



CORE

Public Health Functions for BC

Evidence Review:
Prevention of Harms
Associated with
Substances

Population Health and Wellness
BC Ministry of Health

This paper is a review of the scientific evidence for this core program. Core program evidence reviews may draw from a number of sources, including scientific studies circulated in the academic literature, and observational or anecdotal reports recorded in community-based publications. By bringing together multiple forms of evidence, these reviews aim to provide a proven context through which public health workers can focus their local and provincial objectives. This document should be seen as a guide to understanding the scientific and community-based research, rather than as a formula for achieving success. The evidence presented for a core program will inform the health authorities in developing their priorities, but these priorities will be tailored by local context.

This Evidence Review should be read in conjunction with the accompanying Model Core Program Paper.

Evidence Review prepared by:

Centre for Addictions Research of British Columbia

Evidence Review accepted by:

Population Health and Wellness, Ministry of Health (October 2006)

Core Functions Steering Committee (February 2009)

TABLE OF CONTENTS

Executive Summary i

1.0 Overview/ Setting the Context..... 4

2.0 Methodology 5

3.0 Background..... 7

 3.1 Spectrum/Continuum of Psychoactive Substance Use 7

 3.2 Patterns of Use and Community Differences..... 9

 3.3 Evidence-based Interventions and Best Practices..... 11

 3.4 Developmental Pathways..... 12

 3.5 Adult Substance Use 14

 3.6 Human Rights Framework..... 14

 3.7 Best Advice to Health Authorities 15

4.0 Proven and Promising Prevention Strategies..... 17

 4.1 Reproductive Health 17

 4.2 Maternal and Fetal Health..... 19

 4.3 Infancy and Early Childhood (0 to 4 Years)..... 21

 4.4 Early School Years (5 to 10 Years) 23

 4.5 Adolescence (11 to 17 Years)..... 24

 4.6 Universal Interventions Impacting All Age Groups 28

5.0 Conclusion 37

References..... 38

Appendix A: Summary Table 47

List of Figures

Figure 1: Spectrum of Psychoactive Substance Use..... 7

List of Tables

Table 1: A Matrix of Risky Substance Use Patterns and Examples of Associated Harms to Early Development, Health, Safety and Well-Being 9

Table 2: Prevalence of Mental Illness by Source of Data 33

EXECUTIVE SUMMARY

In 2006, the Ministry of Health and the Centre for Addictions Research of BC produced a document, *Following the Evidence: Preventing Harms from Substance Use in British Columbia*. The purpose of the evidence paper is to establish a common understanding and provide some priorities based on the best available evidence on how to address and prevent harms associated with substances. The evidence paper is for the government, non-government and private sectors, and those involved in community-based activity both locally and provincially. It speaks to the responsibilities of the health system and other public systems in British Columbia, including education, social services, police, courts, judiciary, victim services and corrections, including probation and parole. The paper is intended to guide the development of prevention services and activities to help ensure consistency across inter-sectoral approaches to psychoactive substance use. *Following the Evidence* articulates core concepts, guiding principles, key strategic directions and actions for British Columbia that are based on the best available evidence, and is meant to broaden the understanding of prevention, help provide access to what is known to be effective and draw attention to the variety of potentially successful prevention strategies.

Local and regional partners form much of the service delivery infrastructure for preventing harms from substance use. Together, they have the most immediate role to play as either direct providers or funders of health promotion, prevention, harm reduction, treatment and support services. The rich and complex web of inter-relationships that currently exists (and can be enhanced) among health, education, local government, social services, employment and enforcement partners at the regional and local level will form the foundation of an integrated and comprehensive response to preventing harms from substance use.

What follows is an evidence review paper on the prevention of harms associated with substances, focused on evidence of effective public health services at the health authority level. This in turn is meant to assist the health authorities to develop a “gap analysis” between what is provided and the set of functions or interventions that are recommended; this will, in turn, lead to the development of performance improvement targets and plans.

This evidence review paper adopts similar guiding principles contained in *Following the Evidence: Preventing Harms from Substance Use in British Columbia* (Ministry of Health 2006). It also follows the same strategic directions that international evidence suggests will have the most impact on preventing harms from substance use:

- Influencing developmental pathways and acknowledging that different life stages present differing risks and protective factors for harms.
- Delaying and preventing alcohol, tobacco and cannabis use among adolescents, a time of life when problematic patterns of use for these substances can lead to significant harms later in life.
- Reducing risky patterns of substance use, emphasizing interventions that can impact those types of substance use that have the greatest likelihood of causing harm.
- Creating safer contexts, which acknowledges that the setting or environment where substance use occurs can affect the risk of harms.

Core Public Health Functions for BC: Evidence Review

Prevention of Harms Associated with Substances

- Influencing economic availability, whereby pricing mechanisms can be used to influence the use of substances such as alcohol and tobacco.

Psychoactive substance use occurs in all societies, but the consequences of substance use vary depending upon the level and context of use, as well as individual susceptibility. Recent estimates for 2000 indicate that approximately 7 million deaths globally were associated with the use of psychoactive substances: 70 per cent due to long-term effects of tobacco, 25 per cent from problematic alcohol use and 5 per cent from illegal psychoactive substances. The overall direct and indirect impacts of alcohol and tobacco were almost equal and jointly accounted for 90 per cent of disability-adjusted-life-years due to problematic substance use, with illegal drugs accounting for the remaining 10 per cent (Rehm and Room 2005). In emerging economies, the impacts are greater for alcohol than tobacco. The overall impact of problematic substance use is greatest in the developed world but is still substantial elsewhere, especially in countries with emerging economies and longer overall life expectancy.

A recent Canadian cost study, based on 2002 data, estimates the overall social cost of problematic substance use to be \$39.8 billion, representing a cost of \$1,267 to every Canadian. Tobacco accounts for about \$17.0 billion (42.7 per cent of the total estimate), alcohol accounts for about \$14.6 billion (36.6 per cent) and illegal drugs for about \$8.2 billion (20.7 per cent). The social costs included in the 2006 study include the direct costs of health care, enforcement, and research and prevention, and the indirect costs of lost productivity in the workplace or at home (Canadian Centre on Substance Abuse 2006). The focus of this evidence review paper is on how this great toll of death, injury and illness might be reduced for future generations by implementing effective prevention interventions.

Adolescence presents many concerns as young people test their limits and develop their own social networks, often in an attempt to express their independence. Many adults express concern about adolescent experimentation with psychoactive substances that are illegal. However, the most common patterns of risky substance use are usually with more familiar substances such as tobacco and alcohol. Furthermore, the use of these socially sanctioned substances has generated increasing concern, with evidence of increased “binge” drinking by teenagers in the United Kingdom, Europe, Canada and Australia, as well as relatively high levels of tobacco use in this age group (Hibell et al. 2004; Plant, Miller and Plant 2005; Chikritzhs, Pascal and Jones 2004; Adlaf, Begin and Sawka 2005). Also, in many countries there has been a marked increase in the use of cannabis, “party drugs” such as ecstasy, and injectable drugs such as heroin, cocaine and various amphetamine-type drugs over the past three decades (Adlaf et al. 2005).

Early use of psychoactive substances often predicts later problematic use, general health and mental health problems, and developmental delays in cognitive and emotional functions in young adulthood. Alcohol-related motor vehicle crash deaths frequently remain the leading cause of death among persons aged 15 to 24 years. Tobacco kills more people than all the other psychoactive substances combined, and uptake of tobacco smoking usually starts during the teenage years (Younie et al. 2005).

In many countries, significant investments have been made into prevention programs and their evaluation. Recent reviews of interventions for prevention of substance use and its harms (Stockwell et al. 2005; Loxley et al. 2004; Babor et al. 2003) have documented what can be learned from the global experience. These reviews have identified key elements that influence

Core Public Health Functions for BC: Evidence Review
Prevention of Harms Associated with Substances

substance use patterns and contribute to or mitigate harms: the structure of the adult world that influences children and shapes their future patterns of substance use; recent contributions from research on brain development that isolate critical factors during pregnancy, birth, infancy and childhood that might be modified to reduce the risk of later behavioural problems, including those associated with substances; and a number of more general lessons and principles that underpin effective prevention that can be extracted from international experience of what works in certain settings or cultures. This brief review will try to summarize some of these lessons, identify some general principles and give a few specific examples of effective prevention practice that have been documented in different parts of the world; these examples may be of use to health authorities charged with the responsibility for developing and delivering an effective, integrated and comprehensive response to preventing harms from substance use.

1.0 OVERVIEW/ SETTING THE CONTEXT

In 2005, the British Columbia Ministry of Health released a policy framework to support the delivery of effective public health services. The *Framework for Core Functions in Public Health* identifies the prevention of harms associated with substances as one of the 21 core programs that a health authority provides in a renewed and comprehensive public health system.

The process for developing performance improvement plans for each core program involves completion of an evidence review used to inform the development of a model core program paper. These resources are then utilized by the health authority in their performance improvement planning processes.

This evidence review was developed to identify the current state of the evidence based on the research literature and accepted standards that have proven to be effective, especially at the health authority level. In addition, the evidence review identifies best practices and benchmarks where this information is available.

2.0 METHODOLOGY

The best advice contained in this paper for health authorities to prevent harms from substance use is based upon evidence collected using search techniques that follow rigorous conventional academic guidelines. Such a strategy ranks the strength and quality of evidence along a continuum, from systematic reviews and meta-analyses of randomized controlled trials at the top, to expert opinion and consensus near the bottom. This provides a mechanism of quality control to ensure that any advice provided to the health authorities is sound and grounded in the peer-reviewed scientific literature. To this end, the best advice for health authorities includes both proven and promising prevention interventions.

Two thorough and comprehensive reviews of the best evidence for the prevention of harms associated with substances have recently been published:

- *The Prevention of Substance Use, Risk and Harm in Australia: A Review of the Evidence* (2004), by Loxley et al.
- *Preventing Psychoactive Substance Use and Related Harms Among Children and Adolescents: A Review of Theory and Global Best Practices to Address Psychosocial and Neurobiological Factors* (2005), by Stockwell et al. (Prepared for the World Health Organization).

In the review by Loxley et al. (2004), scholarly electronic databases and online libraries were explored for published and unpublished literature. The databases searched included: PsycINFO, Medline, Embase, Current Contents, Dissertation Abstracts, SIGLE, Social Work Abstracts, National Clearinghouse on Alcohol and Drug Information (IDA), DRUG database, Alcohol and Alcohol Problems Science Database (ETOH), CINCH (the Australian Institute of Criminology library), The Cochrane Library, Campbell Collaboration (criminal justice version of Cochrane), the Lindesmith Centre and general internet searches for specific reports in pdf and html format using the GOOGLE search engine.

The initial searches produced over 9,000 studies. All titles and abstracts of articles produced in these searches were then examined in order to select potentially relevant reviews as per the areas of interest designated for investigation. The final search strategy supplemented this material with relevant literature identified by experts contracted to assist with the project.

Explicit, internationally recognized criteria were considered both for assessing the calibre of the evidence under review and for reporting conclusions regarding the effectiveness of specific interventions. In particular, considerable attention has been given to ensuring that any conclusions drawn are linked to the strength of the evidence and do not exceed the evidence reviewed, and that values attached to outcomes (such as costs and risks of harm) are also considered. To ensure that key reviews were included, a number of experts were consulted to identify important material and to review drafts of the sections on interventions.

In general, reviews were excluded where they relied on expert views and provided no attempt to systematically utilize levels of evidence criteria to appraise empirical research. Reviews were appraised as of high, moderate or weak quality according to their fit with the criteria articulated

above. A standardized evaluation checklist guided reviewers' assessments. Individual reviews were not evaluated separately. Rather, the checklist was used by reviewers to derive a qualitative assessment of the strength of the evidence for each type of strategy, and this is reported in the text.

Based on evidence from existing reviews and the appraisal of primary evidence, conclusions were reached regarding the effectiveness of strategies for reducing harmful drug use. Six mutually exclusive categories were developed to briefly summarize the status of research evidence as to how each strategy addresses different categories of harmful drug use at different life stages. The following categories were used to convey conclusions regarding the implication for future investment in research and dissemination: limited investigation; evidence is contra-indicative; warrants further research; evidence for implementation; evidence for outcome effectiveness; and evidence for effective dissemination. These criteria for evidence for outcome are congruent with definitions commonly used by the National Health and Medical Research Council (NHMRC), The Cochrane Collaboration and other groups (e.g., systematic review of randomized trials).

Hence, these reviews were composed from extensive searches and culminate in a series of recommended prevention interventions and strategies based upon the best evidence gleaned from the research literature. The quality of the evidence is taken into consideration in both reviews, and recommended strategies are rated based upon the level of evidence supporting the effectiveness of prevention interventions. This paper is essentially an amalgamation of these two major recent reviews; it attempts to focus on prevention interventions that are appropriate best practices for British Columbia and are within the scope of health care programs and services delivered by the health authorities.

3.0 BACKGROUND

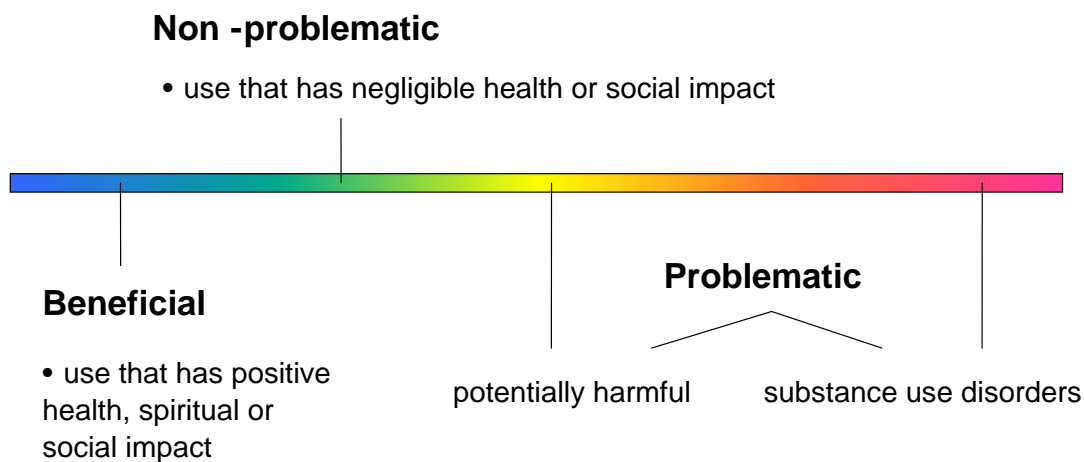
3.1 Spectrum/Continuum of Psychoactive Substance Use

Within society, there is a spectrum, or continuum, of psychoactive substance use ranging from beneficial to problematic.

The majority of British Columbians use one or more psychoactive substances. They include, among other substances: alcohol, tobacco, certain medications and currently illegal drugs, such as cannabis, heroin and cocaine. These substances are widely available everywhere in the world (United Nations Office on Drugs and Crime 2005), through either legal regulated markets for some substances, or through illegal markets for prohibited substances.

Substance use can occur along a spectrum, from beneficial use through to non-problematic, problematic and dependent use. Problematic substance use includes episodic use that can have negative health consequences and chronic use that can lead to substance use disorders (e.g., dependence) or other serious illnesses. Figure 1 illustrates the idea that as substance use becomes more intense (i.e., greater quantities per occasion with greater frequency) the likelihood of negative outcomes increases.

Figure 1: Spectrum of Psychoactive Substance Use



Substance use may begin at one point on the above spectrum and remain stable, or move gradually or rapidly to another point. For some people, their use of one substance may be beneficial or non-problematic, while their use of other substances may be problematic. Furthermore, the same pattern of substance use may have benefits in one area of a person's life and potential risks in another.

In moderation, many psychoactive substances can be consumed and enjoyed without harm, and some provide important benefits (Health Officers Council of British Columbia 2005; Shewan and Delgarno 2005). Humans have used a variety of substances for millennia as sacraments, to stimulate thought, enhance awareness or creativity, for social purposes and for simple pleasure.

Core Public Health Functions for BC: Evidence Review

Prevention of Harms Associated with Substances

Some people choose to abstain from using any psychoactive substances, while most people choose to use some and abstain from others. It is important to emphasize that abstinence is a healthy lifestyle choice.

When substance use is problematic, harms caused to individuals, families and communities demand attention. Some of the harms, for example lung cancer and liver disease, result from hazardous use over a number of years. Many other harms, such as injuries when intoxicated, or overdoses and infections transmitted by sharing needles, can arise from a single episode of use. Some substance use may simultaneously provide both benefits and risks. For example, frequent light alcohol consumption may protect older people against heart disease, but can also elevate the risk of some cancers (Babor et al. 2003). The risk of harms is determined by the nature and/or composition of the substance, its concentration, the amount used on an occasion, the way it is administered and the setting in which use occurs.

However, the intensity of substance use is not the only factor that determines whether harms or benefits occur. For example, much of the harm attributed to illegal psychoactive substances is actually consequent to prohibition of the substances themselves. Harms can be exacerbated or originate from laws and policies that fail to take into account or ignore their unintended consequences. The enforcement-based model for drug use continues to fuel the HIV pandemic around the world—especially in China, Russia, Thailand, Malaysia, Ukraine and Vietnam—and blocks governments from adopting proven harm reduction strategies. Sharing needles and injection equipment is a major cause of the escalating HIV rates; in many countries, people who inject drugs account for most new HIV infections and, excluding Africa, injection drug use now accounts for 30 per cent of all new HIV infections worldwide. The harms attendant to a criminal-prohibition framework for drugs are significant and the benefits are modest. Many argue that a change in policy to a public health approach, where control of production and distribution can be taken away from criminal interests, and where a range of effective harm reduction strategies can be implemented and evaluated, is overdue (Health Officers Council of British Columbia 2005).

Table 1 summarizes the main patterns of substance use that increase risks of harmful outcomes, with examples from the major domains of health, social well-being and personal safety. Effective prevention needs to reduce these risky patterns of use and modes of administration if it is to impact on population levels of harm.

Table 1: A Matrix of Risky Substance Use Patterns and Examples of Associated Harms to Early Development, Health, Safety and Well-Being

Category of Harm	Drug Administration	Intoxication, Acute Effects	Regular Use, Chronic Effects	Dependence
Developmental harm examples	Use in pregnancy (Fetal Alcohol Spectrum Disorder); environmental tobacco smoke and children	Family conflict; impaired parenting	Early and regular use by children; parental modelling	Child abuse and neglect
Physical health examples	Blood-borne pathogen transmission associated with injection drug use; Smoking, increasing risk of respiratory diseases	Acute medical conditions (e.g., poisoning, overdose)	Cancers; strokes; liver or heart disease	Withdrawal symptoms; seizures
Personal safety examples	Death from burning due to discarded cigarettes	Intentional and unintentional injuries to self and others	Increased risk of injury as a result of loss of tolerance due to liver disease	Risk-taking to protect supply
Mental health examples	Increased risk of dependence from quick action methods (e.g., smoking, injecting)	Psychosis; reckless behaviour	Cognitive deficits	Mood disorders
Social well-being examples	Stigma associated with injection drug use; criminal record; incarceration	Legal problems, unwanted pregnancy	Financial problems; unsafe communities due to crime	Financial, work or relationship problems

Adapted from Stockwell, et al. 2005.

3.2 Patterns of Use and Community Differences

Local patterns of use and community differences in use should guide the implementation of specific interventions.

3.2.1 Patterns of Use

While new, unfamiliar and illegal drugs create most concern and discussion, risky and harmful patterns of use of familiar and mundane substances, such as tobacco and alcohol, are usually both more common and cause more problems. The concept of the “Prevention Paradox” is relevant here: numerous but commonplace and apparently low-risk behaviours often cause far more health and safety problems than do a small number of visible and apparently high-risk behaviours. One example is the significant community concern in a number of countries associated with the increased use of methamphetamine (or “crystal meth”), when the numbers of deaths caused by this substance are typically 100 times fewer than those from alcohol (e.g., Ministry of Health Services 2004). That is not to say strategies for dealing with new illegal

substances should not be discussed; however, the overall attention and resources allocated to preventing harm from different substances should reflect the actual local levels of harm they each cause. Furthermore, community concern about a new, potentially dangerous psychoactive substance provides an opportunity to mobilize support and action to deal with the full-spectrum of substance use problems.

It is important to add that levels of current problems associated with substances are only one dimension of the harm to be considered. The potential for later problems, including dependence, health, social and legal problems, need to be taken into account as well. Efforts to measure the extent of harm from substance use have tended to focus on health impacts, and to a lesser extent social impacts (Collins and Lapsley 2002). There has been little attention to costs related to “developmental harm,” such as the tendency for adult substance use to disrupt the development of children and for adolescent substance use to lead to later problematic substance use and related problems.

The World Health Organization (WHO) has produced a number of guidelines for monitoring regional and national patterns of use and the harms from tobacco, alcohol and illegal drugs (WHO 1998; 2000a; 2000b). It is recommended that, whenever possible, prevention campaigns are carefully informed by available health, police and survey statistics on local and regional levels of harm related to the full spectrum of legal and illegal substances. In many countries, the available evidence suggests that the overwhelming contribution to health and social problems is from tobacco and alcohol; thus, these substances should usually be the primary targets for prevention programming.

3.2.2 Community Differences

In addition to the importance of monitoring patterns of substance use and harm, it is important to understand community differences in the factors that influence substance use. Communities are characterized by different pathways to the development of harmful drug use. Problems that young children are often exposed to in many disadvantaged communities (e.g., familial substance use problems, poor family functioning, and a high rate of harmful drug use and trafficking in the neighbourhood) characterize developmental pathways to drug-related harm. In more advantaged communities, many young people with few risk factors in childhood become involved in developmentally harmful drug use in adolescence, due to community and family pressures and to peer influences operating in schools and communities. The existence of community differences in the risk processes that operate to adversely influence child and adolescent development suggests the need to carefully assess developmental risk and protective factors at the community level, in order to tailor appropriate developmental prevention strategies (e.g., Arthur and Blitz 2000).

On a more positive note, communities also exhibit features of social interactions that facilitate co-operation for mutual benefit, such as networks, social norms and social trust (WHO 2004). Such features, referred to as social capital, enable collective action and promote social and economic growth and development by complementing other forms of capital, such as physical and human capital. Communities with high levels of social capital will be those in which individuals are well-connected with each other in many co-operative and mutually beneficial ways, for social, commercial, cultural and educational exchanges.

Research over the last two decades has suggested links between social capital and economic development, the effectiveness of human service systems and community development. Impressive evidence has recently demonstrated that social capital can help mitigate the impact of social and economic disadvantage and promote better health (Putnam 2000). Social capital has been found to influence individual health, even after controlling for income, education and risk behaviours such as smoking (Loxley et al. 2004).

The potential benefits of social capital are incredibly broad: preventing delinquency and crime, promoting successful youth development, improving educational outcomes, decreasing health disparities and even increasing economic productivity (Cohen and Prusak 2001). However, there can be a significant downside. Communities with high social capital have the means, and possibly the motive, to be exclusive or to resist changes that have important benefits (World Bank 1999). Nonetheless, social capital has increasingly been identified as a mechanism to explain relationships between social factors and health outcomes (Loxley et al. 2004). It is a powerful tool in understanding the complex relationships identified within community systems and population health approaches.

The concept of social capital is useful for the purposes of preventing harms from substance use as it emphasizes the importance of focusing not only on the substances being used but on the communities of people who use them. Fostering healthy social networks and building community capacity are important activities to complement more specific strategies recommended in the document.

3.3 Evidence-based Interventions and Best Practices

Interventions should be evidence-based and development and implementation should be guided by best practices.

The recent major review by Loxley et al. (2004) rates the strength of the evidence base for 159 prevention initiatives on a 6-point scale. Prevention strategies cover the full range from negative evidence, suggesting the strategy was ineffective or even harmful, to many positive published outcome studies with well-developed models for wide dissemination and implementation. In Stockwell et al. (2005), the authors conclude that often the extent of investment in prevention measures in economically developed countries is inversely related to the strength of the effectiveness evidence—ineffective interventions are often funded over effective ones. They also conclude that the overall effectiveness of most prevention efforts is directly correlated to the amount of investment dedicated to strategies with the strongest evidence base. It is also necessary to modify any strategy to meet local needs and insist the effective elements are followed. These principles regarding the implementation of evidence-based strategies are outlined by McBride (2005) regarding school-based programs.

However, the nature of the evidence needed depends on what is meant by effectiveness. For the purpose of this paper, effectiveness refers to the extent to which the intended outcomes of an intervention are achieved in accordance with stated values, and within the limited resources available, particularly within the funding envelopes of each health authority. To ensure efficient as well as effective use of resources, it will be important for policy-makers and service providers

to understand what an integrated response to prevention will likely cost in terms of the resources it consumes and the type of outcomes that can be expected. Much evidence still rests on the effectiveness of programs, without specifying the resources needed to bring this about (Loxley et al. 2004).

Other challenges also face communities seeking to apply the evidence. Research, practice and policy have usually been constructed to affect the entire population without specific attention to differential effects on women and men, or various sub-groups such as Aboriginal men or teenage girls. As such, evidence is usually lacking on the impact of population-level policies on many sub-populations, as well as on targeted approaches that address vulnerabilities specific to diverse groups of women and men.

In summary, all evidence has weaknesses and we can rarely know enough to act with absolute certainty, but we can be sure enough of the quality of the existing evidence to make recommendations for action (WHO 2004). The precautionary principle borrowed from the field of environmental sustainability states that, where there are threats of serious or irreparable damage, lack of full scientific certainty shall not be used as a reason for postponing measures to prevent harm. The challenge for policy-makers and service providers is to actively seek and promote the use of the best available evidence, and to support the accumulation of a more complete evidence base, while continuing to take decisive action to prevent and reduce harm.

3.4 Developmental Pathways

Prevention interventions should address developmental pathways that are common precursors to multiple problem behaviours including problematic substance use.

Important factors that operate throughout early human development shape the likelihood of a range of problematic behaviours in adolescents, including problematic substance use. These factors interact with genetic traits (e.g., personality) and other aspects of brain function and influence the emergence of substance use problems (Karkowski, Prescott and Kendler 2000). Therefore, prevention involves the identification of both risk and protective factors that influence psychosocial development and maturation. This is summarized by Toumbourou and Catalano (2005) and is predicated on the evidence that an accumulation of risk factors and an absence of protective factors greatly increase the likelihood of problem behaviours in adolescence. The range of protective factors is influential, from positive engagement and bonding with family, friends and community, to optimum levels of cognitive functioning and emotional self-regulation. Risk factors can be identified for each developmental level, and include elements that disrupt and impede healthy neurobiological, psychological and social development in key life domains.

Several opportunities for intervention have been identified at particular developmental stages and at key social transitions. It is important for persons to adapt and succeed during these stages in order to achieve later health and social adjustment in relation to substance use, mental health or conduct disorders (e.g., Australian Attorney-General's Department 1999; Loxley et al. 2004). The following are a few examples:

Core Public Health Functions for BC: Evidence Review

Prevention of Harms Associated with Substances

- Prenatal nutrition and the avoidance of harmful substances such as alcohol are critical for proper early brain and body development.
- The first few weeks and months of life provide a foundation for mother-child bonding, critical for normal infant development—nutrition, stimulation, nurturing and an absence of environmental tobacco smoke through this period reinforce the bonding mechanism and promote optimal functioning.
- Preschool preparation for basic language and cognitive skills, and acceptance of authority, are critical for successful learning in the classroom.
- Early school experiences can modify developmental pathways.
- The teenage years are critical for establishing social skills and networks, healthy behaviours and eventual entry into adult environments that may or may not involve substance use.

Evidence-based interventions at these and other critical stages can prevent harmful substance use as well as other social and mental health problems.

Risk factors for substance use problems can also be understood in terms of deficits in brain development and functioning. Many factors, from the genetic to the social environmental, directly impact the brain to influence the expression of psychological and behavioural anomalies that commonly precede substance use problems (Tarter et al. 1999). Social deprivation, poverty, traumatic stress and prenatal drug exposure can each impair brain functioning and lead to the development of later problem behaviours. The relationship between genetic, neurobiological and environmental processes is interactive, fluid and cumulative. However, brain function deficits, whether genetic or environmental in origin, can be modified through targeted social and environmental interventions. Interventions directed at promoting normal neurological development will most likely have preventive benefits.

While the accumulation of social, neurobiological and developmental risk factors can significantly increase the incidence of early substance use and associated problems, it is also the case that many low- and average-risk adolescents can experience significant harms when under the influence of the most widely used substances (alcohol and tobacco). In one study, the majority of adolescents who regularly smoked cigarettes and/or engaged in "binge drinking" were assessed as low or average on social and developmental risk measures (Stockwell et al. 2004). Genetic and biological factors were not assessed directly in this study, but are understood to be closely related to the social and developmental factors that were formally assessed. This reinforces the need to adapt prevention responses to both specific individual and community conditions. In some communities, individual risk factors that have an impact at an early age may need to be the prevention focus, while, in others, the focus should be upon broader social environmental and harm reduction strategies such as monitoring alcohol sales and marketing, more access to prenatal care and educational programs that reduce child abuse.

3.5 Adult Substance Use

Prevention interventions must take into account adult substance use.

Patterns of adult substance use can impact choices and behaviours of children and adolescents. Changing societal patterns in alcohol and drug use have led to increasing levels of substance use among women (Holdcroft and Iacono 2002). This in turn increases the risk of perinatal alcohol or drug exposure, as young women with heavy patterns of substance use enter the life stage for conception and birth, possibly unaware that conception has occurred. Heavy maternal alcohol and other substance use during pregnancy can result in a range of disabilities and difficulties that affect normal brain development and mental health, should the pregnancy result in a live birth. Adverse impacts on children from parent's problematic substance use are well documented and include the effects of passive smoking, neglect, family discord, physical and sexual abuse (Fergusson, Horwood and Lynskey 1994). These patterns of behaviour are often repeated by the next generation. However, adverse outcomes for children are not inevitable, and depend on other factors such as the extent of parents' problematic use of psychoactive substances, availability and response to treatment, and economic and other social conditions.

There are also subtle ways adult substance use can affect the health and well-being of children. Risky patterns of substance use by adults provide a powerful role model to children. Patterns of substance use by children are partly predicted by parents' behaviours and attitudes; children with parents who smoke are more likely to smoke themselves, and children whose parents drink excessively or have problems with other drugs are also more likely to engage in these behaviours (Hawkins, Catalano and Miller 1992). Parents may also influence the likelihood of their children experiencing substance use and other behavioural problems through genetic mechanisms; genes coded for susceptibility to substance dependence may be inherited by their children (O'Connor et al. 1998a; Barnes et al. 2000).

Finally, communities across the world vary considerably with regard to their social norms and cultural traditions around the use of different psychoactive substances. These are communicated formally and informally to children and young people and influence the acceptability and availability of different substances. Legally available substances like tobacco and alcohol may be easily and cheaply available not only to adults in a particular community but also to adolescents and even children if regulatory controls are absent or ineffective. In short, comprehensive prevention strategies regarding young peoples' substance use will have limited or no effect if they do not address adult culture around risky patterns of use, availability and regulatory controls.

3.6 Human Rights Framework

Prevention of harm from substance use must occur within a framework of human rights.

It is increasingly understood that environmental and societal factors increase or perpetuate the vulnerability of certain individuals and groups more than others. Vulnerability, in turn, limits the extent to which people are capable of making informed decisions about their own health, safety and well-being. These factors—which include unemployment, poverty, single motherhood, geographic isolation and aboriginal status, among others—play key roles in influencing individual risk and risk-taking behaviour. A human rights framework, with its emphasis on the

social, economic and cultural dimensions of human development and well-being, provides an intersectoral context for addressing these broad determinants of health and substance use. Effective vulnerability reduction means going beyond the immediate risk-taking act to address the underlying factors that create environments that support and encourage risk behaviour. A human rights perspective allows us to consider how marginalization, disadvantage and social exclusion affect substance use, the burden of harm from use and the experience of policy and program interventions.

Human rights include individual civil, political, economic, social and cultural rights. These rights empower individuals and communities by granting them entitlements that give rise to legal obligations on governments. Human rights, for example, can help to equalize the distribution and exercise of power within society, thereby mitigating the powerlessness of the poor. The principles of equality and freedom from discrimination demand that particular attention be paid to vulnerable groups. The right to participate in decision-making processes can help to ensure that marginalized groups are able to influence health-related matters and strategies that affect them (WHO 2004). Greater involvement of people who use drugs in the planning of policies, programs and services that affect them is an example of how this principle can work in the substance use field (Canadian HIV/AIDS Legal Network 2005).

A human rights framework offers a useful tool for understanding and responding to public health issues, such as problematic substance use. For example, the violation of human rights can increase the risk of problematic substance use and, conversely, such use can negatively affect the extent to which human rights are upheld. By acknowledging the dynamic and mutually reinforcing relationship between health and human rights, the concepts of vulnerability and risk, distribution of health outcomes and effectiveness of policies can be better understood (Gruskin, Plafker and Smith-Estelle 2001).

3.7 Best Advice to Health Authorities

In May 2004, the BC government released *Every Door is the Right Door: a British Columbia Planning Framework to Address Problematic Substance Use and Addiction* (Ministry of Health Services 2004), to assist health authorities and their partners to plan, implement and evaluate integrated and evidence-based responses to problematic substance use and mental disorders. The framework is intended as a tool for health authorities and their partners to use in developing regional plans and initiatives in health promotion, prevention of problematic substance use, harm reduction and treatment for substance use disorders and mental disorders.

In particular, the framework is intended to assist health authorities and communities to: assess their strengths, challenges and priorities in responding to problematic substance use and mental disorders; develop integrated health service delivery plans; work with partners to implement plans; monitor progress; and evaluate and plan improvements in service delivery.

The vision promoted by the framework is a client-centred and sustainable health system that supports people to stay healthy, get better, live with illness or disability and cope with end-of-life issues. It is a system that enables people to have their care needs met seamlessly as they move

Core Public Health Functions for BC: Evidence Review
Prevention of Harms Associated with Substances

through the health system, regardless of who has the administrative or management responsibility for health services.

The framework also acknowledges that child and youth health will ultimately depend on the success of efforts to prevent the development of problematic substance use and mental disorders, rather than simply upon the ability to treat them. The foundation of an effective response is comprehensive health promotion and prevention strategies that provide children and adolescents with meaningful and constructive opportunities to develop their interests, abilities and resilience.

As the health authorities grapple with how to provide the best prevention programs and services, planning can be guided by the strategic directions outlined in *Following the Evidence: Preventing Harms from Substance Use in British Columbia*, and interventions can be informed by the relevant best evidence outlined in this evidence review. What follows in this review are some evidence-based prevention strategies, along with suggestions for specific evidence-based interventions for health authorities to consider.

4.0 PROVEN AND PROMISING PREVENTION STRATEGIES

Effective prevention programs influence developmental pathways across the lifespan by addressing social and structural determinants, reducing individual risk factors and increasing protective factors. Particular attention to those transition points at which problems from substance use often emerge is important. Such key developmental stages include the prenatal/post-natal period, the transition to school, adolescence and the transition to high school, transition to independence (going to college or entering the workforce), and transitions relating to family and occupation, including retirement. The reader should note that both the interventions and the proposed initiatives have been rated as either proven (α) or promising (β).

4.1 Reproductive Health

4.1.1 Background

The likelihood of a healthy and well-adjusted childhood and adolescence is increased if adults are prepared for pregnancy, childbirth and parenthood, and are supported with sufficient economic and social resources. Conversely, unplanned pregnancies present risks to the development and health of the fetus, the bonding process between mother and infant and the prospects for positive future maturation and adjustment. Adverse outcomes, however, are not inevitable, and multiple formal and informal responses can protect against the increased risk of negative consequences.

At first glance, it may seem obvious that interventions that reduce the risk of unwanted pregnancies are the most “upstream” of all that might reduce the risk of problem behaviours. However, while there is an increased risk of later problem substance use for children born from some unplanned pregnancies, such a result is not inevitable, as there are many potential positive intervening steps throughout the maturation process from childhood to adulthood. The real risk, however, of an unplanned pregnancy resulting in a child with later problematic substance use is illustrated by an American study that found associations between increased provision of legal abortion at one point in time with reductions of teenage crime 15 to 20 years later (Donohue and Levitt 2001).

4.1.2 Possible Mechanisms of Action

- Unplanned pregnancies are more likely among young, single women with limited economic, social and emotional resources to support a child.
- Women who are pregnant, or planning to become pregnant, are often likely to quit smoking and cut down alcohol intake for the health of their future child (Flanagan and Kokotailo 1999). In contrast, unplanned pregnancies due to unprotected sex (voluntary or involuntary) are more likely to be accompanied, especially in the early and most vulnerable stages of the pregnancy, by risk-taking behaviour such as heavy alcohol and other substance use.
- Levels of alcohol consumption in a population and levels of risky alcohol use are correlated both with each other and with the effectiveness of social and economic

controls on alcohol availability (Babor et al. 2003). Therefore, there is reason to suppose that the prevalence of risky sexual behaviour, and hence of unwanted pregnancy, is also affected by the availability of alcohol and other psychoactive substances.

- In Australia, rising levels of alcohol use among young women are temporally associated with a trend toward increasing rates of child abuse and neglect (Toumbourou, Rowland and Jefferies 2005). This trend is also true for other countries, and in association with other drugs (e.g., methamphetamine).

4.1.3 Interventions

The following comments are based on the evidence that children from unplanned and unwanted pregnancies have generally worse life outcomes, including problem substance use, than the general population. Any intervention that reduces the likelihood of such pregnancies is recommended and includes some or all of the following:

- **a** Effective sex education for teenagers from multiple credible sources within the community.
- **a** Availability of health services that include affordable and effective contraception for young people, including high-risk teenagers.
- **a** Sex education and sexual health services can be particularly effective when delivered as bundled, multi-component interventions (Koo et al. 1994).
- **a** Targeted programs for young and vulnerable women (e.g., with problematic substance use) have been shown to reduce substance use for high-risk young mothers (Catalano et al. 1999).
- **a** Availability and access to termination for unwanted pregnancies, within a health care setting that provides such services legally and safely.
- **a** Universal interventions that reduce risky patterns of substance use among all members of the population, including women of childbearing age (Babor et al. 2003).

4.1.4 Proposed Health Authority Initiatives

- **a** Provide effective sex education for teenagers from multiple credible sources within the community.
- **a** Ensure the availability of health services that include affordable and effective contraception for young people, including high-risk teenagers.
- **a** Provide targeted programs for young and vulnerable women (e.g., with problematic substance use), in order to reduce substance use for high-risk young mothers.

- α** Ensure availability of and access to termination for unwanted pregnancies, within a health care setting that provides such services legally and safely.
- β** Develop fetal alcohol spectrum disorder prevention strategies in each regional health authority in British Columbia.

4.2 Maternal and Fetal Health

4.2.1 Background

Maternal health has a major effect on the health and cognitive development of the fetus. Any impairment of this development reduces the chances for good health and social adjustment in later life. The origins of brain and behavioural dysfunction are both genetically and environmentally determined (O'Connor et al. 1998a; Pike et al. 1996). Several types of cognitive dysfunction are associated with particular behaviours and personality traits that pose a risk for substance use problems, such as impaired judgment, sensation-seeking, attention deficits, and impulsivity (Barnes et al. 2000; Raine 1993).

Nutritional intake, substance use, and maternal mental status and stress levels during pregnancy are among the most potent factors affecting fetal development (Glover 1997). Stress and smoking during pregnancy can lead to young gestation age, low birth weight and small head circumference (Lou et al. 1994). Stress has also been shown to lead to impaired brain function. Prenatal exposure to psychotropic drugs may cause disrupted neurotransmitter function, which leads to the development of tolerance and sensitization at the time of birth; this, in turn, predisposes one to active substance use in early adolescence (Allan et al. 1998; Slotkin 1998). Another prenatal factor leading to later substance use problems may be drug-induced brain injury to the fetus. Brain injury often results in cognitive (e.g., learning disability, attention problems), behavioural (e.g., conduct disorders) and mood disturbances (e.g., irritability), which in turn increase the risk of later substance use problems.

4.2.2 Mechanisms

- The inheritance of specific genetic characteristics increases the risk of substance use problems later on in life. Studies suggest that individuals prone to substance dependence possess deviations in certain genes (i.e., polymorphisms) that affect the activity and metabolism of the neurotransmitters serotonin, norepinephrine and dopamine (Fishbein 1998).
- Nutritional intake, substance use and the mother's mental state and stress levels during pregnancy are among the most potent factors affecting fetal development.
- Birth complications such as prematurity, hypoxia, infectious disease and prolapsed cord during delivery can predispose infants toward impaired brain function and later behavioural problems (Piquero and Tibbets 1999).
- Vertical transmission of HIV from mother to fetus is a common occurrence, especially in developing regions in Africa and Asia. In addition to sexual transmission, HIV and other

blood-borne viruses are frequently transmitted through the practice of sharing needles between people who inject drugs.

- Stress during pregnancy can lead to developmental problems beginning in infancy. Stress during pregnancy may also activate genes linked to psychological disorders (Stabenau 1977; van Os and Selten 1998) because of abnormal brain development (Kaufer et al. 1998; Senba and Ueyama 1997). These conditions impair later psychosocial adjustments and can increase the risk for substance dependence and other behavioural problems.
- Excessive maternal alcohol, tobacco and other drug use can disrupt neurodevelopment, causing health impairment in the fetus, particularly impairment of brain functions responsible for learning, behavioural control and mood regulation (e.g., fetal alcohol spectrum disorder).

4.2.3 Interventions

- α** Adequate access to prenatal care, including HIV testing and treatment. Emphasizing access to prenatal care for low-income populations should reduce future involvement with the mental health and criminal justice systems, given the association between pre- and perinatal complications and later conduct disorders in children.
- α** Home visiting by a health professional at regular intervals from pregnancy to a child's second birthday, to provide family support, with a special focus on reducing fetal and infant exposure to maternal or other family harmful drug use. A classic American study, now replicated (Olds et al. 1999) found significant benefits for low-income single mothers and reduced problem behaviour for children, including a reduction in cigarette and alcohol consumption at the age of 15 years.
- α** Needle/syringe distribution programs and other harm reduction strategies, such as methadone maintenance, are extremely effective and cost-effective means of reducing the incidence of HIV/AIDS as well as other blood-borne viruses such as hepatitis B and C (Loxley et al. 2004). These programs both benefit and maintain the health of women of childbearing age, and can therefore reduce the incidence of babies born with life-threatening illnesses.
- β** Prenatal screening, brief advice and follow-up that focuses on alcohol and tobacco use as well as other lifestyle issues, such as nutrition and exercise for pregnant women. A few small-scale studies have demonstrated feasibility and acceptability, but positive behavioural outcomes have not yet been clearly demonstrated (Loxley et al. 2004).

4.2.4 Proposed Health Authority Initiatives

- α** Ensure adequate access to prenatal care, including HIV testing and treatment.

- α** Enhance the effectiveness and reach of community-based pregnancy support programs to assist expectant mothers and identify conditions that might undermine healthy child development.
- β** Ensure broad access to information about alcohol, tobacco or other substance use on fetal development during pregnancy, and provide targeted campaigns to address high-risk populations.

4.3 Infancy and Early Childhood (0 to 4 Years)

4.3.1 Background

Infancy and early childhood are important years for social, physical and cognitive development; these years are also often a focus for broad-based prevention strategies directed toward general mental and behavioural health, as well as later substance use or other conduct problems. Priority areas for preventive interventions targeting these years include the child's need for sustenance, nurturing, effective parenting, plus social and cognitive stimulation.

Positive bonding between the primary caregiver and infant provides the sensory and social stimulation necessary for healthy brain development. About 50 per cent of all learned responses used throughout the life-span are established during the first year of life. Infants who do not receive an appropriate level of social stimulation, or who do not develop a secure attachment with a primary caregiver, are at increased risk of aggressiveness, attention deficit disorder, anxiety, emotional disturbances, social withdrawal and later substance use problems.

Sensory stimulation is also essential for optimum brain development (Kuhn and Schanberg 1998). Stimulus deprivation in infancy and early childhood is associated with later learning disabilities (e.g., Kuhn and Schanberg 1998), problems with emotional self-regulation, aggression and depression (Agid et al. 1999; Kuhn and Schanberg 1998; Post and Weiss 1997). These consequences of chronic stimulus deprivation augment the risk of problematic substance use in later life.

Many studies have found an association between childhood physical abuse and subsequent risk for substance use and related problems (Maxfield and Widom 1996). Physical abuse has been linked to developmental lags in neural connectivity and resultant brain abnormalities (Ito et al. 1998; Shin et al. 1997). Stress experienced during childhood has long-term adverse psychosocial effects, including low self-esteem and social competency, as well as increased acquiescence in later life (De Goeij, Dijkstra and Tilders 1992; Virgin and Sapolsky 1997). Thus, for several reasons, child abuse amplifies the risk for problematic substance use, via effects on neurobiological systems that alter effective coping and behavioural self-regulation.

4.3.2 Mechanisms

- Healthy social and psychological development requires adequate nutrition and social and cognitive stimulation during infancy and early childhood (Fishbein, Tartar and Eldreth 2005).

- Environmental stress impedes early brain development and function (Bremner, Southwick and Charney 1999). Child abuse and neglect are two well-recognized stressors that increase the risk for problematic substance use, by altering brain chemistry, physiology and cognition (Sinha 2001).
- Bonding with the mother during breastfeeding and maternal care of the infant is critical for the development of a positive and nurturing relationship (Toumbourou and Catalano 2005). Many factors underlie poor mother-child bonding. For example, low socio-economic status may require the mother to work outside the home; having many siblings may diminish bonding opportunities with each child; or parents with mental health problems may be less able to emotionally invest in their children or have adequate parenting skills.
- Social-learning events and opportunities within the parent-child interaction can create an environment where undesirable behaviours are either properly managed, or evolve into an escalation of child-behaviour problems.

4.3.3 Interventions

- α** *Parent education programs* initially focusing on developing successful bonding between the mother and baby and then on later broader competencies for parents, have shown significant benefits for particular high-risk groups of mothers, as seen in some well-designed, controlled studies. Benefits have been demonstrated for mothers with depression, intellectual disability and/or children with early behavioural problems (Mitchell et al. 2001). One focus of such programs should be on enhancing social and cognitive stimulation for the infant, which has been shown to provide life-long benefits (e.g., Risch 1997; Kuhn and Schanberg 1998). Increasing social and cognitive stimulation in the home environment of high-risk children can improve their cognitive and neurological development (Weisglas-Kuperas et al. 1993).
- α** *School preparation programs* provide support for parents from disadvantaged backgrounds, and provide structured classroom experiences for children before school enrolment. These programs can provide multiple benefits for children throughout their development, including decreased drug use, teenage pregnancy, school dropout and improved employment prospects (e.g., Schweinhart and Weikart 1993). Estimates state that for every \$1 spent on such programs, \$2 is saved on other government expenditures (Mitchell et al. 2001).
- β** *Targeted programs* to reduce the impact of parental and other environmental smoking and to assist families with problems associated with substances have been implemented and show promise, but there is limited evidence of the impact on either maternal drug use or later child development (Loxley et al. 2004). Neurological and psychophysiological assessments, such as electrophysiological instruments that detect the brain's electrical activity in various regions (e.g., electroencephalogram [EEG]) (Palomo et al. 2004), might be used in addition to psychosocial indicators of risk, though such methods remain unproven. Documentation of birth complications and of maternal substance use problems

might also assist in the assessment of high-risk children who would benefit from preventive and supportive interventions.

4.3.4 Proposed Health Authority Initiatives

- α** In collaboration with regional staff from the Ministry of Children and Family Development, engage parents in training opportunities aimed to improve skills for healthy child and family relationships, parenting skills and awareness of family support networks.
- α** Enter into a partnership with school districts to increase children's access to structured preschool environments that provide intellectual stimulation and social interaction.
- β** Deploy a program of home visitation by professionals, such as public health nurses, for new parents, with targets that include reducing infant exposure to harmful substance use and reducing early developmental risk factors that may result in the child's later involvement in problematic substance use.

4.4 Early School Years (5 to 10 Years)

4.4.1 Background

The transition to school is a critical one, and the early school years are important for shaping a child's ability to form positive relationships with authority figures and peers. Because of the social and intellectual demands of the structured school environment, at-risk children tend to experience difficulties in temperament, conduct problems, poor social competency skills, inability to regulate emotional responses, cognitive deficits and mental health issues once they enter the school setting. Any combination of these factors can lead to poor self-esteem, difficulties in coping with stressful situations, social adjustment problems and low grades. These conditions may interfere with the development of other skills important to avoiding high-risk behaviours later in life.

4.4.2 Mechanisms

- Poor adjustment to school and peer group, poor school achievement, behavioural problems in the class and aggression are all predictors of problem behaviour in adolescence and beyond.
- Prior deficits in cognitive function and emotional regulatory abilities significantly increase the development of adjustment difficulties and later behavioural problems.
- Children growing up in low-income families, especially among those with mental health or substance use problems, will often have less social, physical and economic supports during these developmental years.

4.4.3 Interventions

- α *Family support programs* for families with primary school-age children attempt to build children's social and emotional competence and encourage consistent discipline and the development of wider social support networks. These programs can have broad benefits by reducing alcohol use and aggressive behaviour in later years. Savings in government revenues have been estimated at \$9 for every \$1 invested (Spoth et al. 2002).
- α *School organization and behaviour management programs* train teachers to better manage disruptive behaviour in the classroom, especially for high-risk children. These programs not only provide benefits in terms of classroom behaviour and school achievement, but also in later reduced substance use and delinquency (Hawkins et al. 2001).
- α The identification of individual children who are suffering from academic or behavioural difficulties, followed by the provision of appropriate remedial services, has been shown in at least one study to reduce student substance use problems (Bry et al. 1998).

4.4.4 Proposed Health Authority Initiatives

- α Work with the Ministry of Education and school district officials to utilize school transition points (entry into preschool/kindergarten, middle school and high school) as opportunities to provide universal parenting education and follow-up as indicated.
- α Implement policies and services that improve access to psychosocial supports, such as parenting support, crisis intervention and grief counselling.
- α Give special attention to deprived neighbourhoods and communities when implementing all interventions related to key developmental stages.

4.5 Adolescence (11 to 17 Years)

4.5.1 Background

Frequently, initiation of psychoactive substance use occurs during the early teenage years. Furthermore, adolescents often use both legal and illegal substances in a manner that places their health and safety at risk and also compromises the safety of those around them. Tobacco use and hazardous alcohol consumption causes 90 per cent of all deaths, illnesses and disabilities related to substance use in BC (Ministry of Health Services 2004). Smoking tobacco and drinking too much alcohol during teenage years can lead to later social and health problems—and increase the likelihood of other substance use. Preventing the uptake of tobacco use and delaying the use of alcohol by teenagers can be achieved through many strategies, thereby preventing serious problems in later life. Reducing tobacco use may also have beneficial effects on rates of cannabis use, but separate strategies also need to be developed and tested for reducing, delaying and preventing cannabis use in this age group.

4.5.2 Possible Underlying Mechanisms

- Adolescence is a time when social and sexual identities are established through relationships with peers and older teenagers. Psychotropic substances that facilitate social behaviours, whether by disinhibition, improving mental alertness or reducing anxiety, are increasingly used during adolescence.
- Adolescence can be a stressful time, when individuals are required to develop their own social networks and personal identities, acquire social and vocational skills and strive to achieve social expectations. The neural basis of stress and its relationship with substance use problems is progressively becoming clearer. For example, a decline in brain serotonin activity and alterations in dopaminergic systems occur in conjunction with stress (Davis et al. 1997; Southwick et al. 1997). Low serotonin levels are associated with poor self-control and negative affect (Flory et al. 2004), and altered dopamine activity is associated with novelty-seeking, which is often present in people who begin using drugs at an early age (Lusher, Chandler and Ball 2001). In response to chronic or severe stress, adolescents can develop a heightened sensitivity to the reward from psychoactive drugs in association with the alterations in neurotransmitter systems (Gordon 2002; Vazquez et al. 2002). Thus, high levels of stress in genetically susceptible individuals can trigger neurochemical changes, leading to substance dependence.
- Positive choices, lifestyles and opportunities are available and encouraged under optimal socio-environmental circumstances. The ability to take advantage of existing external resources, make adaptive choices and reach one's potential depends upon the integrity of an individual's decision-making and problem-solving abilities—functions that rely on age-appropriate brain development and functioning. In the absence of favourable external resources and developmentally appropriate brain function, high-risk behaviour is likely to become the default option. Learning disabilities, cognitive deficits and emotional dysregulation are signs of neurodevelopmental delays or impairment, and have been found to predispose toward later substance use problems in adolescents (Cosden 2001).
- Employment opportunities can provide disposable income. One Australian study found that the number of cigarettes smoked by teenagers was closely correlated to their disposable income (Stockwell et al. 1995). Young people are especially price-sensitive (Österberg 2001); the cheaper that legal and illegal drugs are, the more likely young people will purchase and consume them at risky levels.
- Access to tobacco and alcohol from retail sources becomes increasingly feasible, often through a third party who appears old enough to purchase legally. In addition, laws on underage purchasing are not always well enforced (Grube 1997) and are implemented for different ages in different countries.
- Adolescents are also trying to establish increasing independence, and tend to model the behaviour of older children and respected adults, whether they are family members, acquaintances or media celebrities (Toumbourou and Catalano 2005).
- Early use of both legal and illegal substances during adolescence, especially more intense levels of use, has been identified as a potent predictor of later mental health problems and

more serious problems with alcohol and other drug use in young adulthood (Toumbourou and Catalano 2005).

- Physical and economic availability strongly influence the overall levels of consumption and related harms in a given population for both alcohol (Babor et al. 2003) and tobacco (Younie et al. 2005). This in turn will increase not only opportunities for young people to drink, but also the extent of modeling of high-risk consumption by older people.

4.5.3 Interventions

β *Environmental prevention strategies* recognize that adolescents, even under normal neurobiological and environmental conditions, are prone to greater levels of high-risk behaviours than any other age group, due to the underdevelopment of connections between the prefrontal cortex of the brain (responsible for impulse control, goal direction, problem solving and decision making) and lower limbic structures (responsible for emotional responses). Full development of these connections does not occur until at least age 21, and sometimes later.

Thus, harm reduction strategies attempt to reduce opportunities for high-risk behaviours in the immediate environment as well as to reduce the impact on health and safety when high-risk behaviours persist. Strategies such as the following are all worthy of exploration, although there has been little evaluation of them: parental supervision and monitoring; alternative activities in schools and neighbourhoods; legal restrictions on availability of harmful products and behaviours (e.g., driving with other teenagers in the car); restrictions on advertisements, games and other media that promote high-risk activities; and the availability of moderation-based self-help programs.

- α** *Legal restrictions on youth access to alcohol and tobacco* are strongly supported in many well-conducted studies that have examined the impact of changes in the legal age. Increased legal drinking age from 18- or 19-years old to 21-year-old in many American jurisdictions is estimated to have reduced alcohol-related crashes among young drivers by 20 per cent (Voas, Tippetts and Fell 2003).
- α** *Enforcement of legal age restrictions on access to alcohol and tobacco* are also strongly supported (Loxley et al. 2004). In many countries there is little community support or political will to raise the legal drinking age. Enforcement of existing laws, however, has strong community support and can have equal effect (Stockwell 2004).
- α** *Voluntary codes and legal restrictions on youth access to solvents and precursor chemicals* can greatly reduce opportunities for such dangerous practices as sniffing glue or other solvents as well as reduce opportunities to access psycho-stimulant drugs such as amphetamine and methamphetamine (Loxley et al 2004). It is also important to limit media discussion and sensationalization of these issues, to reduce awareness and interest among young people in accessing these dangerous substances.

- α** *School-based drug education* has been shown to be potentially effective, especially in relation to tobacco and alcohol use (Loxley et al. 2004). While many school education programs have been found to be ineffective, the key ingredients of successful programs have been identified and include the use of student input to ensure interesting and interactive class exercises, investment in teacher training, and booster sessions throughout the secondary school years (McBride 2005).
- α** *Community mobilization* programs have been found in some well-researched demonstration projects to be effective at harnessing school and parent influences, to alter the acceptability of and access to both legal and illegal substances by adolescents (Toumbourou et al. 2005).
- β** *Youth sport and recreation programs and mentorship schemes* have promise but must include careful matching of mentors to clients, training, ongoing support and evaluation. Furthermore it cannot be assumed that sports clubs and sports settings *per se* discourage risky substance use (Loxley et al. 2004).

In addition, adolescents can also benefit from the strategies previously described in relation to younger children; for example, school organization and behaviour management, parent education and family interventions with high-risk groups (Toumbourou et al. 2005). There is some support for the efficacy of individual-level programs to prevent behavioural problems related to risk for substance dependence, particularly those that aim to improve: (a) the quality of home life, relationships with others and intimate bonds, and (b) neurobehavioural development in terms of cognitive, emotional, social and behavioural skills (Riggs et al., in press).

Although underlying mechanisms are unknown, environmental interventions that maximize positive features of the individual's living circumstances may work to catalyze functional development of the brain (Chambers, Taylor and Potenza 2003). Similarly, minimizing exposures to stressful conditions, improving psychological self-regulation and providing rehabilitation services for those who show signs of neurological delays or dysfunction (e.g., speech and language therapy, functional and integrative training and cognitive neurorehabilitation) all have potential to positively influence brain function in the future design of programs to prevent eventual substance dependence (Fishbein 2000).

4.5.4 Proposed Health Authority Initiatives

- β** In collaboration with the Ministry of Education and appropriate ministries, promote programs that provide youth with an opportunity to engage in volunteering and to benefit from mentorship, in order to develop employable skills and social responsibility.
- α** Work with the appropriate ministries to increase access to community supports and training programs that target young adults and address financial matters, positive relationships and independent living.
- α** Lobby the provincial government and municipalities to implement strategies to enforce age-identification for tobacco and alcohol sales.

- α** Use media to increase public awareness of harms related to use of alcohol, tobacco or cannabis by minors, and of enforcement efforts and consequences for non-compliance with current regulations.
- α** Use media and parent education strategies to encourage responsible supervision of youth access to alcohol in the home and social contexts.
- α** Support community mobilization programs that aim to reduce perceived favourable community norms, and restrict access to alcohol, tobacco and cannabis.
- β** Encourage implementation of sports campaigns that include education about harms from substance use, and consider expanding beyond sports to other recreational and social contexts.
- β** In collaboration with the Ministry of Education and other responsible ministries, increase youth exposure to mentorship programs that include careful matching of mentors to clients, training, ongoing support and evaluation.
- β** Utilize peer involvement to create healthy contexts and activities and to reduce perceived favourable norms. Be aware that peer interventions that aggregate youth with behaviour problems have the potential to encourage negative outcomes.
- α** Work with school districts to promote effective smoke-free school policies with a high degree of perceived enforcement.

4.6 Universal Interventions Impacting All Age Groups

4.6.1 Background

From conception to young adulthood, human development is considerably affected by the use of psychoactive substances among adults living in the prevailing society. Adverse impacts on physical, cognitive, social and emotional well-being caused by substance use have been identified in the earlier sections of this paper. The overall impact of the availability of different psychoactive substances and the effectiveness of regulatory controls on human development and behaviour has also been alluded to in earlier sections. In addition, the principle of dealing with the substance use of young people in conjunction with accepted norms and patterns of adult substance use has been stressed.

Some important underlying mechanisms link legislative controls, regulatory structures and cultural norms regarding the use of psychoactive substances with the likelihood of harmful substance use by young people. Examples of underlying mechanisms and broader interventions of proven effectiveness are described below, and have the potential to contribute significantly to the more global prevention of harmful substance use in ways that are different to the more circumscribed strategies identified in previous sections of this evidence review.

As previously mentioned, wider-ranging reviews of these options can be found in Stockwell et al. (2005), Loxley et al. (2004) and Babor et al. (2003). The types of intervention under consideration here are mostly regulatory and legislative options for attempting to reduce harms from substance use at the population level. The examples below are mainly drawn from the legal drugs of tobacco and alcohol, simply because there is more research and evidence for universal policy responses to the problems posed by these more widely used substances. Cogent arguments have also been put forward to consider alternative legal frameworks for currently illegal drugs, but the evidence base for these is still at a developmental stage (Lenton 2005).

British Columbia's strategy for addressing the problems related to substance use acknowledges that the use of psychoactive substances ranges from beneficial, or non-problematic, to problematic use (related to mode of administration, intoxication, chronic use or dependence). Within this framework, a prevention strategy must focus on reducing harm by addressing those patterns of substance use associated with the highest risk. In some cases, this will mean the goal is to eliminate, or at least reduce, use. In other situations, it may involve identifying and reducing risky patterns of use or promoting an understanding of safer use.

4.6.2 Possible Underlying Mechanisms

- Cigarette smokers, heavy drinkers and people using illegal drugs can be negative role models for children and young people.
- The absolute number of cigarette smokers and heavy drinkers in a population is affected by changes in the price of tobacco and alcohol and the availability of these products (in terms of the distance needed to travel and the hours when retail outlets are open) (Babor et al. 2003).
- Young people and heavy consumers of tobacco and alcohol, who are particularly at risk of harm, are most likely to reduce their consumption when costs increase and marketing strategies are controlled.
- The legal status of different substances—which varies markedly across different countries of the world—and the effectiveness of law-enforcement strategies should, in principle, affect price, purity and availability of illegal substances. In practice, however, there is only limited available data about which types of law-enforcement may or may not be effective (Anthony 2005).

4.6.3 Interventions

- **a** *Taxation strategies* to maintain or increase the price of legal substances have repeatedly been identified as among the most effective means of preventing risky substance use and harm (Babor et al. 2003; Holder, Treno and Levy 2005; Younie et al. 2005). An optimal taxation strategy for these products that has public health and safety concerns in mind would do the following:
 - (i) Ensure that taxes are collected in accordance with the amount of alcohol or tobacco in a product, rather than the cost of manufacture or retail price, thus

- giving an advantage to lower-alcohol products, rather than cheap-to-manufacture, high-alcohol content beverages.
- (ii) Maintain the overall level of taxation relative to the cost of living; i.e., index alcohol and tobacco taxes to inflation to prevent the overall price ranging over the years.
 - (iii) Create an additional tax on alcohol and tobacco products, the proceeds of which would then be used to fund much-needed prevention, treatment and research programs aimed at reducing harm from psychoactive substances (Chikritzhs, Stockwell and Pascal 2005). Some Canadian jurisdictions have also introduced minimum pricing policies in government-controlled retail outlets.

α *Brief interventions in primary health care* that identify smokers and high-risk alcohol drinkers are also highly supported in the scientific literature (e.g., Roche 2004). These interventions typically involve a general practitioner or other health professional working in a community setting, screening their patients for these and sometimes other health risk behaviours. Because primary health care workers have a multiplicity of health problems to respond to, these programs work best if embedded into the standard intake assessment processes, as well as standard health visits conducted by primary health care clinics.

The practitioners are trained to discuss the health effects of the behaviour in a non-judgmental way that includes sympathetic advice for behaviour change. The patients might then be encouraged to self-monitor and be seen again by the health professional in a few weeks, to see if any progress has been made. While only 10 to 15 per cent of patients will respond to these interventions, their brevity still makes them highly cost-effective and, if delivered on a population-wide basis, they are capable of making major improvements in public health and safety (Heather 2004).

α *Treatment for alcohol and other drug problems* is a key ingredient of comprehensive prevention policies. Treatment can have population-level impacts (e.g., on levels of crime and health problems in the community). Interventions can occur with family members of people with drug problems. This often increases treatment effectiveness and may minimize the intergenerational transmission of mental health and substance use problems. There is strong evidence that treatment programs for alcohol and other drug problems can be effective in reducing drug use and drug-related crime, and improving mental and physical health and social functioning. Programs targeting high-risk and dependent drinkers reduce the harms experienced across the community, but most people with an alcohol problem do not receive treatment.

The evidence suggests that:

- For smokers, nicotine replacement therapy is effective.
- For alcohol problems, effective approaches include motivational interviewing, brief interventions, social skills training, community reinforcement, relapse prevention and some aversion therapies.

- For illegal drug use, treatment normally entails addressing both the physical and the psychosocial aspects of drug dependence. This may include pharmacotherapies, detoxification, counselling and psychosocial interventions. The effectiveness varies according to the drug and pattern of use. Various treatments for cannabis and amphetamines have been trialled, but the evidence for their efficacy is not as strong.

The strongest evidence for efficacy is in the treatment of opioid dependence with methadone maintenance treatment, which has achieved reductions in drug use, criminal behaviour and mortality, and improvements in health status. Over the past 15 years, the British Columbia Methadone Program has expanded from 1,000 to over 8,000 methadone maintenance treatment (MMT) patients. MMT is now available in most parts of the province and is delivered by community physicians and pharmacies. A recent study analyzing BC PharmaNet data (Anderson and Warren 2004) found that retention rates in the BC Methadone Program are favourable and consistent with published rates. The rapid expansion of the program has not impacted on retention once the effects of client age and dose are accounted for; and adequate daily dosing appears crucial to both initial retention and return to treatment. Furthermore, the expansion of MMT in BC has been accompanied by a significant reduction in new HIV infections among people who inject drugs, as well as reductions in illegal drug overdose deaths and property crime.

- a** *Harm reduction strategies* seek to minimize or limit the harms associated with drug use without necessarily seeking to eliminate use. These strategies are distinct from treatment approaches that aim to reduce the level of drug use. In their focus on reducing harm without necessarily reducing drug use, they operate in a similar way to developmental protective factors, although they typically apply at a later stage in the development of drug use problems. Together with demand reduction and supply reduction, harm reduction is an integral part of a harm minimization approach and has been part of British Columbia's provincial drug policy since the policy was introduced in the mid 1990s. Although harm reduction is often thought of mainly in terms of reducing the spread of blood-borne viruses among people who inject drugs, it covers a much wider range, with initiatives relating to the use of tobacco, alcohol, illegal drugs, and pharmaceuticals. Programs for which there exists the strongest evidence are: regulations to reduce passive smoking; random breath testing of drivers of motor vehicles; needle and syringe distribution; treatment of opiate dependence to reduce risk of overdose and blood-borne viruses; and hepatitis B vaccination.

The Provincial Health Services Authority purchases supplies and equipment in bulk for the regional health authorities to deliver needle/syringe distribution services to people who inject drugs. The BC Harm Reduction Policy Committee, a collaborative partnership of all BC health authorities and the Ministry of Health, has produced provincial guidelines to ensure that distribution services follow best practices and are consistent with the best evidence to date, including not restricting the number of clean needles/syringes distributed to any one individual, providing flexible hours of operation

and mobile services and, in many instances, engaging people who inject drugs in distribution and cleanup efforts.¹

In recognition of the important role communities and local government have in the delivery of comprehensive harm reduction services, the Ministry of Health, in partnership with the Ministry of Community Services and the Union of British Columbia Municipalities, developed *Harm Reduction: A British Columbia Community Guide*, to support local government efforts (Ministry of Health 2005).

The first legally sanctioned supervised injection facility in North America (InSite) opened in 2003 in Vancouver's Downtown Eastside. InSite is a pilot project operating under the authority of the federal government, and is undergoing a rigorous evaluation. Other provincial municipalities, such as Victoria, have expressed interest in opening additional supervised injection facilities in BC.

In contrast, British Columbia has not yet implemented all the evidence-based interventions known to provide an effective and rigorous population health approach to impaired driving. The province has not established a broad network of roadside sobriety checkpoints and, in particular, does not routinely administer random breath testing to motor vehicle drivers stopped at roadside checks. Recently, the provincial government introduced a compulsory assessment and treatment program for repeat drinking and driving offenders. However, although this type of initiative can assist the rehabilitation of individual impaired drivers, it provides at best only a weak population health effect. The majority of motor vehicle crashes and deaths involving drinking drivers are not caused by repeat offenders. This is yet another example of the prevention paradox. In order to continue to reduce the number of incidents and fatalities associated with drinking and driving, interventions must target the much larger group of drinking drivers who have not yet come under legal sanction or scrutiny.

- α** *Regulation of the physical availability of alcohol* is strongly supported by international research evidence (Babor et al. 2003) as a means of reducing demand and lowering levels of risky alcohol use. In particular, limits on late trading hours (Chikritzhs and Stockwell, 2002) and liquor outlet density are recommended. These interventions need to be locally tailored to enable each community to find its own level in balancing the demand for public access to these products with public health and safety concerns. High densities of liquor outlets can lead to a highly competitive local liquor market, with heavy discounting and irresponsible serving to drunk and underage customers (Graham et al. 2005).

- β** *Educational and media campaigns* that target individuals at all ages who tend to exhibit the behavioural and psychological traits of novelty- and stimulation-seeking, may hold promise (Bardo, Donohew and Harrington 1996). This global prevention strategy incorporates messages that attract individuals with this biological predisposition. One United States-based research group (Lorch et al. 1994; Palmgreen et al. 1994) has

¹ For more information on these guidelines, see <http://www.bccdc.org/download.php?item=1040>.

implemented interventions aimed at high-risk teens that convey anti-drug messages using highly sensational program content. Significant changes in attitudes towards drugs were observed. In general, media strategies appear to be most effective when complementary to on-the-ground regulatory and other interventions (Loxley et al. 2004).

β *Judicial procedures* that target drug offenders have become increasingly popular over the past 15 years. There is a significant link between crime—particularly violence and property crime—and the use of alcohol and other drugs, and this incurs high costs to the community. Judicial systems and procedures designed to improve outcomes both for the community and for those who commit drug-related crimes include:

- (i) Diversion strategies aimed at preventing early offenders from entering the criminal justice system, and diverting offenders with drug problems into appropriate education and/or treatment.
- (ii) More serious drug offenders may be offered an opportunity to have their offence heard in a drug court that offers supervised treatment in the place of custodial sentences.
- (iii) For those (criminals) who receive a custodial sentence, there is a range of programs in prisons to restrict the supply of drugs into the prison, reduce demand for drugs by prisoners and minimize harmful drug use.

A recent systematic review of the scholarly literature (Ogloff, Davis and Somers 2005) concludes that substance use disorders are among the most prevalent mental disorders in the criminal justice system. Substance use problems are endemic among prisoners, and concurrent disorders (co-morbid major mental disorder and substance dependence) are the rule rather than the exception for mentally disordered offenders.

A further analysis of BC criminal justice and health-linked data (Somers, Jones and Queree 2005) found that the prevalence of all measured mental health and substance use problems is greater among the corrections cohort than the corresponding population rates (see Table 2).

Table 2: Prevalence of Mental Illness by Source of Data

	Adult				Youth				Gen. Pop. Rates ²
	Custody		Community		Custody		Community		
	No.	Rate %	No.	Rate %	No.	Rate %	No.	Rate %	
Overall ¹	9,269		34,590		1,150		7,084		
Severe Mental Illness	750	8.1	4,096	11.8	66	5.7	426	6	6.2
Less Severe Mental Illness	1,417	15.3	6,566	19	216	18.8	1,300	18.4	12.7
Substance Use Disorder	1,575	17	4,795	13.9	72	6.3	269	3.8	1.3
Cognitive Disorder	39	0.4	146	0.4	1	0.1	7	0.1	0.1
Any Disorder	2,555	27.6	10,482	30.3	288	25	1,618	22.8	16.8

¹ Denominator column for rate calculations (per cent)

² Ages 15-64 only

The literature review (Ogloff et al. 2005) found that a relatively poor job is done in adequately identifying the needs of mentally disordered offenders prior to the time they enter the criminal justice system. Due to the multiple and complex needs of a small but significant number of very difficult offenders, the fractionalization of the health and social services and justice systems, and other factors, the costs and inefficiencies escalate.

There is also little published work pertaining to effective interventions for substance-using offenders. However, diversion of mentally disordered offenders is a necessary element of the criminal justice system, as research generally shows that a majority of these individuals commit only low-level, non-violent, offences. But, while a positive concept, diversion may have relatively little benefit to substance-using offenders due to the lack of appropriate community-based services generally available. Diversion of offenders with substance use disorders from the criminal justice system can occur at all stages of contact with the criminal justice system: pre-booking (crisis intervention, etc.), drug courts (divert into community-based treatment program after arrest and charge), and post-incarceration (transition back into community). Unfortunately, contrary to their purpose, many diversion programs often result in a lengthier and more intensive intervention than in more traditional criminal justice processes.

Although the number of drug treatment courts (DTC) has increased dramatically throughout the United States and other western countries, evidence supporting the effectiveness of this intervention is lacking. In particular, studies have been hobbled by poor design and methodology (Anderson 2001; Christie and Anderson 2003), and the conceptual and philosophical underpinnings of DTCs have been severely criticized (Anderson 2003; Fischer 2003; Hoffman 2000). A final evaluation of the Vancouver Drug Treatment Court is pending; nevertheless, based on preliminary results, there is no reason to believe that the British Columbia experience will differ from what has already been reported in the published, peer-review literature.

With respect to interventions in prison, there is evidence that MMT is effective and it is now available within the BC Corrections system. Needle/syringe distribution programs should also be effective in prison but have yet to be implemented in BC. In contrast, there is no evidence to suggest that efforts aimed at restricting the supply of drugs in prisons reduces either demand for drugs or harm related to drug use.

4.6.4 Proposed Health Authority Initiatives

- α** Encourage and support primary care and other health care providers to screen their patients for hazardous substance use, utilize brief interventions with individual follow-up and promote self-management materials as appropriate.

- α** Work with employers and unions to encourage the development of clear workplace policies, and support these with educational materials and training in brief interventions applicable to the workplace.

Core Public Health Functions for BC: Evidence Review
Prevention of Harms Associated with Substances

- α** Develop and promote innovative computer-assisted and internet-based resources for people to self-assess their use of psychoactive substances and receive individually tailored feedback and monitoring.
- α** Work with school districts to support and implement brief intervention programs for students in all secondary schools, and provide the necessary support materials and training.
- α** Support brief intervention programs for offenders with alcohol and/or other drug problems and provide the necessary support materials and training for police and correctional staff.
- α** Provide access to telephone-based brief intervention services.
- α** Develop and implement social marketing campaigns to restrict the exposure of children and others to second-hand smoke in homes and private vehicles.
- α** Promote consistent and repeated messages from health care professionals and others that reinforce the risks and encourage behaviour change.
- α** Ensure unrestricted universal access for people who inject drugs to needle and syringe distribution programs in both urban and rural settings.
- α** Ensure fairly immediate access to primary response services that provide brief intervention and referral to other services.
- α** Establish multi-faceted support centres for people who have drug problems (sleeping quarters, cheap food, linkages to services) and a multi-component system (wet-damp-dry housing, contact centres, employability skills training and apprenticeship/experience programs).
- α** Address barriers that inhibit access to treatment services, including methadone treatment, and expand the range of treatment services offered.
- β** Work with the Ministry of Public Safety and Solicitor General to integrate and coordinate the full range of substance use services, including treatment and harm reduction programs, with programs within all corrections facilities and programs operating in British Columbia, including assertive community treatment and diversion programs.
- α** Conduct public health and safety risk assessments of licensed premises, which examine, among other factors, the costs and benefits of the more attractive pricing of low- and non-alcoholic drinks versus other alcoholic drinks.

Core Public Health Functions for BC: Evidence Review
Prevention of Harms Associated with Substances

- α** Explore local agreements between municipalities, police and liquor licensees, which promote responsible service and pricing policies that favour lower-alcohol and non-alcoholic drinks.

- α** Encourage local accords between municipalities, police and liquor licensees or introduce municipal bylaws that promote responsible service, limit price discounting and ban all forms of local price advertising.

- α** Engage the media in monitoring the success of industry accords, and in reporting offenders and problem establishments.

5.0 CONCLUSION

There are a wide range of strategies that have proven effectiveness with regard to whether people use psychoactive substances and experience related harms. The strategies identified cover a wide range of levels of intervention and modes of delivery. In keeping with a community systems model (Holder et al. 2005), examples of effective interventions are given that span many levels in society from the individual up to the national level. A particular emphasis has been given with regard to interventions that reduce the likelihood of harm from the use of legal substances (principally alcohol and tobacco), in recognition of the much greater prevalence and more substantial levels of death, injury and illness associated with use of these substances in many countries (Rehm and Room 2005).

Illegal drug use is also heavily considered in light of evidence that use of these substances is strongly associated with particular biological and psychological traits that predispose individuals to especially high-risk behaviours. Underlying mechanisms concerned with healthy psychosocial and cognitive development have been emphasized, in addition to the neurological and biological processes that may underlie these functions. It is highly encouraging that there is now evidence of effective interventions that are "upstream" of adolescent substance use, in terms of influencing early developmental processes in a positive way.

New techniques and discoveries in the field are needed, such as determining the extent to which neuropsychological assessments can be used to identify high-risk children who might benefit from intensive preventive interventions. It is also encouraging that even classroom-based school interventions, when conducted and developed on evidence-based principles, can have some measurable benefit. In essence, a more comprehensive and effective approach to the science and prevention of substance use problems involves exploration of the relationship between neurobiological and psychosocial forces.

In closing, the greatest return from investment in prevention strategies will come from a comprehensive approach, which tackles cultural norms and regulatory models that determine the price and availability of the psychoactive substances used by people of all ages in modern society, as well as working towards healthy psychosocial and brain development throughout pregnancy, infancy and childhood.

REFERENCES

- Adlaf, E.M., Begin, P., and Sawka, E. (Eds.). 2005. *Canadian Addiction Survey (CAS) A national survey of Canadians' use of alcohol and other drugs: Prevalence of use and related harms: Detailed report*. Ottawa, ON: Canadian Centre of Substance Abuse.
- Agid, O., Shapira, B., Zislin, J., Ritsner, M., Hanin, B., Murad, H., Troudart, T., Bloch, M., Heresco-Levy, U., and Lerer, B. 1999. Environment and vulnerability to major psychiatric illness: a case control study of early parental loss in major depression, bipolar disorder and schizophrenia. *Molecular Psychiatry* 42:163-172.
- Allan, A.M., Wu, H., Paxton, L.L., and Savage, D.D. 1998. Prenatal ethanol exposure alters the modulation of the gamma-aminobutyric acidA1 receptor-gated chloride ion channel in adult rat offspring. *Journal of Pharmacology and Experimental Therapeutics* 284: 250-257.
- Anderson, J.F. 2001. What to do about “much ado” about drug courts? *International Journal of Drug Policy* 12 (5,6):469-475.
- Anderson, J.F. 2003. Drug courts: Societal adaptation or demonic parody of an authentic myth? *Addiction Research and Theory* 11 (4):257-262.
- Anderson, J.F., and Warren, L. 2004. Client retention in the British Columbia Methadone Program 1996-1999. *Canadian Journal of Public Health* 95 (2):104-109.
- Anthony, J.C. 2005. US policy on illegal drugs: What we don't know keeps hurting us—A perspective on future research needs. *Preventing harmful substance use: The evidence base for policy and practice*. (pp. 325-336), edited by T. Stockwell, P. Gruenewald, J. Toumbourou, and W. Loxley. United Kingdom: John Wiley and Sons.
- Arthur, M.W., and Blitz, C. 2000. Bridging the gap between science and practice in drug abuse prevention through needs assessment and strategic community planning. *Journal of Community Psychology* 28 (3):241-255.
- Australian Attorney-General's Department. 1999. *Pathways to prevention - Developmental and early intervention approaches to crime in Australia - Full report*. Canberra: National Crime Prevention, Attorney-General's Department.
- Babor, T., Caetano, R., Casswell, S., Edwards, G., Giesbrecht, N., Hill, L., Holder, H., Homel, R., Österberg, E., Rehm, J., Room, R., and Rossow, I. 2003. *Alcohol: No ordinary commodity – Research and public policy*. Oxford: Oxford University Press.
- Bardo, M.T., Donohew, R.L. and Harrington, N.G. 1996. Psychobiology of novelty seeking and drug seeking behaviour. *Behaviour and Brain Research* 771 (2):23-43.
- Barnes, G., Murray, R., Patton, D., Bentler, P., and Anderson, R. 2000. *The addiction prone personality*. New York: Plenum Press.

Core Public Health Functions for BC: Evidence Review
Prevention of Harms Associated with Substances

- Bremner, J.D., Southwick, S.M., and Charney, D.S. 1999. The neurobiology of posttraumatic stress disorder: An integration of animal and human research. In *Posttraumatic Stress Disorder: A Comprehensive Text* (pp. 103-143), edited by P. Saigh, and J.D. Bremner. New York: Allyn and Bacon.
- Bry, B. H., Catalano, R. F., Kumpfer, K. L., Lochman, J. E., and Szapocznik J. 1998. Scientific Findings from Family Prevention Intervention Research, In *Drug Abuse Prevention Through Family Interventions* [NIDA Research Monograph 177] (pp. 103-129), edited by R.S. Ashery, E.B. Robertson, and K.L. Kumpfer. Rockville, MD: US Department of Human Services, National Institute on Drug Abuse.
- Canadian Centre on Substance Abuse. 2006. *Highlights of the costs of substance abuse in Canada 2002*. Ottawa, ON: Author.
- Canadian HIV/AIDS Legal Network. 2005. “Nothing about us without us” – greater, meaningful involvement of people who use illegal drugs: A public health, ethical, and human rights imperative. Toronto: Author.
- Catalano, R.F., Gainey, R.R., Fleming, C.B., Haggerty, K.P., and Johnson, N.O. 1999. An experimental intervention with families of substance abusers: one-year follow-up of the focus on families project, *Addiction* 94:241-254.
- Chambers R.A., Taylor J.R., and Potenza M.N. 2003. Developmental neurocircuitry of motivation in adolescence: a critical period of addiction vulnerability. *American Journal of Psychiatry* 160 (6):1041-1052.
- Chikritzhs, T., Pascal, R., and Jones, P. 2004. Under-aged drinking among 14-17 year olds and related harms in Australia. *National Alcohol Indicators Bulletin No. 7*. Australia: National Drug Research Institute, Curtin University.
- Chikritzhs, T., and Stockwell, T.R. 2002. The impact of later trading hours for Australian public houses (hotels) on levels of violence. *Journal of Studies on Alcohol* 63 (5):591-599.
- Chikritzhs, T., Stockwell, T., and Pascal, R. 2005. The impact of the Northern Territory’s Living With Alcohol Program, 1992–2002: Revisiting the evaluation. *Addiction* 100:1625-1636.
- Christie, T., and Anderson, J.F. Drug courts are popular but do they work and are they ethical and appropriate for Canada? *Health Law in Canada* 23 (4):70-79.
- Cohen, D., and Prusak, L. 2001. *In good company: How social capital makes organizations work*. Boston: Harvard Business School Press.
- Collins, D., and Lapsley, H. 2002. Counting the cost: Estimates of the social costs of drug abuse in Australia in 1998-9. *Monograph 49*. Canberra: Australian Government Department of Health and Ageing.
- Cosden, M. 2001. Risk and resilience for substance abuse among adolescents and adults with LD. *Journal of Learning Disabilities* 34 (4):352-358.

Core Public Health Functions for BC: Evidence Review
Prevention of Harms Associated with Substances

- Davis, L.L., Suris, A., Lambert, M.T., Heimberg, C., and Petty, F. 1997. Post-traumatic stress disorder and serotonin: New directions for research and treatment. *Journal of Psychiatry Neuroscience* 22 (5):318-326.
- De Goeij, D.C., Dijkstra, H., and Tilders, F.J. 1992. Chronic psychosocial stress enhances vasopressin, but not corticotropin-releasing factor, in the external zone of the median eminence of male rats: Relationship to subordinate status. *Endocrinology* 131 (2):847-853.
- Donohue, J., and Levitt, S. 2001. The impact of legalized abortion on crime. *Quarterly Journal of Economics* 115 (2):379-420.
- Fergusson, D.M., Horwood, L.J., and Lynskey, M. 1994. The childhoods of multiple problem adolescents: A 15-year longitudinal study. *Journal of Child Psychology and Psychiatry* 35: 1123-1140.
- Fischer, B. 2003. Doing good with a vengeance: a critical assessment of the practices, effects and implications of drug treatment courts in North America. *Criminal Justice* 3 (3):227-248.
- Fishbein, D.H. 1998. Differential susceptibility to comorbid drug abuse and violence. *Journal of Drug Issues* 28 (4).
- Fishbein, D.H. 2000. The import of neurobiological research to the prevention of antisocial behaviour and drug abuse. *Prevention Science* 1 (2):89-106.
- Fishbein, D., Tartar, R., and Eldreth, D. 2005. *Application of neuroscience for preventing substance abuse*. Geneva: World Health Organization.
- Flanagan, P., and Kokotailo, P. 1999. Adolescent pregnancy and substance use. *Clinics in Perinatology* 26 (1):185-200.
- Flory, J.D., Manuck, S.B., Matthews, K.A., and Muldoon, M.F. 2004. Serotonergic function in the central nervous system is associated with daily ratings of positive mood. *Psychiatry Research* 129 (1):11-19.
- Glover, V. 1997. Maternal stress or anxiety in pregnancy and emotional development of the child. *British Journal of Psychiatry* 171:105-106.
- Gordon, H.W. 2002. Early environmental stress and biological vulnerability to drug abuse. *Psychoneuroendocrinology* 27(1-2): 115-126.
- Graham, K., Bernards, S., Osgood, D.W., Homel, R., and Purcell, J. 2005. Guardians and handlers: The role of bar staff in preventing and managing aggression. *Addiction* 100 (6):755-766.
- Grube, J.W. 1997. Preventing sales of alcohol to minors: Results from a community trial. *Addiction* 92 (Suppl. 2):S251-S260.

Core Public Health Functions for BC: Evidence Review
Prevention of Harms Associated with Substances

- Gruskin, S., Plafker, K., and Smith-Estelle, A. 2001. Understanding and responding to youth substance use: The contribution of a health and human rights framework. *American Journal of Public Health* 91 (12):1954-1963.
- Hawkins, J.D., Catalano, R.F., and Miller, J.Y. 1992. Risk and protective factors for alcohol and other drug problems in adolescence and early adulthood: Implications for substance abuse prevention. *Psychological Bulletin* 1992 112 (1):64-105.
- Hawkins, J.D., Guo, J., Hill, K., Battin-Pearson, S., and Abbott, R. 2001. Long term effects of the Seattle Social Development intervention on school bonding trajectories. In: *Applied Developmental Science: Special Issue: Prevention as Altering the Course of Development* (pp. 225-236), edited by J. Maggs and J. Schulenberg.
- Health Officers Council of British Columbia. 2005. *A public health approach to drug control in Canada*. British Columbia: Author.
- Heather, N. 2004. Brief interventions. In: *The Essential Handbook of Treatment and Prevention of Alcohol Problems*. (pp. 117-138), edited by N. Heather, and T. Stockwell, T. United Kingdom: John Wiley and Sons.
- Hibell, B., Andersson, B., Bjarnasson, T., Ahlström, S., Balakireva, O., Kokkevi, A., Morgan, M., et al. 2004. *The 2003 ESPAD report: Alcohol and other drug use among students in 30 European countries*. Stockholm: Swedish Council for Information on Alcohol and other Drugs.
- Hoffman MB. 2000. Commentary: The drug court scandal. *North Carolina Law Review* 78:1437-1527.
- Holdcroft, L.C., and Iacono, W.G. 2002. Cohort effects on gender differences in alcohol dependence. *Addiction* 97:1025-1036.
- Holder, H.D., Treno, A., and Levy, D. 2005. Community systems and ecologies of drug and alcohol problems. In *Preventing Harmful Substance Use: The Evidence Base for Policy and Practice* (pp. 149-162), edited by T. Stockwell, P. Gruenewald, J. Toumbourou, and W. Loxley. United Kingdom: John Wiley and Sons.
- Ito, Y., Teicher, M.H., Glod, C.A., and Ackerman, E. 1998. Preliminary evidence for aberrant cortical development in abused children: A quantitative EEG study. *Journal of Neuropsychiatry and Clinical Neuroscience* 10 (3):298-307.
- Karkowski, L.M., Prescott, C.A., and Kendler, K.S. 2000. Multivariate assessment of factors influencing illicit substance use in twins from female-female pairs. *American Journal of Medical Genetics* 96 (5):665-670.
- Kaufer, D., Friedman, A., Seidman, S., and Soreq, H. 1998. Acute stress facilitates long-lasting changes in cholinergic gene expression. *Nature* 393 (6683):373-377.

Core Public Health Functions for BC: Evidence Review
Prevention of Harms Associated with Substances

- Koo, H.P., Dunteman, G., George, C., Green, Y., and Vincent, M. 1994. Reducing adolescent pregnancy through a school- and community based intervention: Denmark, South Carolina, revisited. *Family Planning Perspectives* 26:206-211, 217.
- Kuhn, C.M., and Schanberg, S.M. 1998. Responses to maternal separation: Mechanisms and mediators. *International Journal of Developmental Neuroscience* 16:261-270.
- Lenton, S. 2005. Deterrence theory and the limitations of criminal penalties for cannabis use. In *Preventing harmful substance use: The evidence base for policy and practice* (pp. 101-112), edited by T. Stockwell, P. Gruenewald, J. Toumbourou, and W. Loxley. United Kingdom: John Wiley and Sons.
- Lorch, E.P., Palmgreen, P., Donohew, L., Helm, D., Baer, S., and D'Silva, M. 1994. Program context, sensation seeking and attention to televised anti-drug public service announcements. *Human Communication Research* 20:390-412.
- Lou, H.C., Hansen, D., Nordenfoft, M., Pryds, O., Jensen, F., Nim, J., and Hemmingsen, R. 1994. Prenatal stressors of human life affect fetal brain development. *Developmental Medicine and Child Neurology* 36: 826-832.
- Loxley, W., Toumbourou, J., Stockwell, T., et al. 2004. *The prevention of substance use, risk and harm in Australia: A review of the evidence*. Canberra: Australian Government Department of Health and Ageing.
- Lusher, J.M., Chandler, C. and Ball, D. 2001. Dopamine D4 receptor gene (DRD4) is associated with Novelty Seeking (NS) and substance abuse: the saga continues. *Molecular Psychiatry* 6 (5):497-499.
- Maxfield, M.G., and Widom, C.S. 1996. The cycle of violence. Revisited 6 years later. *Archives of Pediatric and Adolescent Medicine* 150 (4):390-395.
- McBride, N. 2005. The evidence base for school drug education interventions, In *Preventing Harmful Substance Use: The Evidence Base for Policy and Practice* (pp. 101-112), edited by T. Stockwell, P. Gruenewald, J. Toumbourou, and W. Loxley. United Kingdom: John Wiley and Sons.
- McBride, N., Farrington, F., Midford, R., Meuleners, L., and Phillips, M. 2004. Harm minimization in schools: Final results of the School Health and Alcohol Harm Reduction Project (SHAHRP). *Addiction* 99:278-291.
- Ministry of Health. 2005. *Harm reduction: A British Columbia community guide*. Victoria, BC: Author.
- Ministry of Health. 2006. *Following the Evidence: Preventing Harms from Substance Use in British Columbia*. Victoria, BC: Author.
- Ministry of Health Services. 2004. *Every door is the right door: A British Columbia planning framework to address problematic substance use and addiction*. Victoria, BC: Author.

Core Public Health Functions for BC: Evidence Review
Prevention of Harms Associated with Substances

- Mitchell, P., Spooner, C., Copeland, J., Vimpani, G., Toumbourou, J.W., Howard, J. and Sanson, A. 2001. A literature review of the role of families in the development, identification, prevention and treatment of illicit drug problems. *National Health and Medical Research Council Monograph*. Australia: Commonwealth of Australia.
- O'Connor, T.G., Reiss, D., McGuire, S., and Hetherington, E.M. 1998. Co-occurrence of depressive symptoms and antisocial behaviour in adolescence: A common genetic liability. *Journal of Abnormal Psychology* 107:27-37.
- Ogloff, J.R.P., Davis, M.R., and Somers, J.M. 2005. *Mental disorder, substance use, and criminal justice contact: a systematic review of the scholarly literature*. Victoria, BC: Ministry of Health.
- Olds, D.L., Henderson, C.R., Kitzman, H.J., Eckenrode, J.J., Cole, R.E., and Tatelbaum, R.C. 1999. Prenatal and infancy home visitation by nurses: Recent findings. *The Future of Children* 9 (1):44-65.
- Österberg, E., 2001. Effects of price and taxation, In: *International Handbook of Alcohol Dependence and Problems* (pp. 685-698), edited by N. Heather, T.J. Peters, and T. Stockwell. United Kingdom: John Wiley and Sons.
- Palmgreen, P., Lorch, E.P., Donohew, L., Harrington, N.G., D'Silva, M., and Helm, D. 1994. Reaching at-risk populations in a mass media drug abuse prevention campaign: Sensation seeking as a targeting variable. *Drugs and Society* 8:29-45.
- Palomo, T., Kostrzewa, R.M., Beninger, R.J., and Archer, T. 2004. Gene-environment interplay in alcoholism and other substance abuse disorders: expressions of heritability and factors influencing vulnerability. *Neurotoxicity Research* 6 (5):343-361.
- Pike, A., Hetherington, E.M., Reiss, D., and Plomin, R. 1996. Using MZ differences in the search for nonshared environmental effects. *Journal of Child Psychology and Psychiatry* 37:695-704.
- Piquero, A., and Tibbetts, S.G. 1999. The impact of pre/perinatal disturbances and disadvantaged familial environment in predicting criminal offending. *Studies on Crime and Crime Prevention* 71.
- Plant, M.A., Miller, P., and Plant, M.L. 2005. Trends in drinking, smoking and illicit drug use among 15 and 16 year olds in the United Kingdom 1995-2003. *Journal of Substance Use*. 10(6):331-339.
- Post, R.M., and Weiss, S.R. 1997. Emergent properties of neural systems: how focal molecular neurobiological alterations can affect behavior. *Development and Psychopathology* 9 (4):907-929.
- Putnam, R. 2000. *Bowling alone: The collapse and revival of American community*. New York: Simon and Schuster.

Core Public Health Functions for BC: Evidence Review
Prevention of Harms Associated with Substances

- Raine, A. 1993. *The psychopathology of crime: Criminal behaviour as a clinical disorder*. San Diego: Academic Press.
- Rehm, J., and Room, R. 2005. The global burden of disease attributable to alcohol, tobacco and illicit drugs. In *Preventing Harmful Substance Use: The Evidence Base for Policy and Practice* (pp. 25-42), edited by T. Stockwell, P. Gruenewald, J. Toumbourou, and W. Loxley. United Kingdom: John Wiley and Sons.
- Riggs, N.R., Greenberg, M.T., Kusche, C.A., and Pentz, M.A. (in press). The mediational role of neurocognition in the behavioural outcomes of a social-emotional prevention program in elementary school students: Effects of the PATHS curriculum. *Prevention Science*.
- Risch, S.C. 1997. Recent advances in depression research: From stress to molecular biology and brain imaging. *Journal of Clinical Psychiatry* 58 (Suppl. 5):3-6.
- Roche, A. 2004. Brief interventions: Good in theory but weak in practice. *Drug and Alcohol Review* 23 (1):11-18.
- Schweinhart, L.J., and Weikart, D.P. 1993. Success by empowerment: The high/scope Perry preschool study through age 27. *Young Children* 49:54-58.
- Senba, E., and Ueyama, T. 1997. Stress-induced expression of immediate early genes in the brain and peripheral organs of the rat. *Neuroscience Research* 29:183-207.
- Shewan, D., and Dalgarno, P. 2005. Low levels of negative health and social outcomes among non-treatment heroin users in Glasgow (Scotland): Evidence for controlled heroin use? *British Journal of Health Psychology* 10:1-17.
- Shin, L.M., McNally, R.J., Kosslyn, S.M., Thompson, W.L., Rauch, S.L., Alpert, N.M., Metzger, L.J., Lasko, N.B., Orr, S.P. and Pitman, R.K. 1997. A positron emission tomographic study of symptom provocation in PTSD. *Annals of the New York Academy of Sciences* 821:521-523.
- Sinha, R. 2001. How does stress increase risk of drug abuse and relapse? *Psychopharmacology* 158:343-359.
- Slotkin, T.A. 1998. Fetal nicotine or cocaine exposure: Which one is worse? *Journal of Pharmacology and Experimental Therapeutics* 285:931-945.
- Somers, J.M., Jones, W., and Queree, M. 2005. *Mental disorder, substance use, and criminal justice contact: Linked data analyses*. Victoria, BC: Ministry of Health.
- Southwick, S.M., Krystal, J.H., Bremner, J.D., Morgan, C.A., Nicolaou, A.L., Nagy, L.M., Johnson, D.R., Heninger, G.R., and Charney, D.S. 1997. Noradrenergic and serotonergic function in posttraumatic stress disorder. *Archives of General Psychiatry* 54 (8):749-758.

Core Public Health Functions for BC: Evidence Review
Prevention of Harms Associated with Substances

- Spoth, R.L., Gyll, M., and Day, S.X. 2002. Universal family-focused interventions in alcohol-use disorder prevention: Cost-effectiveness and cost-benefit analyses of two interventions. *Journal of Studies on Alcohol* 63 (2):219-228.
- Stabenau, J.R. 1977. Genetic and other factors in schizophrenic, manic-depressive, and schizoaffective psychoses. *Journal of Nervous and Mental Disorders* 164 (3):149-167.
- Stockwell, T. 2004. Harm reduction: The drugification of alcohol policies and the alcoholisation of drug policies. In *From Science To Action? 100 Years Later - Alcohol Policies Revisited* (pp. 49-59), edited by H. Klingemann, and R. Muller. Netherlands: Kluwer Academic Publishers.
- Stockwell, T., Dyskin, E., and O'Connor, J. 1995. *The impact of the Tobacco Control Act (WA) 1990 on Perth schoolchildren 1991-1994*. Perth: National Centre for Research into the Prevention of Drug Abuse, Curtin University of Technology.
- Stockwell, T., Fishbein, D., Toumbourou, J.W., Tarter, R., and Eldreth, D. 2005. *Preventing psychoactive substance use and related harms among children and adolescents: A review of theory and global best practices to address psychosocial and neurobiological factors*. World Health Organization.
- Stockwell, T., Gruenewald, P., Toumbourou, J., and Loxley, W. (Eds). 2005. *Preventing harmful substance use: The evidence base for policy and practice*. United Kingdom: John Wiley and Sons.
- Stockwell, T., Toumbourou, J., Letcher, P., Smart, D., Sanson, A., and Bond, L. 2004. Risk and protection factors for different intensities of adolescent substance use: When does the Prevention Paradox apply? *Drug and Alcohol Review* 23 (1):67-77.
- Tarter, R., Vanyukov, M., Giancola, P., Dawes, M., Blackson, T., Mezzich, A., and Clark, D.B. 1999. Etiology of early age onset substance use disorder: A maturational perspective. *Development and Psychopathology* 11:657-683.
- Toumbourou, J.W., and Catalano, R.F. 2005. Predicting developmentally harmful substance use. In *Preventing Harmful Substance Use: The Evidence Base for Policy and Practice* (pp. 53-66), edited by T. Stockwell, P. Gruenewald, J. Toumbourou, and W. Loxley. United Kingdom: John Wiley and Sons.
- Toumbourou, J.W., Rowland, B., and Jefferies, A. 2005. Could an alcohol-abstinence focus through childhood and adolescence reduce alcohol-related harm? *Drug Info Clearinghouse* 13:1-21. Melbourne: Australian Drug Foundation.
- Toumbourou, J.W., Williams, J., Waters, E., and Patton, G. 2005. What do we know about preventing drug-related harm through social developmental intervention with children and young people? In *Preventing Harmful Substance Use: The Evidence Base for Policy and Practice* (pp. 87-100), edited by T. Stockwell, P. Gruenewald, J. Toumbourou, and W. Loxley. United Kingdom: John Wiley and Sons.

Core Public Health Functions for BC: Evidence Review
Prevention of Harms Associated with Substances

- United Nations Office on Drugs and Crime. 2005. *World drug report 2005*. Vienna: Author.
- Van Os, J., and Selten, J.P. 1998. Prenatal exposure to maternal stress and subsequent schizophrenia. The May 1940 invasion of The Netherlands. *British Journal of Psychiatry* 172:324-326.
- Vazquez, D.M., Eskandari, R., Zimmer, C.A., Levine, S., and Lopez, J.F. 2002. Brain 5-HT receptor system in the stress infant rat: Implications for vulnerability to substance abuse. *Psychoneuroendocrinology* 27 (1-2):245-272.
- Virgin, C.E., and Sapolsky, R.M. 1997. Styles of male social behaviour and their endocrine correlates among low- ranking baboons. *American Journal of Primatology* 42 (1):25-39.
- Voas, R.B., Tippetts, A.S., and Fell, J.C. 2003. Assessing the effectiveness of minimum legal drinking age and zero tolerance laws in the United States. *Accident Analysis and Prevention* 35:579-587.
- Weisglas-Kuperus, M.N., Baerts, W., Smrkovsky, M., and Sauer, P.J. 1993. Effects of biological and social factors on the cognitive development of very low birth weight children. *Pediatrics* 92:658-665.
- The World Bank. 1999. What is social capital? *Poverty Net*.
- World Health Organization 1998. *Guidelines for controlling and monitoring the tobacco epidemic*. Geneva: World Health Organization.
- World Health Organization 2000a. *Guide to drug abuse epidemiology*. Geneva: World Health Organization, Division of Mental Health and Prevention of Substance Abuse.
- World Health Organization 2000b. *International guide for monitoring alcohol consumption and related harm*. Geneva: World Health Organization.
- World Health Organization. 2004. *Promoting mental health: Concepts-emerging evidence-practice: Summary Report*. Geneva: World Health Organization.
- Younie, S., Scollo, M., Hill, D., and Borland, R. 2005. Preventing tobacco use and harm: what is evidence based policy? In *Preventing Harmful Substance Use: The Evidence Base for Policy and Practice* (pp. 337-350), edited by T. Stockwell, P. Gruenewald, J. Toumbourou, and W. Loxley. United Kingdom: John Wiley and Sons.

APPENDIX A: SUMMARY TABLE

Domain	Mechanisms	Proven and Promising Interventions²	Best Advice for Health Authorities
Reproductive Health	<ul style="list-style-type: none"> • Unplanned pregnancies are more likely among young, single women with limited economic, social and emotional resources to support a child. • Unplanned pregnancies are more likely to be accompanied by risk-taking behaviour such as heavy alcohol and other substance use. • The prevalence of risky sexual behaviour is affected by the availability of alcohol and other psychoactive substances. • Rising levels of alcohol use among young women are temporally associated with a trend towards increasing rates of child abuse and neglect. 	<ul style="list-style-type: none"> α Effective sex education. α Health services that include affordable and effective contraception for young people. α Targeted programs for young and vulnerable women (e.g., with problematic substance use) have been shown to reduce substance use for high-risk young mothers. α Availability and access to termination for unwanted pregnancies. α Universal interventions that reduce risky patterns of substance use. 	<ul style="list-style-type: none"> α Provide effective sex education for teenagers from multiple credible sources within the community. α Ensure the availability of health services that include affordable and effective contraception for young people, including high-risk teenagers. α Provide targeted programs for young and vulnerable women (e.g., with problematic substance use), in order to reduce substance use for high-risk young mothers. α Ensure availability of and access to termination for unwanted pregnancies, within a health care setting that provides such services that are legal and safe. β Develop fetal alcohol spectrum disorder prevention strategies in each regional health authority in British Columbia.
Maternal and Fetal Health	<ul style="list-style-type: none"> • The inheritance of specific genetic characteristics increases the risk of substance use problems later on in life. • Nutritional intake, substance use and the mother's mental state and stress levels during pregnancy all affect fetal development. • Birth complications can predispose infants toward impaired brain function and later behavioural problems. • HIV and other blood-borne viruses are frequently transmitted through sharing needles between people who inject drugs. • Stress during pregnancy can lead to developmental problems during infancy. • Excessive maternal alcohol, tobacco and other drug use can disrupt brain development (e.g., fetal alcohol spectrum disorder). 	<ul style="list-style-type: none"> α Adequate access to prenatal care, including HIV testing and treatment. α Home visiting by a health professional at regular intervals from pregnancy to a child's second birthday. α Needle/syringe distribution programs and other harm reduction strategies, such as methadone maintenance, are extremely effective and cost-effective means of reducing the incidence of HIV/AIDS as well as other blood-borne viruses such as hepatitis B and C. β Prenatal screening, brief advice and follow-up that focuses on alcohol and tobacco use, as well as other lifestyle issues. 	<ul style="list-style-type: none"> α Ensure adequate access to prenatal care, including HIV testing and treatment. α Enhance the effectiveness and reach of community-based pregnancy support programs to assist expectant mothers, and identify conditions that might undermine healthy child development. β Ensure broad access to information about alcohol, tobacco or other substance use on fetal development during pregnancy and provide targeted campaigns to address high-risk populations.

² α = proven β = promising

Core Public Health Functions for BC: Evidence Review
Prevention of Harms Associated with Substances

Domain	Mechanisms	Proven and Promising Interventions ²	Best Advice for Health Authorities
Infancy and Early Childhood (0 to 4 Years)	<ul style="list-style-type: none"> • Healthy social and psychological development requires adequate nutrition, and social and cognitive stimulation during infancy and early childhood. • Environmental stress impedes early brain development and function. • Bonding with the mother during breast-feeding and maternal care of the infant is critical for the development of a positive and nurturing relationship. • Social-learning events and opportunities within the parent-child interaction can create an environment where undesirable behaviours are either properly managed, or evolve into an escalation of child-behaviour problems. 	<ul style="list-style-type: none"> α <i>Parent education programs</i> initially focusing on developing successful bonding between the mother and baby, and then on later broader competencies for parents. α <i>School preparation programs</i> provide support for parents from disadvantaged backgrounds, and provide structured classroom experiences for children before school enrolment. β <i>Targeted programs</i> to reduce the impact of maternal smoking and to assist families with problems associated with substances. 	<ul style="list-style-type: none"> α In collaboration with regional staff from the Ministry of Children and Family Development, engage parents in training opportunities aimed to improve skills for healthy child and family relationships, parenting skills and awareness of family support networks. α Enter into a partnership with school districts to increase access to structured preschool environments that provide intellectual stimulation and social interaction. β Deploy a program of home visitation by professionals, such as public health nurses, for new parents, with targets that include reducing infant exposure to substance use and reducing early developmental risk factors that may result in a child's later problematic substance use.
Early School Years (5 to 10 Years)	<ul style="list-style-type: none"> • Poor adjustment to school and peer group, poor school achievement, behavioural problems in the class and aggression are all predictors of problem behaviour in adolescence and beyond. • Prior deficits in cognitive function and emotional regulatory abilities significantly increase the development of adjustment difficulties and later behavioural problems. • Children growing up in low-income families, especially among those with mental health or substance use problems, will often have less social, physical and economic supports during these developmental years. 	<ul style="list-style-type: none"> α <i>Family support programs</i> for families with primary school-age children. α <i>School organization and behaviour management programs</i> train teachers to better manage disruptive behaviour in the classroom, especially for high-risk children. α The identification of individual children who are suffering from academic or behavioural difficulties, followed by the provision of appropriate remedial services. 	<ul style="list-style-type: none"> α Work with the Ministry of Education and school district officials to utilize school transition points (entry into preschool/kindergarten, middle school and high school) as opportunities to provide universal parenting education and follow-up as indicated. α Implement policies and services that improve access to psychosocial supports such as parenting support, crisis intervention and grief counselling. α Give special attention to deprived neighbourhoods and communities when implementing all interventions related to key developmental stages.

Core Public Health Functions for BC: Evidence Review
Prevention of Harms Associated with Substances

Domain	Mechanisms	Proven and Promising Interventions ²	Best Advice for Health Authorities
Adolescence (11 to 17 Years)	<ul style="list-style-type: none"> • Psychotropic substances can facilitate social behaviours and identity exploration. • Adolescence can be a stressful time, when individuals are required to develop their own social networks and personal identities, acquire social and vocational skills and strive to achieve social expectations. • Learning disabilities, cognitive deficits, and emotional dysregulation can predispose children toward later substance use problems in adolescence. • Employment opportunities can provide disposable income. • The cheaper legal and illegal drugs are, the more likely young people will purchase and consume them at risky levels. • Access to tobacco and alcohol from retail sources becomes increasingly feasible. • Adolescents are trying to establish increasing independence and tend to model the behaviour of older children and respected adults. • Early use of both legal and illegal substances during adolescence is a potent predictor of later mental health problems and more serious problems with alcohol and other drug use in young adulthood. 	<ul style="list-style-type: none"> β <i>Harm reduction strategies</i> that reduce opportunities for high-risk behaviours in the immediate environment as well as reduce the impact of these on health and safety when high-risk behaviours persist. α <i>Legal restrictions</i> on youth access to alcohol and tobacco. α <i>Enforcement of legal age restrictions</i> on access to alcohol and tobacco. α <i>Voluntary codes and legal restrictions</i> on youth access to solvents and precursor chemicals. α <i>School-based drug education</i> that includes the use of student input to ensure interesting and interactive class exercises, investment in teacher training, and booster sessions throughout the secondary school years. α <i>Community mobilization</i> programs alter the acceptability of and access to both legal and illegal substances. β <i>Youth sport and recreation</i> programs and mentorship schemes. 	<ul style="list-style-type: none"> β In collaboration with the Ministry of Education and appropriate ministries, promote programs that provide youth with the opportunity to engage in volunteering and benefit from mentorship. α Work with the appropriate ministries to increase access to community supports and training programs. α Continue to work with municipalities to enforce retailer compliance with age-identification for tobacco sales, and to lobby the provincial government and municipalities to implement strategies to enforce age-identification for alcohol sales. α Use media to increase public awareness of harms related to use of alcohol, tobacco or cannabis by minors and of enforcement efforts and consequences for non-compliance with current regulations. α Use media and parent education strategies to encourage responsible supervision of access to alcohol in the home and social contexts. α Support community mobilization programs. β Encourage implementation of sports campaigns that include education about harms from substance use, and consider expanding beyond sports to other recreational and social contexts. β In collaboration with the Ministry of Education and other responsible ministries, increase exposure to mentorship programs. β Utilize peer involvement to create healthy contexts and activities and to reduce perceived favourable norms. α Work with school districts to promote effective smoke-free school policies, with a high degree of perceived enforcement.

Core Public Health Functions for BC: Evidence Review
Prevention of Harms Associated with Substances

Domain	Mechanisms	Proven and Promising Interventions ²	Best Advice for Health Authorities
<p>Universal Interventions Impacting All Age Groups</p>	<ul style="list-style-type: none"> • Cigarette smokers, heavy drinkers and people with problematic use of illegal drugs can be negative role models for children and young people. • The absolute number of cigarette smokers and heavy drinkers in a population is affected by changes in the price of tobacco and alcohol, and the availability of these products in terms of the distance needed to travel and the hours when retail outlets are open. • Young people and heavy consumers of tobacco and alcohol, who are particularly at risk of harm, are most likely to reduce their consumption when costs increase and marketing strategies are controlled. • The legal status of different substances and the effectiveness of law-enforcement strategies should affect price purity and availability of illegal substances. In practice, however, there is only limited available data about which types of law enforcement may or may not be effective. 	<ul style="list-style-type: none"> α Taxation strategies to maintain or increase the price of legal substances. α Brief interventions in primary health care that identify smokers and high-risk alcohol drinkers. α Treatment for alcohol and other drug problems is a key ingredient of comprehensive prevention policies. α Harm reduction strategies that seek to minimize or limit the harms associated with drug use without necessarily seeking to eliminate use. α Regulation of the physical availability of alcohol as a means of reducing demand and lowering levels of risky alcohol use. β Educational and media campaigns that target individuals who tend to exhibit traits of novelty- and stimulation-seeking. β Judicial procedures that target drug offenders for diversion from prison and provide evidence-based addiction treatment services. 	<ul style="list-style-type: none"> α Encourage and support screening and brief interventions for hazardous substance use in primary care. α Work with employers and unions to encourage the development of brief interventions applicable to the workplace. α Develop and promote innovative computer-assisted and internet-based resources for people to self-assess and receive individually tailored feedback and monitoring of their substance use. α Work with school districts to support and implement brief intervention programs for students in all secondary schools. α Support brief intervention programs for offenders with alcohol and/or other drug problems. α Provide access to telephone-based brief intervention services. α Develop and implement social marketing campaigns to restrict the exposure of children and others to second-hand smoke. α Promote consistent messages from health care professionals that reinforce the risks and encourage behaviour change. α Ensure unrestricted universal access for people who inject drugs to needle and syringe distribution programs in both urban and rural settings. α Ensure access to primary response services that provide brief intervention and referral to other services. α Establish multi-faceted support centres for people who have drug problems and a multi-component system (wet-damp-dry housing, contact centres, employability skills training and apprenticeship/experience programs). α Address barriers that inhibit access to treatment services and expand the range of treatment services offered. β Work with the Ministry of Public Safety and Solicitor General to integrate and coordinate the full range of substance use services with programs within all corrections facilities and programs operating in British Columbia, including assertive community treatment and diversion programs.

Core Public Health Functions for BC: Evidence Review
Prevention of Harms Associated with Substances

Domain	Mechanisms	Proven and Promising Interventions²	Best Advice for Health Authorities
Universal Interventions Impacting All Age Groups			<ul style="list-style-type: none"> α Conduct public health and safety risk assessments of licensed premises. α Explore local agreements between municipalities, police and liquor licensees, which promote responsible service and pricing policies. α Encourage local accords between municipalities, police and liquor licensees, which promote responsible service, limit price discounting and ban all forms of local price advertising. α Engage the media in monitoring the success of industry accords and in reporting offenders and problem establishments.