitivity Analysis

The Monte Carlo simulation results, given the various assumptions and parameter distributions assumed in this model, are shown in Figure 5.25 and Table 5.7.

Figure 5.25 – NPV Result Distribution
Frequency Distribution



Source: Delsys Research

When the NPV distribution of results from the 10,000 Monte Carlo trials are examined, it is evident that the NPV central tendency is about -$1.690 Billion with a range from -$26 Billion to +11 Billion. About one quarter of all sensitivity trials resulted in a positive NPV.

Table 5.7 – NPV Result Distribution
Summary Statistics

Forecast: NPV-TOT		Forecast: NPV-TOT	
Statistic	Forecast values	Percentile	Forecast values
Trials	10,000	0%	-$26,289,518,277
Mean	-$1,687,872,721	10%	-$4,860,448,101
Median	-$1,342,604,699	20%	-$3,346,114,210
Mode	'---	30%	-$2,481,262,361
Standard Deviation	$2,855,961,358	40%	-$1,880,177,393
Variance	8.157E+18	50%	-$1,342,809,145
Skewness	-1.4200	60%	-$859,519,865
Kurtosis	9.02	70%	-$329,264,841
Coeff. of Variability	-1.69	80%	$310,124,093
Minimum	-$26,289,518,277	90%	$1,160,314,066
Maximum	$10,010,797,264	100%	$10,010,797,264
MSE	$28,559,614		

Source: Delsys Research

Investigation of the trials for which there is a positive NPV showed that such trials were more likely to be associated with:

- lower Status Quo scenario supply prices (combined across the three supply markets), primarily lower Designated-Person supply price and Personal-Use supply price;

- relatively higher consumption in the Policy scenario as a result of more Grams Per Year and a lower proportion of cases (21% of trials with positive NPV) for which the affordability constraint was operative (compared to 61% of trials with negative NPV) and/or higher maximum percentage of mean annual income comprising that affordability constraint; and

- more inelastic demand in the Policy scenario (although more elastic than the Status Quo) which results in a higher Demand intercept and slope[35].

The first of these reduces the Consumer Surplus measure in the Status Quo scenario. The second and third increase the Consumer Surplus measure in the Policy scenario. In all of these cases, there is considerable variability in the range of parameters that can generate a positive NPV result. This study looked at the mean value of various parameters for trials for which the NPV result is positive and compared this to means values for trials for which the NPV result is negative.

5.4.1 **Key Parameters**

The sensitivity analysis, Figure 5.26, shows the most important assumptions that give rise to variability for the NPV-Total result. The most important assumptions, in terms of contribution to variance, are:

DP-Cost - the Supply Cost (reference case = $2.80/gram) for Designated Producer in the Status Quo scenario.

PC-INCOME - the Maximum % of Mean Annual Income (for Users) that the Annual Cost of Marihuana Supply can account for (reference case = 15%).

P-ELAS-SQ - the Price Elasticity of Demand (reference case = -0.25) for all users in the Status Quo scenario.

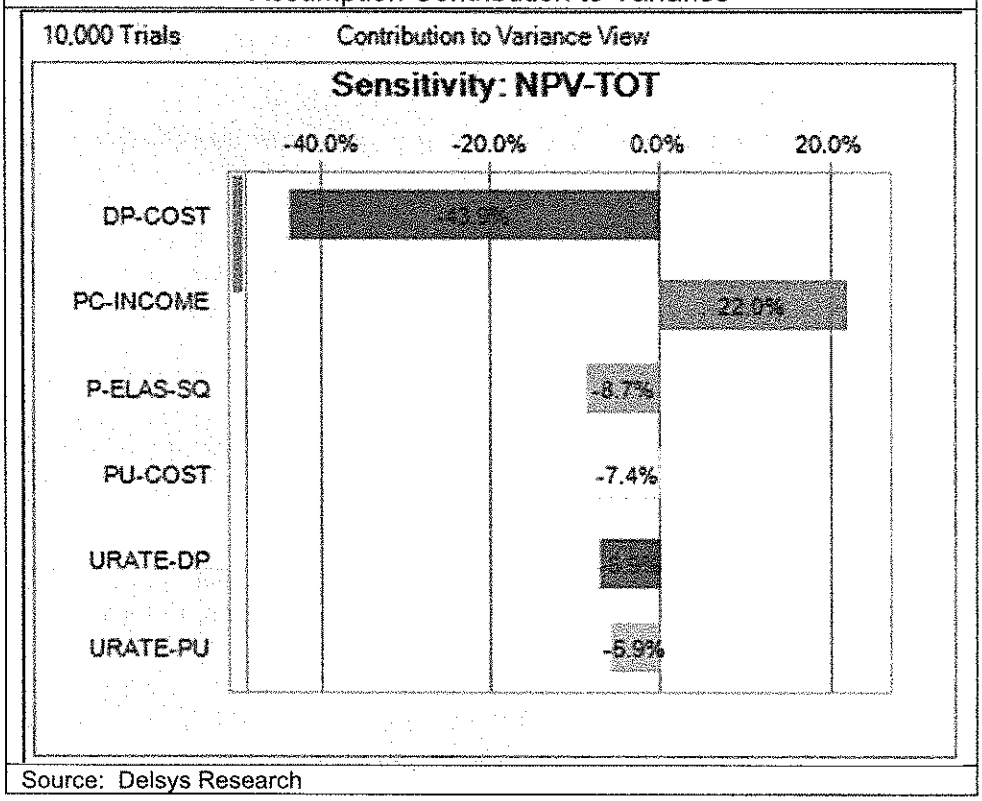
PU-Cost - the Supply Cost (reference case = $1.80/gram) for Personal Use in the Status Quo scenario.

URATE-DP - the Utilization Rate for Designated Persons in the Status Quo scenario, which is a ratio of the estimated actual usage relative to a theoretical maximum quantity based on the Proposed Daily Amount (9.0 grams) included in the ATP application by the user.

[35] More elastic demand in the Status Quo scenario leads (generally) to fewer legal users of Marihuana for Medical Purposes in the Policy scenario.

URATE-PU - the Utilization Rate for Personal Use in the Status Quo, which is a ratio of the estimated actual usage relative to a theoretical maximum quantity based on the Proposed Daily Amount (7.6 grams) included in the ATP application by the user.

Figure 5.26 – NPV-Total Sensitivity
Assumption Contribution to Variance



Source: Delsys Research

Further assessment of the sensitivity analysis shows the rank correlation between each of these important assumptions and the NPV result:

DP-Cost	ρ = -.50 to NPV
PC-INCOME	ρ = .35 to NPV
P-ELAS-SQ	ρ = -.22 to NPV
PU Cost	ρ = -.21 to NPV
URATE-DP	ρ = -.20 to NPV
URATE-PU	ρ = -.18 to NPV

For further discussion of response functions for key parameters of the CBA model, refer to Annex 2.

5.4.2 Discussion – Uncertainty in Quantitative Modeling

The most important finding of the sensitivity analysis is the considerable variation in possible NPV results from realistic parameter values and the complex interactions that are captured in the model.

This variability does not diminish the sense that the Reference case is the single most likely result.

The variability does reflect inherent uncertainty of the impacts of the proposed regulatory change. There are several key aspects of this variability, which is another way of reflecting regulatory risk:

1. Rapid Growth of the MMAP;
2. Fundamental Change;
3. Complex Dynamic Behaviour;
4. Establishment of a New Market; and
5. A Wide Range of Plausible Outcomes.

1. Rapid Growth of the MMAP

The MMAP has grown exponentially at an average annual rate of 40% for more than eight years. While it is believed there is a ceiling (upper limit) to future growth, it is expected that this will not be reached until the end of the forecast period. As a result of this inherent growth, the values involved (e.g., users, KG consumed, Administration Costs, safety and security events) are expected to change substantially. Any time that there are such large growth factors, there is an inherent risk regarding forecast accuracy and confidence levels over the forecast period.

One important qualitative impact, which the literature on drug crime prevention (which forms part of the policy rationale for proposed regulatory change) has identified, is that such crime prevention has a higher probability of success when the market is relatively small and emerging. While the illicit marihuana market is mature, the levels of MMAR misuse of residential home cultivation of marihuana are quite small (in FY2012) compared to the levels that are expected to arise by the end of the forecast period (FY2023-24). This suggests the need for reform of the regulatory regime before the scale of authorized cultivation of marihuana for medical purposes in homes grows further. It will be much harder (and possibly less successful) to reduce this activity (once declared illegal as a result of the elimination of PUPLs/DPPLs) if the policy change were delayed for five or ten years.

2. Fundamental Change

Regulatory change modelling is much easier and more certain when reform is incremental in nature. The proposed regulatory change for access to marihuana for medical purposes is more fundamental, especially the elimination of PUPLs/DPPLs which comprise 80% of user supply, in terms of persons, and the bulk (perhaps 97%) of legal KG supply.

It is unreasonable to believe that all residential marihuana cultivation that would have occurred under MMAR (and misuse) will cease as a result of its prohibition. This study has thus modelled a behavioural response that depends on the probability of conviction and builds in an effect which reflects the current inhibition that law enforcement authorities have stated exists with respect to their ability to take investigative police action once a problem resident (association with a MMAR production license) is identified. Once that inhibition is removed (a process of increasing clarity by eliminating the additional evidence required to obtain reasonable and probable grounds to investigate potential misuse), it is anticipated that there will be a deterrence effect on misuse associated with residential marihuana cultivation.

This study also anticipates that the effective supply price for marihuana for medical purposes will increase as LP Market supply is projected to be more expensive than PUPL/DPPL supply. It is expected that there will be a price elasticity effect that will consequently reduce the quantity of marihuana consumed for medical purposes in the Policy scenario LP Market relative to what would have been consumed in the Status Quo. This is the price effect.

Both the deterrence and price effects involve fundamental and large regulatory changes whose outcomes on behavioural change are inherently difficult to predict.

3. Complex Dynamic Behaviour

Human behaviour, in terms of criminal activity, crime prevention, market entrance and market demand), involves complex interactions and options. For the purposes of modelling the regulatory impact, this study assumed a degree of individual rationality and predictability of human behaviour in response to incentives (rewards and penalties).

That production activities which are authorized under the current MMAR will, under the proposed regulatory change, become illegal, raises an issue of regulatory compliance. Access to marihuana for medical purposes remains a debated subject of public policy[36]. By some Canadian public opinion evidence, Canadians appear divided on issues regarding the criminality (and morality) of marihuana use. This divided public opinion, and the sense that many Canadians may believe they have a right to access marihuana[37], means that the degree of compliance with the proposed regulatory change is uncertain.

4. Establishment of New Market

[36] Not to mention the broader policy of marihuana decriminalization, which is outside the scope of the proposed regulatory change and this CBA.

[37] Canadian court decisions, which underpin the MMAR regulatory regime, appear to recognize a right to access a legal supply of marihuana for medical purposes.

Most regulatory analysis deals with legal activities for which there is some history and experience in terms of market outcome. In the case of marihuana for medical purposes, the current MMAR regime has three distinct markets, of which only one (the Designated-Person supply market) might reflect a competitive market outcome. However, the market outcome in this case is not observed by Health Canada (as the regulator of participation in the MMAP).

The elimination of PUPLs/DPPLs and the termination of the contract governing the Government Supply market will bring about the establishment of a new LP Market.

This CBA study has attempted to estimate and anticipate likely demand and supply parameters for this market.

Market dynamics, in terms of entry of new LP suppliers, the growth of the existing incumbent (i.e., Contract Government Supply provider), the response of users to higher prices, and the elimination of legal residential marihuana cultivation, are complex and uncertain.

There is also a high degree of financial/business risk that Licensed Producers will face in the establishment of this new market.

5. A Wide Range of Plausible Outcomes

All of the above factors suggest that the analysis cannot project with any certainty, what the initial post-transition (i.e., phasing out of MMAR authorizations and production licenses) market outcomes will be, nor what these market outcomes will be in FY2023-24.

The broad variability of NPV outcomes, as reflected in the NPV Result distribution, is a simple quantified reflection of the underlying uncertainty and risks inherent in the proposed regulatory change.

5.5 Qualitative Discussion

5.5.0 Reference Case Qualitative Impacts

The Reference case generates a negative Net Present Value result and is based on reasonable assumptions that are inherently uncertain. Note that certain factors (i.e., impacts, behavioural responses) have been excluded from the quantitative CBA as there is insufficient information on which to assess the factor. As such, the quantitative analysis does not tell the full story of the overall impact of the proposed regulations. There are costs and benefits – possibly significant in size – that could not be quantified but which are relevant for public policy purposes.

The following subsections examine the qualitative impacts that are applicable across all of the scenarios considered under the probabilistic analysis, and discuss some core issues and trends which are likely to result from the proposed changes to the regulation (and creation of the new industry). Before these issues are examined in depth, however, it bears examination which qualitative impacts will (or will not) be evident under the Reference case.

Perhaps the most notable impact of the Reference case, and of the program in general, is the introduction of a regulated marihuana production and distribution industry (for the use of marihuana for medical purposes) into the Canadian economy. The proposed marihuana

access program will create hundreds of new jobs across Canada within the projected ten-year period. As private businesses, the licensed producers/distributors will be subject to scrutiny and attention from the public as well as the media. This process may inhibit marihuana production that operates outside the bounds of the law (i.e., at least as it pertains to marihuana use for medical purposes) and raises questions as to the product safety of using illicitly-obtained marihuana. Just as bootleg whiskey is considered to be more dangerous and more variable in quality in relation to a quality-controlled product available from a regulated industry, so too could a regulated marihuana for medical purposes industry make the illicit product less attractive over time.

Under the Reference case, a reduction in the alleged misuse of marihuana for medical purposes is anticipated. However, not all criminal activity will cease. The proposed regulations provide certain safeguards against illicit diversion from licensed producers: a) the requirements and background checks prescribed by the new regulations are significant; and b) the significantly lower number of entities subject to regulation, enforcement and monitoring by Health Canada should allow for more effective management and greater compliance over time.

The quantitative CBA includes calculations as to the impact of ending personal and designated person production, both of which involve fire hazards, crime risk and concern as to the evidentiary requirements in investigating potential misuse. From a qualitative perspective, this is one of the most noticeable impacts of the new policy structure. Whereas law enforcement authorities previously encountered difficulty in determining which residences where marihuana was being produced were operating outside the law, the proposed regulations provide certainty that any residence conducting marihuana cultivation will be strictly outside the law and subject to enforcement. This regulatory simplification should increase the effectiveness of law enforcement efforts and result in improvements in compliance dynamics.

The Reference case assumes that the new industry will ramp up and become competitive quickly. While the first six months of the transitional period will be challenging for most new LPs, the already significant and growing demand for product will justify additional investment and short-term staffing/production to smooth over the difficult start-up phase that is likely to be experienced by many new licensed producers.

Once LPs are up and running, additional qualitative factors may come into effect. The regulations specifically will not allow the advertisement of marihuana to the general public. However, the marihuana for medical purposes client base tends to be socially connected and capable of using social networks to quickly spread information informally. While LPs will not be able to advertise their products in a conventional sense there is likely to be a strong incentive for individuals accessing marihuana from LPs to share information (e.g., with respect to pricing, delivery, customer service, personal perceptions of the impact of usage, etc.) among themselves, and support the creation of brand identities – even without LPs having the legal ability to manage this process overtly.

This informal branding/advertising structure may have two impacts: a) it will raise awareness of the new system and LP industry; and b) it will provide a means for the regulator and for LPs to conduct market research on consumer attitudes, word-of-mouth response with respect to all products and LPs in the market.

The first effect is akin to restaurant reviews using social networking which will increase the power of the word-of-mouth dynamic for branding and product differentiation.

The second impact is akin to an early warning system and provides customer informal feedback and customer preference indicators with respect to product/service characteristics (e.g. price responsiveness, product perception, service experiences, customer problems) which provides the opportunity for product/service adaptation and improvement.

The Reference case projects the continued growth of marihuana for medical purposes usage in Canada and assumes that medical professionals will continue to expand their support of patient access. The Reference case projects that the average cost of a gram of marihuana will increase under the new regime over the average supply price under the existing MMAR regime, largely due to the elimination of lower cost personal-use and designated-person production. From a qualitative perspective, there are two price-response factors that can be identified: a) the legal supply price (for marihuana for medical purposes) is expected to remain below the illicit street price for marihuana (for retail quantities); and b) market dynamic forces may lead to product improvement over time from R&D and, potentially, investment in science to meet the Health Canada requirement for authorization as a therapeutic drug.

The expected LP price will likely be less than that of the illicit market. Persons wanting to access marihuana for medical purposes are therefore, it is suggested, unlikely to want to access their product from the illicit street supply. It is anticipated that the market demand for marihuana for medical purposes usage is driven by a perception that this is an effective means of treating certain health conditions. An increase in the 'legal supply' price (i.e., the price for the LP market is expected to be above that for the MMAR supply markets) may result in users (and potential future users) considering alternative treatment options and/or in using less marihuana for medical purposes. Assuming that the projected increase in the Status Quo for use of marihuana for medical purposes is fully reflective of legitimate health conditions, there will be no diminution of the underlying demand for idiosyncratic pain relief or other perceived benefits to individuals.

The complex relationships and interactions between price, access, quality and demand in the Status Quo scenario, Policy scenario and (implicitly) in the illegal market, are captured to a large degree in the Reference case of the CBA where a large and growing number of users remain "willing to pay" for marihuana for medical purposes from LPs in the Policy scenario despite the higher price compared with the Status Quo scenario.

It is anticipated that LPs may have an incentive to invest in R&D and scientific study of the use of marihuana products/delivery methods as recognized medical therapy. This will especially be the case if profitability is high and market growth remains strong. The potential for strong profitability (given regulatory and commercial entry requirements) can spur innovation, which has not been factored into the CBA results.

These are some of the key qualitative impacts of the Reference case pertaining to market dynamics. The following subsections examine other potential impacts.

5.5.1 Safety and Security

A major objective of the regulatory proposal is to enhance public and personal safety and security in Canadian residential communities. The benefits of achieving this objective are captured to a large degree in the quantified CBA.

However, the literature review, stakeholder consultations and other sources indicate some additional benefits regarding public and personal safety and security. These additional benefits are more difficult to quantify and monetize because of the absence of data relevant to the Canadian context. For example, additional improvements in health, quality of life, and the environment will result from the reduced presence and health/safety risks of mould, chemical contamination and problems that are associated with production of marihuana in small, enclosed spaces in private residences.

Improvements in the quality of life and the physical environment are likely to lead to higher residential and other property values. It may also lead to lower home insurance costs for households and businesses in the communities which experience a decrease in the production and misuse of personal use and designated production now taking place under the MMAR regime. The improvement in law enforcement clarity and effectiveness of police resources could allow for better law enforcement outcomes and greater deterrence effect from drug crime policing.

5.5.2 Reduced Information, Administration and Related Transaction Costs

The regulatory proposal is designed to reduce the information, administration, and related transaction costs for access to a regulated supply of marihuana for medical purposes. Compared with the Status Quo scenario, the regulatory proposal (Policy scenario) involves less costly administrative requirements for users/patients and physicians to access a regulated supply of marihuana for medical purposes. While the program administrative costs facing Health Canada has been reflected in the CBA results these patient/health professional benefits have not been included. The time and effort savings under the Policy scenario from a shorter form, reduced processing steps (e.g., no application to Health Canada, no requirement for medical specialist consult) are difficult to quantify but are recognized to be real and tangible.

It is possible that less costly and more timely access could result in greater use uptake than has been forecast and reflected in the CBA results. In particular, removing the government from the physician-patient interaction, eliminating the categories of conditions or symptoms for which an individual may possess marihuana for medical purposes, removing the requirement for some individuals to consult with and obtain permission from a specialist, and simplifying the form to be filled out by the doctor should:

(i) reduce the information and transactions costs and related delays and risks of both physicians and their patients, and

(ii) make the interaction quite similar to doctor/patient discussions on other drug and medical therapies.

Physicians and patients that may have been discouraged from participation in the MMAP in the Status Quo scenario could have some of these impediments overcome by the proposed regulatory changes. This could expand market demand and result in additional incremental benefits of the Policy scenario.

Information was provided through stakeholder consultations with Health Canada regarding administrative and other cost savings, including for certain municipal government functions. The Policy scenario could lead to lower costs and/or greater effectiveness of municipal law

enforcement, fire protection and related services (e.g. by law enforcement) as a consequence of reduced fire risk and reduced misuse associated with residential marihuana production.

5.5.3 Establishment of a Competitive and Innovative Industry

The regulatory proposal will eliminate licensed personal-use and designated-person production (and the current government-contracted supply) of marihuana. It is anticipated that the regulated LP market will grow to be reasonably large (e.g., sales >$1 Billion per year), competitive (perhaps ~50 suppliers) and profitable – which over time has the potential to lead to innovation. The LP market could have the incentives, resources, ability and competitive pressures to undertake (over time) investment in R&D and product, process and organizational innovations that could result in the following[38]:

(i) Economies of scale and scope, accumulated learning, and related internal and external efficiencies;

(ii) Higher yields; lower production, overhead, handling, shipping and other costs; and higher quality products, better strains and greater product variety that better meet the diverse needs of their customers (i.e., some of these dynamics could lead, over time, to reduced product prices [Hazekamp (2006, 2007)];

(iii) User social-networking that will result in shared information and learning between LPs, Health Canada and other government agencies that may lead, over time, to lower compliance, administration and related regulatory costs that will achieve desired regulatory objectives; and

(iv) Industry research and public research to expand the scientific knowledge base regarding the medical efficacy and toxicity of marihuana products and ingestion methods as potentially approved therapies

5.5.4 Potential Benefits and Risks of "Reverse Diversion" from the Illicit Marijuana Industry and Other Legal and Illegal Substances to the Marihuana for Medical Purposes Industry under the Policy Scenario

An extensive body of literature on cannabis/marihuana use suggests the possibility of an unintended consequence of a regulated marihuana production and supply industry. Over time, a regulated market could be characterized by: monopolistic competition based on product differentiation and lesser price elasticity; and a product substitute for persons seeking alternative methods for alleviating pain and other condition symptoms.

Furthermore, the existence of a regulated marihuana supply at a price below the illicit street price raises the potential for what may be referred to as "reverse diversion." This term refers to the desire to substitute illicit marihuana supply with a less expensive supply for reasons other

[38] The diagram Annex I section 5 uses comparative statics analysis to illustrate how user demand and consumer surplus could increase in the future through the combined effects of these dynamic factors. The potential for greater consumer surplus, higher producer surplus, and other economic and societal benefits from the dynamic industry and market changes associated with the Policy scenario over the longer term is the consequence of a number of the pro-competition and pro-innovation features of the Policy scenario compared with the Status Quo scenario.

than medical purposes. The potential demand for access to a legal supply of marihuana may be greater than projected in the CBA[39].

The literature review and stakeholder consultation process both indicated that "reverse diversion" could lead to net incremental benefits. Lower quality-adjusted prices are possible, over time, under dynamic market behaviours. These could generate greater consumer surplus for each user (i.e., infra-marginal gain) as well as greater consumer surplus from induced users (i.e., extra-marginal gain).

The literature suggests that, over the long term, growth in market size, market competitiveness and market innovation capabilities (aided by "reverse diversion" and other processes) could result in decreased abuse of alcohol, marihuana, hard drugs and certain prescription drugs for relieving pain that are reportedly causing problems. As a consequence, additional user and societal benefits could result from the reduction in the addiction, abuse, crime, health, and other problems and government and social costs that are currently associated with alcohol, hard drugs and certain prescription drugs [Payne (2012) and Kilmer et al (2010)].

The process of "reverse diversion" is not without certain costs and risks, however. The illicit drug market has a reputation for responding flexibly, aggressively, and (sometimes) effectively to various market, legal and other risks that threaten its customer base, revenues and profits. Producers, importers and dealers in the illicit market may respond with violence, intimidation, sabotage, theft and other criminal acts when faced with the risk of losing customers to the legal supply market for marihuana for medical purposes. They could also engage in standard economic responses such as predatory pricing, non-price predation and other anti-competitive conduct directed at participants in the legal market and industry [Becker et al (2006) and Rhodes et al (2000)].

The potential for "reverse diversion" is a risk to the undermining of public confidence in the proposed regulatory regime. The public might perceive rapid growth based (in part) on reverse diversion as an abuse of the proposed regulatory regime that was intended to be restricted to persons seeking alleviation of medical conditions under physician or other health care practitioner supervision.

5.5.6 Limitation of CBA

This CBA is intended to quantify the most likely Reference case Net Present Value result, as well as a sensitivity analysis of the NPV Result distribution. The associated qualitative analysis adds further context to the quantitative CBA results.

Government policy decision-making often is based on factors, judgments and priorities that are unlikely to be reflected in a CBA study. Practitioners of CBA are aware of this reality and have been guided to recognize the limitations of their tools, data and analysis.

This CBA study is a fair and reasonable reflection of quantitative and qualitative measures to evaluate the proposed regulatory changes to access to marihuana for medical purposes. It is offered in full accordance with Treasury Board Secretariat Guidelines for Cost-Benefit Analysis.

[39] It is also possible that the rapid expansion of the existing MMAP (and its projected future growth in the Status Quo scenario) is also a result of similar desire to access marihuana for other than medical purposes.

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The order of magnitude of the quantitative CBA results reasonably account for the most important aspects of the policy rationale related to the proposed regulatory change. These CBA results may not, however, reflect the weight, priority and valuation of factors leading to the development of the proposed MMAR regulatory change. The CBA results are one form of regulatory analysis, among others, that have been undertaken in accordance with the Federal Government regulatory impact assessment requirements.

CHAPTER SIX

6.0 Conclusions

The monetized CBA results, in terms of Discounted Net Present Value, show that the expected benefits and costs of the proposed Regulatory change fall onto different stakeholders in varying degrees of impact.

There is no clearly Pareto superior result that supports a statement that one scenario (i.e., Status Quo or Policy) is superior to the other. The fact that the Reference case NPV is negative (-$109.72 Million) indicates that the sum of benefit and cost changes across all stakeholders is negative. The sensitivity analysis of the NPV result clearly shows a wide range of possible outcomes with a central tendency that is not statistically different from zero.

The analysis of the Reference case by stakeholder group shows that one class of stakeholder bears a cost in terms of NPV impact - namely the users of marihuana for medical purposes - while the remaining stakeholders (e.g., the general public, government, licensed producers) are made better off. This is a classic result that demonstrates there is no Pareto superior outcome and that economic analysis methods (such as Cost-Benefit Analysis) cannot, unequivocally, state that one option is better than the other. In such cases it is traditional to rely on priority judgements by policy makers to indicate which option is superior in terms of social welfare.

Both the quantitative and qualitative CBA results reflect the following factors:

i) rapid program uptake and continued growth;

ii) the fundamental nature of the regulatory change;

iii) the complex dynamic behavioural changes that could occur as a result of the elimination of residential marihuana cultivation and its replacement by higher cost commercial supply;

iv) the uncertainty surrounding the establishment of a new industry and market; and

v) the inherently unknown final outcome of the regulatory change after ten years.

It is important to bear in mind that while, from an economic perspective, user benefit is measured from the consumption of marihuana for medical purposes in terms of consumer surplus, the available scientific evidence does not support the authorization of marihuana use for therapeutic purposes under the Food and Drugs Act and Regulations. Canadian courts have ruled that individuals have a legal right to possess marihuana for medical purposes and that the Government of Canada has an obligation to provide reasonable access to a legal supply of marihuana for such medical purposes.

The consumer surplus measure of user benefit does not purport to show, and should not be taken as evidence, that there is any quantifiable medical benefit attributed to the consumption of marihuana for medical purposes.

Policy makers, apparently, have attributed much more weight to the negative impacts on social welfare that have been shown to arise from higher safety and security risks attributable to residential marihuana cultivation, and to the much higher program administration costs that would fall on Health Canada if the Status Quo were maintained and significant future growth in MMAP participation were to be accommodated. These have been monetized and quantified as best as possible and they are significant in number and value. While the Reference case does not show these to outweigh the loss of consumer surplus, it may be that the application of a social valuation to these impacts (from an economic perspective) may not adequately reflect a social valuation of the maintenance of public safety and security.

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ANNEX 1 – Consumer & Producer Surplus with Subsidy

1. Consumer & Producer Surplus – Impact of Subsidy

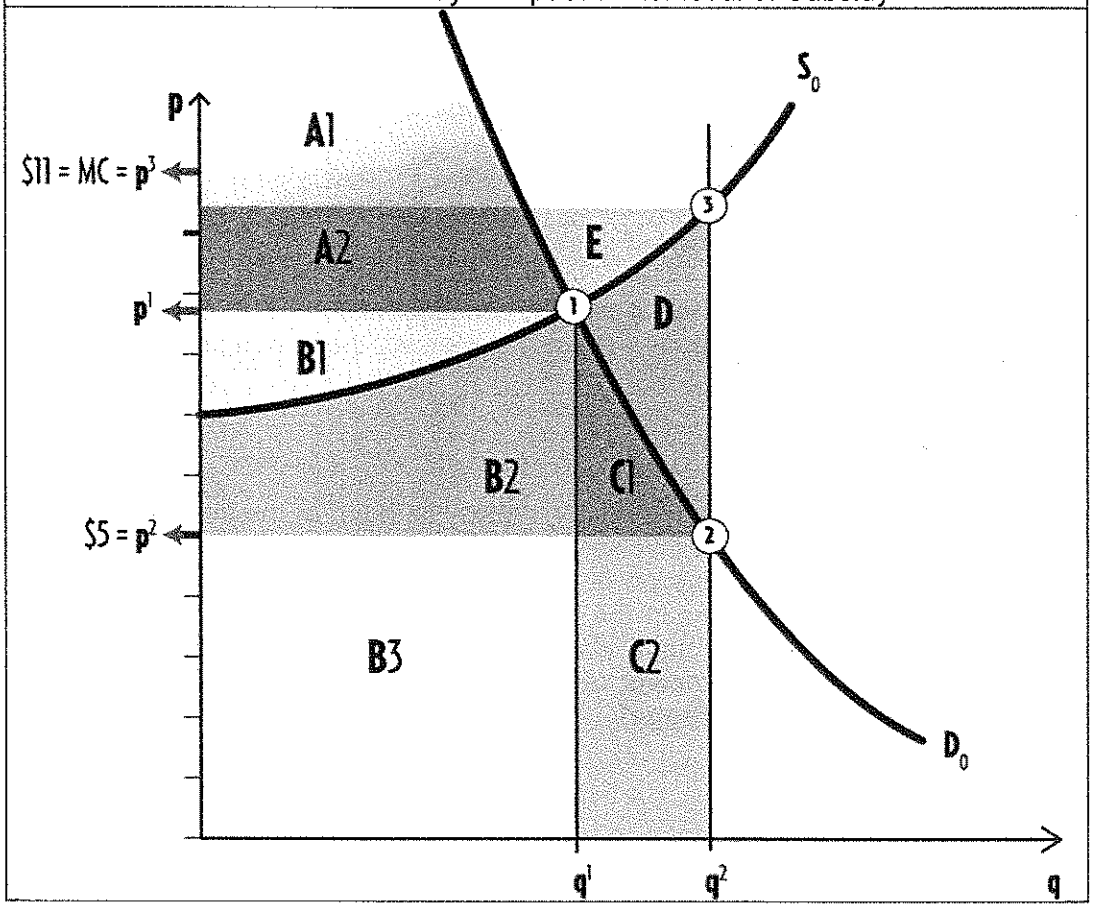
The graphic calculation of Consumer Surplus (CS) and Producer Surplus (PS) is described in a market with an upward sloping Supply curve (S_0) and a downward sloping Demand curve (D_0) that intersect at point 1. This is seen in Figure A-1.

Figure A-1 is used to assess the social welfare consequences of an introduction of a subsidy. First, the outcome of a market without a subsidy is viewed; then changes are observed when a subsidy is introduced.

Equilibrium – No Subsidy (Figure A-1)

The market equilibrium in the absence of any subsidy is found at the intersection of the Supply and Demand curves at point 1 and involves price p^1 and quantity q^1. In a perfectly competitive market the marginal cost of production is equal to p^1 (where the Supply curve shows rising marginal cost as quantity increases in the market) and the marginal willingness-to-pay is also equal to p^1 (where the Demand curve shows falling marginal willingness-to-pay as quantity increases in the market). Total market revenue is $p^1 * q^1$ and is equal to the sum of areas B1+B2+B3 in Figure A-1 (see next page).

Figure A-1 – Consumer & Producer Surplus
Market with Subsidy – Impact of Removal of Subsidy



Consumer Surplus is the area below and to the left of the Demand curve and above the price line at p^1. This equals the sum of areas A1+A2. It represents the amount of consumer willingness-to-pay that exceeds the out-of-pocket expense to secure quantity q^1 in the market. It is a benefit to consumers that is not captured in the market transaction through the price of the good.

Producer Surplus is the area above and to the left of the Supply curve and below the price line at p^1. This equals the area B1. It represents the amount of producer revenue that exceeds the total variable cost to produce quantity q^1 in the market. It is a benefit to producers that is captured in the market transaction through the price of the good.

Equilibrium – With Subsidy (Figure A1)

An allowance is now made for the existence of a price subsidy. The form of the subsidy (i.e. how it is paid) is less important than its existence and impact on market behaviour. The subsidy means that consumers can purchase the good at a price that is below what producers receive for providing the good. The quantity produced and sold in the subsidized market q^2 will be larger than the equilibrium quantity in the absence of the subsidy q^1.

In Figure A-1, consumers will effectively be at some point 2, such that at the traded quantity q^2 the price they face is p^2 and is less than the equilibrium price p^1 without the subsidy. Producers

will conversely be at some point 3, such that at the traded quantity q^2 the price they receive is p^3. The subsidy s (per unit of output) is equal to the difference between the two prices (p^3-p^2 = s) and the quantity demanded equals the quantity supplied at q^2.

While the operation of the market in terms of prices at the quantity q^2 has been explained, the actual market operation is in the reverse order. The existence of the subsidy per unit s generates a subsidy wedge and the subsidized market equilibrium quantity q^2 is determined where the quantity demanded equals the quantity supplied for the given value of the subsidy s.

The subsidy value is the value s * q^2 and is represented in Figure A-1 by the sum of the areas A2+B1+B2+C1+D+E.

The treatment of what is Consumer Surplus and Producer Surplus is complicated by the existence of the subsidy.

The logic used above, which took the Consumer Surplus to be the area below and to the left of the Demand curve and above the price line at p^2, would lead one to believe that this can be measured by the sum of the areas A1+A2+B1+B2+C1. This is obviously larger than in the market equilibrium case. However, the existence of the subsidy does not allow us to associate that area with Consumer Surplus.

The logic used above, which took the Producer Surplus to be the area above and to the left of the Supply curve and below the price line (i.e. at p^3), would lead one to believe that this can be measured by the sum of the areas B1+A2+E. However, the existence of the subsidy does not allow us to associate that area with Producer Surplus.

A new concept, Deadweight Loss, is used to refer to the value of resources consumed in production that exceed (at the margin) the value associated with consumer willingness-to-pay. In the subsidized market, this is the area above the Demand curve and below the Supply curve to the right of the marketing equilibrium point 1 (i.e. in the absence of the subsidy). This is the area D in Figure A-1. This Deadweight Loss is a social loss of productive resources that have been allocated to a use (the production of the good) for which the cost of the resources exceeds the marginal value ascribed to them by consumers (i.e. in their transformed state of the good produced and consumed).

For the purposes of ascertaining Producer Surplus, the lower price p^2 is effectively taken as the appropriate measure of the marginal social valuation of the use of the good. There is, therefore, no Producer Surplus in the subsidized market equilibrium.

Conversely, when measuring Consumer Surplus, the higher price p^3 is effectively taken as the appropriate measure of the margin social cost of the resources used in the production of the good. Therefore, the Consumer Surplus is the area A1 in Figure A-1.

Table A-1 summarizes the impacts on price, quantity and this study's welfare measures of Consumer Surplus, Producer Surplus and Deadweight Loss.

Table A-1 - Consumer Surplus, Producer Surplus & Deadweight Loss In a Market with a Subsidy (Figure 1) Showing Various Results With No Subsidy and With a Subsidy		
Variable	No Subsidy	Subsidy
Price to Seller	p^1	p^3
Price to Buyer	p^1	p^2
Subsidy (per unit)	zero	$s = p^3 - p^2 > 0$
Equilibrium Quantity	q^1	q^2
Value of Subsidy or Value of Transfer	zero	sum of area A2+E+B1+B2+C1+D
Consumer Surplus	sum of area A1+A2	area A1
Producer Surplus	area B1	zero
Deadweight Loss	zero	area D

The introduction of a subsidy involves:

- an increase in quantity demanded and supplied (i.e. $q^2 - q^1$);
- the transfer of value to producers and consumers (usually from taxpayers) equal to the sum of the areas A2+E+B1+B2+C1+D and which equals $s * q^2$ in value;
- the Deadweight Loss equal to area D;
- the elimination of Producer Surplus equal to area B1; and
- the reduction in Consumer Surplus equal to area A2.

In terms of a CBA measure of social welfare change, the transfer enters as a transfer and is neither a gain nor a loss. It is considered a transfer of resources from one owner (perhaps the taxpayer) to another owner (consumers and/or producers).

The only changes that are meaningful from a CBA measure of social welfare, involve the Deadweight Loss (area D), the elimination of Producer Surplus (area B1) and the reduction in Consumer Surplus (area A2). As all these involve a loss of social welfare, it suggests that the introduction of a subsidy in the market for this good resulted in the following Social Welfare Change:

$$(3.1) \quad \Delta\text{Social Welfare} = \Delta\text{Consumer Surplus} + \Delta\text{Producer Surplus} - \text{Deadweight Loss}$$

$$= (-\text{ area A2}) + (-\text{ area B1}) - (\text{area D}) < 0$$

The introduction of a subsidy involves social welfare loss as a result of economic distortions and misallocation of resources from their 'best use' as determined in a market equilibrium without subsidy.

2. Consumer & Producer Surplus – Impact of Shift of the Supply Curve

It is now necessary to assess the social welfare consequences of a shift of the Supply curve in terms of the impact on market equilibrium. This is shown in Figure A-2. In Figure A-2, it is assumed that some change in the structure of the market results in a downward shift in the supply curve from S_0 to S_1.

A downward shift in the Supply curve could result from improvement in technology, reduction of regulatory impediments to efficiency or some other cause. The result is that at any quantity to be supplied in the market the marginal cost (per unit) of production is lower, so that S_1 lies below S_0. As the market can now (i.e. after the shift to supply curve S_1) be supplied more efficiently, a resulting social welfare gain is expected.

First the outcome of a market with Supply curve S_0 is examined; then any changes are observed when the market is supplied by the more efficient (lower marginal cost) Supply curve S_1.

Equilibrium – Supply Curve S_0 (Figure A-2) – Higher Marginal Cost

The market equilibrium is found at the intersection of the Supply curve S_0 and the Demand curve D_0 at point 1 and involves price p^1 and quantity supplied and bought q^1.

As there are more horizontal and vertical lines and points of reference in Figure A-2, some of the areas that were defined in Figure 1 have been broken up into components so that the labelling format for distinct areas of the graphic are more complicated. The relationship between areas is shown in Figure A-2 (versus corresponding areas in Figure A-1) using suffix numbers.

Total market revenue is $p^1 * q^1$ and is equal to the sum of areas (B1.1+B1.2) + (B2.1+B2.2+B2.3) + B3 in Figure 2 (i.e. corresponding to the sum of areas B1+B2+B3 in Figure A-1).

Consumer Surplus is the area below and to the left of the Demand curve D_0 and above the price line at p^1. This equals the sum of areas A1+A2 (i.e. as in Figure A-1).

Producer Surplus is the area above and to the left of the Supply curve S_0 and below the price line at p^1. This equals the sum of the areas (B1.1+B1.2) (i.e. corresponding to area B1 Figure A-1).

Equilibrium – Supply Curve S_1 (Figure A-2) – Lower Marginal Cost

The market equilibrium is found at the intersection of the Supply curve S_1 and the Demand curve D_0 at point 3 and involves price p^3 and quantity supplied and bought q^3.

As marginal cost (per unit produced) is lower along Supply curve S_1 than for Supply curve S_2 the market equilibrium price has fallen (i.e. $p^1 > p^3$) and with the downward sloping Demand curve D_0 the quantity supplied and bought has increased (i.e. $q^3 > q^1$).

Total market revenue is $p^3 * q^3$ and is equal to the sum of areas (B1.2 + B2.2 + C1.2 + B2.3 + C1.3 + B3 + C2.1) in Figure A-2.

Consumer Surplus is the area below and to the left of the Demand curve D_0 and above the price line at p^3. This equals the sum of areas (A1 + A2 + B1.1 + B2.1 + C1.1) in Figure A-2.

Producer Surplus is the area above and to the left of the Supply curve S_1 and below the price line at p^3. This equals the sum of the areas (B1.2+B2.2+C1.2) in Figure A-2.

Figure A-2 – Consumer & Producer Surplus
Market with Subsidy

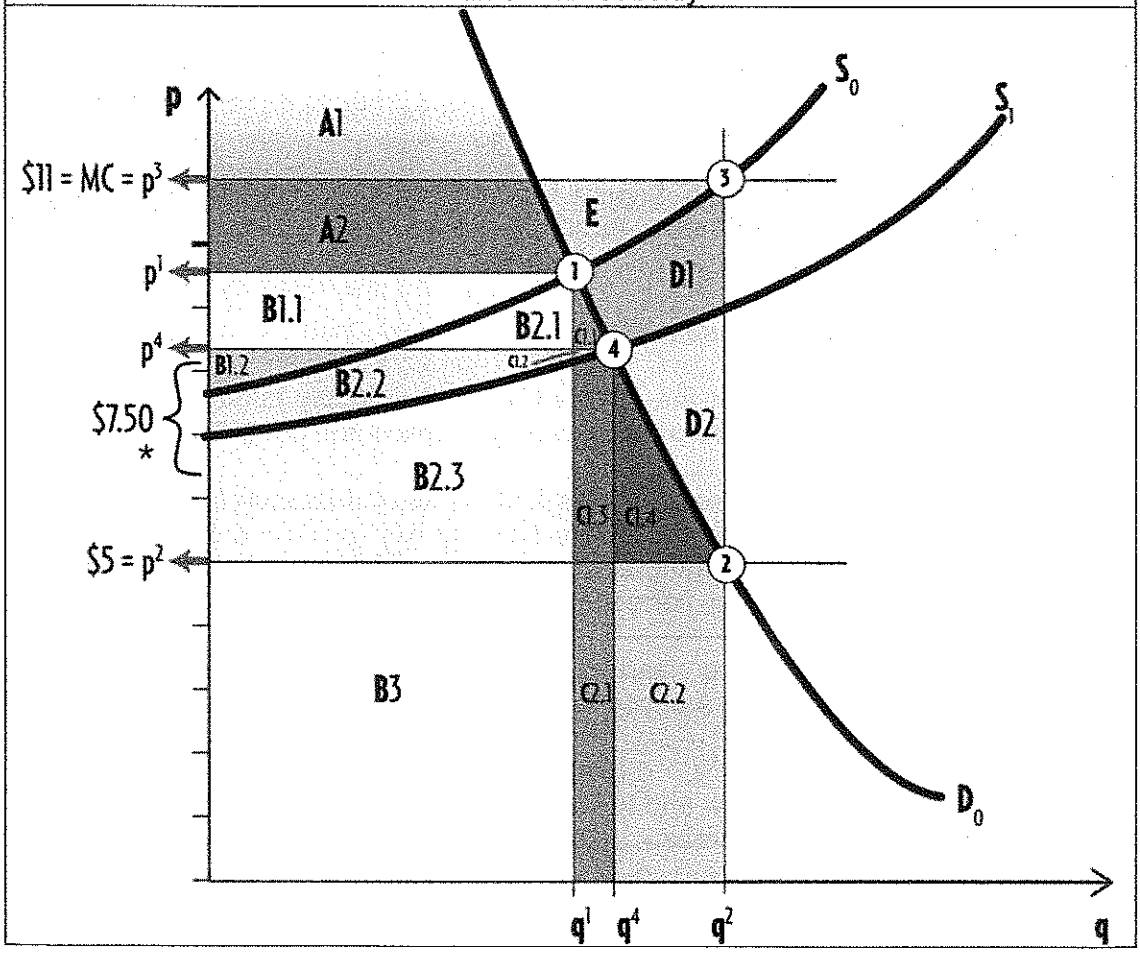


Table A-2 summarizes the impacts on price, quantity and this study's welfare measures of Consumer Surplus and Producer Surplus. As there is no subsidy involved in the shift in Supply curves there is no Deadweight Loss issue.

Table A-2 - Consumer Surplus, Producer Surplus & Deadweight Loss In a Market with a Shift of the Supply Curve (Figure 2) Showing Various Results With Supply Curve S_0 and S_1 (lower cost)		
Variable	Supply S_0 (higher cost)	Supply S_1 (lower cost)
Price to Seller	p^1	p^3
Price to Buyer	p^1	p^3
Subsidy (per unit)	zero	zero
Equilibrium Quantity	q^1	q^3
Value of Subsidy or Value of Transfer	zero	zero
Consumer Surplus	sum of area A1+A2	sum of area A1+A2+B1.1+B2.1+C1.1
Producer Surplus	sum of area B1.1+B1.2	sum of area B1.2+B2.2+C1.2
Deadweight Loss	zero	zero

As can be seen in Table A-2, the value of Consumer Surplus has increased as a result of the shift to a lower marginal cost Supply curve. The change in Consumer Surplus is larger by the sum of the areas B1.1+B2.1+C1.1 in Figure A-2. In deriving the change in Consumer Surplus, the net difference between the two situations was assessed.

For the purposes of ascertaining the change in Producer Surplus, this study will not look at the net difference between the two situations. It is widely accepted in economics (since Schumpeter and the concept of creative destruction) that technological advances create losers and that society is still better off as a result of improvements in technology. Therefore, from the perspective of social welfare change, the elimination of the original Producer Surplus (associated with Supply curve S_0) is not a social welfare loss. The study therefore does not take the difference between in Producer Surplus as the measure of social welfare gain. The measure of social welfare gain is the Producer Surplus associated with the more efficient (lower marginal cost) Supply curve S_1. The Producer Surplus is the sum of the areas B1.2+B2.2+C1.2 in Figure A-2.

The meaningful changes in terms of a CBA measure of social welfare, involve the Producer Surplus (areas B1.2+B2.2+C1.2) and the gain in Consumer Surplus (areas B1.1+B2.1+C1.1). As all these involve a gain of social welfare, it suggests that the shift in Supply curve resulting from more efficient production in the market for this good resulted in the following Social Welfare Change:

$$(3.2) \quad \Delta\text{Social Welfare} = \Delta\text{Consumer Surplus} + \text{Producer Surplus}$$

$$= (\text{areas B1.1+B2.1+C1.1}) + (\text{areas B1.2+B2.2+C1.2}) > 0$$

3. Consumer & Producer Surplus – Combined Effect

To look at the combined effect of the elimination of a subsidy and a shift in Supply curve involving more efficient (lower marginal cost) production, it is necessary to combine (i.e. sum) the two effects that considered above. These can all be seen in Figure A-2 provided that accommodation is made to the break-up of areas into components in the transition from Figure A-1 to Figure A-2.

Table A-3 summarizes the impacts on price, quantity and the welfare measures of Consumer Surplus, Producer Surplus and Deadweight Loss. This combined the results from Tables A-1 and A-2 above.

Table A-3 - Consumer Surplus, Producer Surplus & Deadweight Loss
Combined Effect of a) Elimination of Subsidy and b) More Efficient Supply

Variable	Subsidy Supply S_0	No Subsidy Supply S_0	Lower Cost Supply S_1
Price to Seller	p^3	p^1	p^3
Price to Buyer	p^2	p^1	p^3
Subsidy (per unit)	$s = p^3 - p^2 > 0$	zero	zero
Equilibrium Quantity	q^2	q^1	q^3
Value of Subsidy or Value of Transfer	sum of area A2+E+B1.1+B1.2 +B2.1+B2.2+B2.3 +C1.1+C1.2+C1.3+C1.4 +D1+D2	zero	zero
Consumer Surplus	area A1	sum of area A1+A2	sum of area A1+A2+B1.1+B2.1+C1.1
Producer Surplus	zero	sum of area B1.1+B1.2	sum of area B1.2+B2.2+C1.2
Deadweight Loss	area D	zero	zero

The social welfare consequences of a move from the subsidy case with Supply curve S_0 to a market equilibrium with Supply curve S_1 is the additive impact of the two equations developed above – to allow the addition the combined effects of a) the move from the subsidized to the non-subsidized market equilibrium associated with Supply curve S_0 (as captured in equation 1); and b) the move from higher cost Supply curve S_0 to the lower cost Supply curve S_1 (as captured in equation 2).

The meaningful changes in terms of a CBA measure of social welfare are reflected in the following Social Welfare Change:

$$(3.1) \quad \Delta\text{Social Welfare} = -\Delta\text{Social Welfare(1)} + \Delta\text{Social Welfare(2)}$$

$$= (A2+B1.1+B1.2+D1+D2) + (B1.1+B2.1+C1.1+B1.2+B2.2+C1.2)$$

$$= A2 + B1.1 + B1.2 + B2.1 + B2.2 + C1.1 + C1.2 + D1 + D2 > 0$$

Note that the ΔSocial Welfare(1) is measured for the introduction of the subsidy so the effect of removal of the subsidy is the negative of this value. Also note that there is no 'double-counting' the same area twice if it appears as a benefit for both the removal of the subsidy and the more efficient Supply curve.

In terms of trying to understand the net social welfare gain it is useful to break this up into three components along the lines of equation 1 above:

(3.2) ΔSocial Welfare = ΔConsumer Surplus + ΔProducer Surplus + ΔDeadweight Loss

= (A2+B1.1+B2.1+C1.1) + (B1.2+B2.2+C1.2) + (D1+D2)

This simply rearranges the results from equation 3.1.

The social welfare gain is derived from:

1. The increase in Consumer Surplus as a result of increased consumption of the good (relative to the Consumer Surplus associated with point 3 in Figure A-2 involving price p^3);

2. the Producer Surplus at the final position associated with the more efficient Supply curve S_1 at point 4 and price p^4; and

3. the elimination of the Deadweight Loss associated with the subsidy at point 3.

4. Consumer & Producer Surplus – Estimation

Generally, in order to operationalize this analysis, it is customary to assume linear forms of the Demand and Supply curves and to estimate the area sizes using geometric relationships. Linear forms mean that all the relevant areas are triangles whose area is ½ the value of the corresponding rectangle.

5. Possible Responses of User Demand and Consumer Surplus to a More Competitive and Innovative Industry

The following diagram uses comparative statics analysis in order to illustrate how user demand and consumer surplus could increase in the future through the combined effects of the dynamic factors discussed in section 5.5.3 of the Qualitative Discussion. The demand curve moves outward to the right from D1 in black to D2 in red because the consumer/user of marihuana for medical purposes is willing to pay more for a higher quality and more innovative and reliable legal product that is more accessible and has proven its ability to provide health, quality of life and related benefits.

The supply curve moves downward and to the right from S1 in black to S2 in red because of economies of scale and scope, learning effects, internal and external efficiencies, and reductions in fixed/compliance and variable/administrative regulatory costs.

The combined effects of the changes in position of the demand and supply curves are: higher quantities supplied, demanded and consumed at a lower actual price, resulting in greater consumer surplus for each and every consumer/user of marihuana for medical purposes (as the market equilibrium moves from P1Q1 in black to P2Q2 in red.

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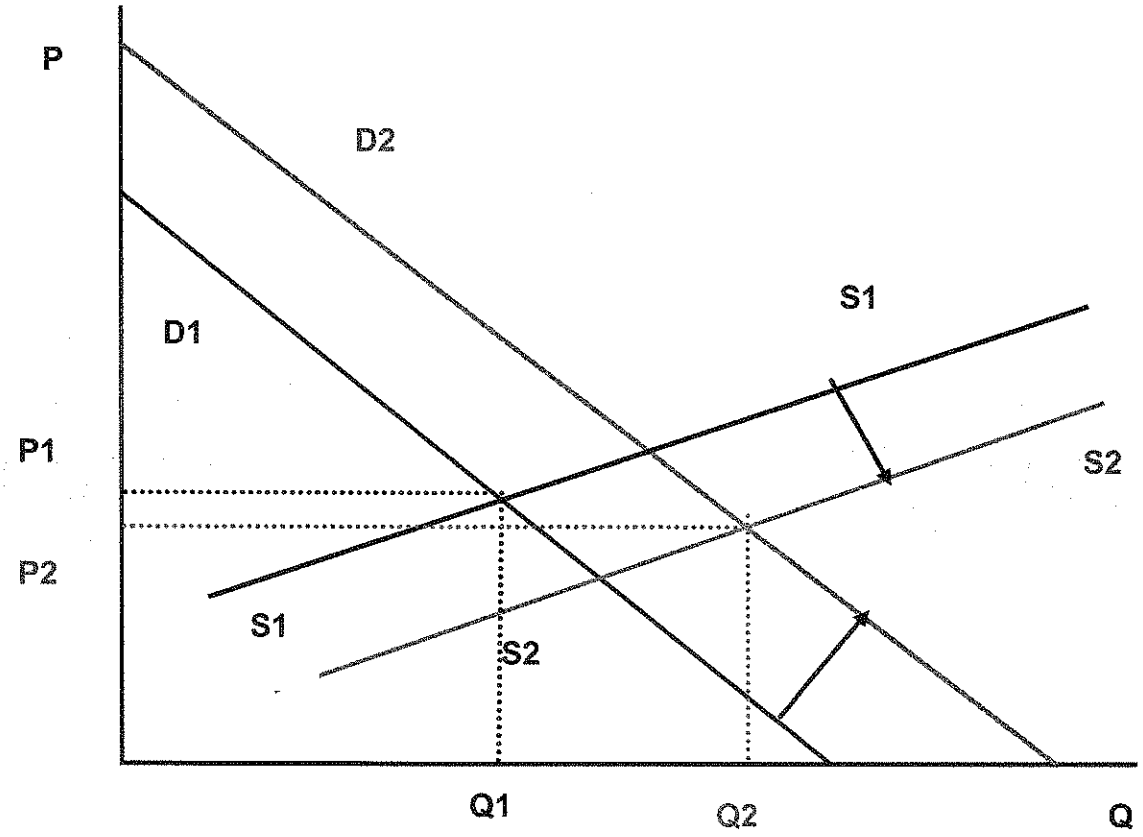


The supply and demand relationships illustrated in the above diagram are fully consistent with the dynamic growth experienced by many new industries and markets that have emerged over the past many decades as a consequence of technological, policy, regulatory, institutional and other transformative and fundamental changes as described in the work of Marshall, Arrow, Romer and the many endogenous growth theorists over the past century.

ANNEX 2 – Response Functions For Key Parameters

It should be noted that this study examines the impact of a 'change of a change', i.e., as the NPV impact is a change (depending on the change of the variable value) of a change (i.e. Total NPV equals NPV-POL minus NPV-SQ).

There are several reasons why the model exhibits non-linearity in several response functions for key parameters:

3. There are two kinds of constraints: a) the 'affordability' condition of expenditures < 15% of mean income; and b) quantity can't fall beyond zero (-100%) for a price elasticity response;

3. There are two avenues for quantity responses from: a) affordability limiting grams per day and b) misuse to reduce the required decrease in Policy users resulting from lower prices; and

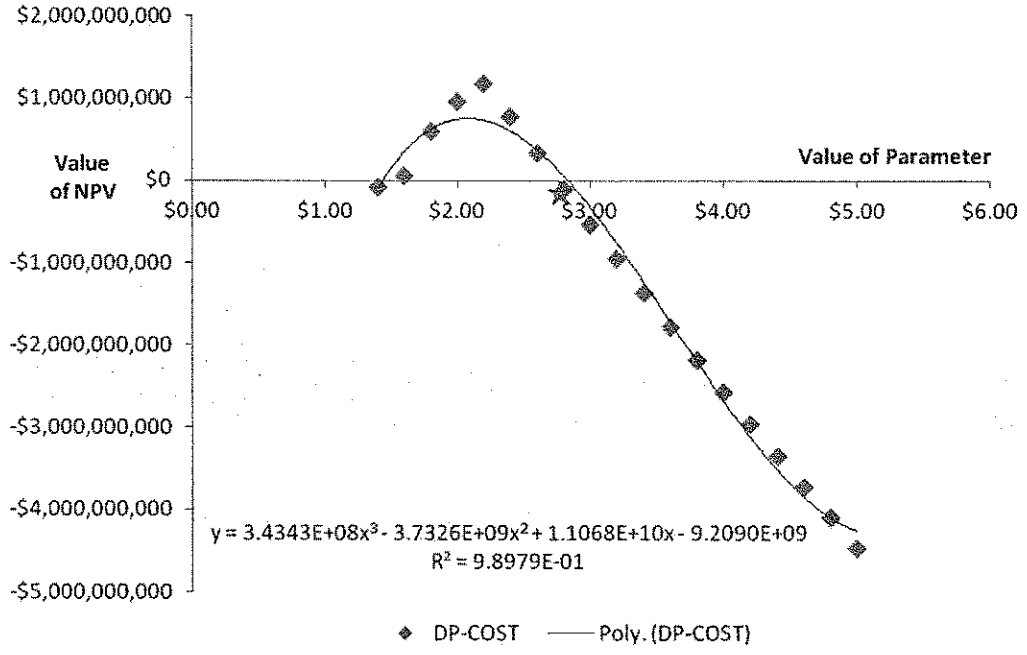
3. There are 'dual' (and opposite effect) uses of the price elasticity of demand to: a) compute the price intercept points which affects Consumer Surplus valuations; and b) affect the transition from the SQ to the Policy scenarios through the User Transition model.

These impacts can be either reinforcing or offsetting.

Designated Person Supply Cost:

The elasticity response to changes in the Designated-Person Supply Cost (DP-COST) is significant. A 1% increase (in the absolute value) of this variable from the Reference Case value of $2.80 (i.e., an increase of $0.028) reduces the NPV by 55% (ε_V=-55.0). The Reference case sits on the negatively sloped portion of the response curve (Figure 5.27).

Figure 5.27 NPV Response Curve: DP-COST



Source: Delsys Research

For most of the response curve ($2.20 < DP_{cost}): there are two reinforcing effects:

- Status Quo scenario: The value of CS-SQ rises with a higher DP_{cost} as a result of a higher price intercept of the Status Quo demand curve, which increases the valuation of consumer surplus in the Status Quo scenario; and

- Policy scenario: The value of CS-POL falls. This effect is caused (at this price level) by the fact that, in the Transition Model, there is no change in the Policy scenario quantity response (as this is dominated by the binding affordability (percentage of income) constraint, which forces the quantity to fall by more than what is required to satisfy the price elasticity effect) while the percentage price change has fallen. This implies that the ELAS-POL is more elastic, so that the price intercept of the Policy demand curve is reduced, which reduces the valuation of consumer surplus in the Policy scenario.

At the middle and high end of the price range, there is no reduction of users in the Policy scenario beyond that from continued misuse, so the overall negative NPV impact (from a DP_{cost} increase) comes from the increase in CS-SQ.

At the low end of the price range, the increase in price requires a quantity reduction that can't be accommodated by the continued misuse, and must be achieved from a reduction in Policy users (transitioning from ATP-D). However, a DP_{cost} increase requires a lesser quantity reduction and therefore results in an increase in the number of Policy users. The CS-POL impact is greater than the CS-SQ impact so there is a positive NPV impact.

Affordability Constraint (Maximum Percent of Mean Income):

The elasticity response to changes in the Maximum Percentage of Income (PC-INCOME) gets at the issue of 'affordability' and how consumers' budget constraints impact on the quantity consumed and the overall value of the resulting consumer surplus in the Policy scenario. A 1% increase of this variable from the Reference Case value of 15% (i.e. an increase of .15 percentage points) increases the NPV by 42% (ε_v=42.0).

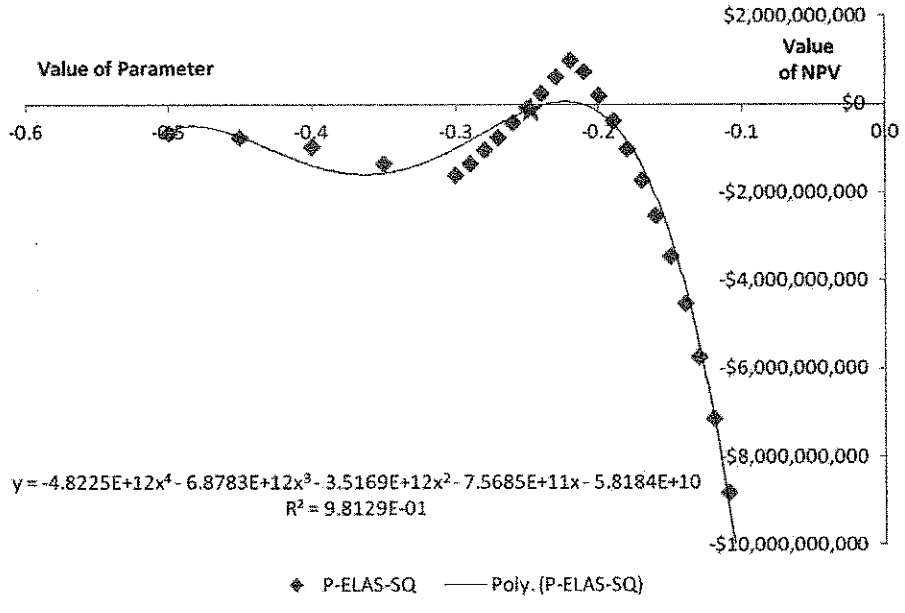
This constraint means that the Grams per Year (and Per Day) will be reduced if the Supply Price increases. In the Policy Transition Model this determines the number of persons who will switch and the level of demand they will exercise in the LP Market.

When the PC-INCOME is lower, this constrains the KG-Demand in the Policy scenario which, despite an increase in the number of Policy Users, reduces the scale of the LP Market and the Consumer Surplus that is generated in the Policy scenario.

Price Elasticity of Demand:

The elasticity response to changes in the Price Elasticity of Demand (P-ELAS-SQ) is significant. A 1% increase (in the absolute value) of this variable from the Reference Case value of -0.25 (i.e. an 'increase' of -.0025, which makes the price elasticity of demand more elastic) reduces the NPV by 23% (ε_v=-23.0). The Reference case sits on a relatively flat position of the response curve (Figure 5.28), where the slope of the response curve is negative.

Figure 5.28 NPV Response Curve: P-ELAS-SQ



Source: Delsys Research

At low (absolute value) levels (-.22 < ε < -.10): The high valuation of CS-SQ overwhelms all other results and generates a high negative NPV, as the inelastic demand generates very high price intercept points for the demand curve in the Status Quo scenario. The same does not occur for the Policy scenario, as the effective price elasticity is more elastic due to the dampening of the pure price elasticity effect caused by the 'opting out' of persons from the

former ATP-P/PUPL, due to misuse. This has the effect of making the Reference case ELAS-POL more elastic (-.35 versus -.25 for P-ELAS-SQ), so that the response in terms of the Policy scenario is muted, relative to the response for the Status Quo scenario. Over this range of values, everything is happening in terms of lower CS-SQ with only minor changes to the number of persons in the Policy scenario - but with no change over this range in the valuation of the CS-POL, as the effective ELAS-POL remains the same (-.31).

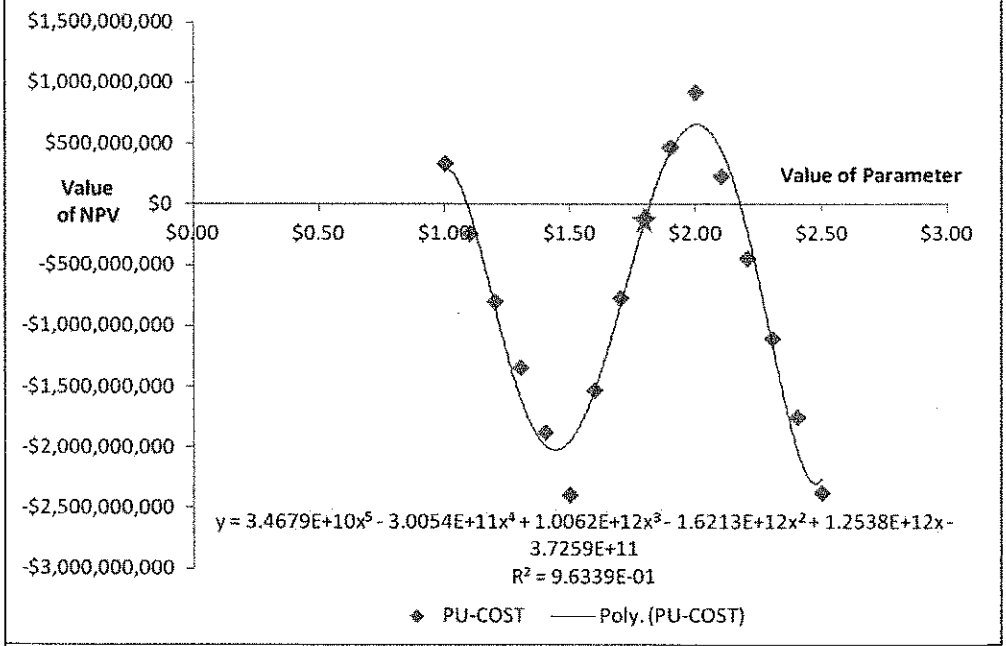
At mid levels ($-.32 < \varepsilon < -.22$): The CS-SQ and CS-POL both fall as the effective price elasticity of demand in the Policy scenario begins to respond to the higher price elasticity in the Status Quo scenario. Over this range of values, the fall in CS-POL is faster than the fall in CS-SQ so that the NPV falls over this range. The Reference case is in this section of the response curve.

At high levels ($-.50 < \varepsilon < -.32$): The fall in CS-POL is slower than the fall in CS-SQ so that the NPV rises over this range.

Personal Use Supply Cost:

The elasticity response to changes in the Designated Person Supply Cost (PU-COST) is significant. A 1% increase (in the absolute value) of this variable from the Reference Case value of $1.80 (i.e., an increase of $0.018) reduces the NPV by 98% (ε_v=-98.0). The Reference case sits on the positively sloped portion of the response curve (Figure 5.29).

Figure 5.29 NPV Response Curve: PU-COST



Source: Delsys Research

There are three distinct cases of response over the range of PU-CCOST.

4.8.1 High Values ($2.00 < PU_{cost}): As PU_{cost} increases there is a gain in CS-SQ, resulting from the higher supply cost and price intercept term in the Status Quo scenario; and a reduction in the price intercept term which leads to a fall in CS-POL, which reinforce the overall effect of a decline in the NPV result.

4.8.2 Mid Values ($1.40 < PU_{cost} < $2.00): As PU_{cost} increases there is a gain in CS-SQ resulting from the higher supply cost and price intercept term in the Status Quo scenario; and a gain in the number of users in the Policy scenario and an increase in the price intercept term which leads to a rise in CS-POL. The change in CS-POL increases at a faster rate than the change in CS-SQ so there is an overall positive slope to the response curve (i.e. the change in CS-POL dominates over the change in CS-SQ).

4.8.3 Low Values (PU_{cost} < $1.40): As PU_{cost} increases in this range, the increase in CS-SQ is reinforced by a decline in CS-POL which leads to the overall decline in the NPV result.

As PU_{cost} increases (at the low end of the range and at the high end of the range) there are reinforcing impacts:

1. an increase in CS-SQ and a reduction in CS-POL which produce the overall negative NPV effect.

As PU_{cost} increases (over the mid range from about $1.50 to $2.00) there are offsetting impacts:

2. an increase in CS-SQ and an increase in CS-POL, with the CS-POL effect dominating which produce the overall positive NPV effect.

It remains to explain why the mid range has different results – which is determined by the change (or lack of change) of the number of Policy scenario users at the high and low ends of the range.

At the high end of the price range, the reduction in quantity resulting from the binding affordability constraint is more than sufficient to achieve the desired price elasticity effect so that there is no loss of users in the Policy scenario beyond that from continued misuse.

At the middle of the price range, there is a need for the number of Policy users to decrease substantially to achieve the desired price elasticity effect. However, as PU_{cost} increases the required change in users is reduced so the impact on Policy users is decreased and this results in the gain in CS-POL.

At the low end of the price range, the reduction in quantity reaches its limit of -100% as Policy users (transitioning from ATP-P) fall to zero. At this extreme point there is no further loss in CS-POL and the reduction in CS-POL comes from the reduced price intercept.

URATE-PU/URATE-DP:

These parameters affect the quantity of marihuana that is estimated to be consumed in the Status Quo scenario. When these values are higher, the quantity of marihuana consumed is higher and the estimated Consumer Surplus (Status Quo) is higher. As the Consumer Surplus (Status Quo) is higher, and there is little impact of these parameters on the Policy scenario, they have a negative impact on the NPV result.

A 1% increase of the URATE-DP from the Reference Case value of 47% (i.e., an increase of .47 percentage points) decreases the NPV by 37% (ε_v=-37.0).

A 1% increase of the URATE-PU from the Reference Case value of 55% (i.e., an increase of .55 percentage points) decreases the NPV by 13% (ε_v=-13.0).

Delsys Research Group Inc. is a consulting company headquartered in Ottawa, Ontario, Canada. It was established as a multi-disciplinary firm, synthesizing the disciplines of law, economics, public administration, Systems Thinking, and Visual Thinking to provide public policy, program administration and regulatory improvement services to public and private sector clients.

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