This document is part of a collection produced by the six National Collaborating Centres for Public Health to encourage mental health promotion for children and youth within a strong, integrated public health practice. The collection provides numerous entry points for the public health sector to collaborate with other stakeholders to support evidence-informed action that addresses the determinants of mental well-being for all children and youth in Canada.

This discussion paper describes how infectious diseases can be both risk factors for, and result from, neurocognitive conditions and mental illnesses and explores how mental health can be a protective factor against some infectious diseases. Details on search methods and terms used for this paper can be found in the introduction document: Population mental health promotion for children and youth - a collection for public health in Canada.

FRAMING THE LINKS BETWEEN INFECTIOUS DISEASES AND MENTAL HEALTH PROMOTION IN CHILDREN AND YOUTH

When it comes to promoting the mental health of children and youth, public health practitioners and policy makers may not immediately think about its connection with infectious diseases. Other factors, such as physical environments and social circumstances, are more likely to come to mind, but infection and infectious diseases are linked in a variety of complex ways with both mental illness and mental health.

First, a growing body of research suggests that infection and infectious diseases may play a role in the development of neuropsychiatric conditions and mood disorders in female and male infants, children and youth, including attention deficit hyperactive disorder (ADHD), schizophrenia, obsessive-compulsive disorder, tic disorders, autism spectrum disorders, anxiety and depression (Benros, Mortensen, &

For more information, please see Environmental influences on population mental health promotion for children and youth: Considerations for Indigenous child and youth population mental health promotion in Canada; Healthy public policies and population mental health promotion for children and youth: Chronic diseases and population mental health promotion for children and youth in this Collection.

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Infectious diseases can threaten mental health as well as contribute to the development of mental illnesses. Research demonstrates that young women and men, and girls and boys, who have contracted sexually-transmitted and blood-borne infections (STBBIs), such as Chlamydia, syphilis, Hepatitis C and HIV, have lower self-esteem and are at heightened risk of social isolation as compared with their peers (Brown, Whiteley, Harper, Nichols, & Nieves, 2015; Catalan et al., 2011; Chen, Wu, Yi, Huang, & Wong, 2008; Fielden et al., 2006; King, 2009; Liampittong, 2016; Logie, James, Tharao, & Loutfy, 2013; Mellins & Malee, 2013). STBBIs are also associated with higher rates of mental illnesses, particularly depression, anxiety and suicidal ideation in male and female children and youth (Public Health Agency of Canada, 2014a). HIV, for example, has been linked with a spectrum of neurocognitive disorders. These conditions, termed HIV-associated neurocognitive dysfunction (HAND), are a result of direct viral infection of the brain and the consequences of immune dysfunction, and affect up to 50% of HIV infected individuals. Human Papilloma Virus (HPV), which is most prevalent in young women and teenaged girls, is associated with cancer as well as depression, anger, and sexual dysfunction, compromised self-image, and loss of self-esteem related to the disfiguring effects of genital warts (Graziottin & Serafini, 2009; Linares et al., 2013; Lopez et al., 2013). Further some medications used to treat Hepatitis C, tuberculosis, and HIV can cause symptoms of mental illness, and treatments for HPV, which are painful and invasive, can contribute to psychological distress (Public Health Agency of Canada, 2014a; Doberty et al., 2013; Graziottin & Serafini, 2009).

Stressful early life experiences and persistent adversity, sometimes referred to as "toxic stress", during childhood and youth can have lasting negative effects on the immune system, with implications for physical and mental health across the lifespan (Fagundes, Glaser, & Kiecolt-Glaser, 2013; Johnson, Riley, Granger, & Riis, 2013; J. P. Shonkoff, Garner, Committee on Psychosocial Aspects of Child and Family Health, Committee on Early Childhood, Adoption, and Dependent Care, & Section on Developmental and Behavioral Pediatrics, 2012)ii.

For more information, please see Environmental influences on population mental health promotion for children and youth in this Collection.
Finally, research on STBBIs demonstrates that both mental health and mental illness can affect the spread of infectious disease. On the one hand, good mental health can help to constrain behaviours that increase the risk of exposure to STBBIs. For instance, one study found that young Indigenous women and men with higher levels of self-efficacy – the ability to complete tasks and reach goals – were more likely to use condoms (Shercliffe et al., 2007). On the other hand, some mood disorders, such as depression, and some neuropsychiatric conditions, such as ADHD and schizophrenia, are associated with risk behaviours that contribute to STBBI exposure and transmission, including abuse of substances, early initiation of sex, sexual coercion and unprotected sex, (Public Health Agency of Canada, 2014a; Public Health Agency of Canada, 2014b). Addictions and mental illnesses can also affect treatment compliance, reducing the chances for cure or control of STBBIs and the risk of transmission (Centre for Mental Health and Addictions, 2014).

Research demonstrates that infections and infectious diseases are more prevalent in vulnerable populations, including those stigmatized and disadvantaged by sex, race, socio-economic status, sexual orientation and other determinants (Public Health Agency of Canada, 2009; Public Health Agency of Canada, 2014b; Gray et al., 2016). Studies also show that low-income girls and boys are at “higher risk of developing mental disorders affecting attention, anxiety, and mood” (Azma, 2013), as are male and female children and youth from ethnic and sexual-minority populations (Hamblin, 2016). What is not yet fully understood is if and how these patterns intersect. More research is needed on the relationships between social and economic

THE RELATIONSHIP BETWEEN DETERMINANTS OF MENTAL HEALTH, MENTAL ILLNESS, AND INFECTIOUS DISEASES

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inequities, infectious diseases, and cognitive, emotional, and social development. It is especially important to gain a better understanding of the challenges and opportunities facing the most vulnerable populations, including children and youth from Indigenous and immigrant communities as well as homeless, impoverished and sexual minority children and youth.

**STTBIs and mental illnesses**

The correlation between the determinants of infectious diseases and mental illnesses is well-documented in relation to STTBIs. Sex and gender, race and ethnicity, poverty and homelessness, sexual orientation and other determinants can influence vulnerability to both STTBIs and mental illnesses. For instance, female youth have higher rates of some STTBIs, such as Chlamydia, gonorrhea, and HPV, and this population is more likely to experience poor mental health, including low self-esteem, and mental illness, such as depression. Male youth are disproportionately represented among those living with syphilis, and rates of neurocognitive disorders such as ADHD and autism are more common among males than females (Public Health Agency of Canada, 2014b). Indigenous youth are more likely than non-Indigenous youth to experience depression, substance use and suicidal ideation, and rates of HIV are higher in this population than in the general youth population (Gray, Richer, & Harper, 2016; Greenwood & de Leeuw, 2012; National Collaborating Centre for Aboriginal Health, 2013).

The relationship between STTBIs, mental illnesses, and the determinants of health is more than coincidental. Social and economic inequities forge mutually-reinforcing connections between STTBIs and mental illness. For example, depression, anxiety, bipolar disorder and post-traumatic stress disorder are more common among homeless and street-involved males and female youth, and these mental illnesses “play a role in the maintenance of sexual behaviours, such as inconsistent condom use, involvement in sex work and multiple sex partners, as well as substance use (e.g., injection drug use), all of which increase vulnerability to STTBIs” (Public Health Agency of Canada, 2014a). Even among street-involved youth, social and economic inequities create greater risk for STTBIs and mental illnesses in some sub-populations. According to the Public Health Agency of Canada, “sexual minority, female, Aboriginal and ethnocultural minority youth are more vulnerable to stigma, discrimination and homophobia, substance use, mental illness and victimization, which also makes them more vulnerable to STTBIs” (Public Health Agency of Canada, 2014a). Further, social and economic inequities intersect to increase the risk of mental illness and STTBIs for vulnerable populations of female and male youth. A 2013 study with HIV-positive African, Caribbean, and Black women in Ontario concluded that “HIV-related stigma, gender discrimination and racial discrimination were significantly correlated with one another and with depression” (Logie et al., 2013). Economically disadvantaged African American women were found to have poor mental health, characterized by a sense of hopelessness about the present and the future, that was associated with behaviours such as having multiple sex partners and unprotected sex placing them at risk of acquiring STTBIs (Raiford et al., 2014). A recent literature review of HIV among Indigenous people in Canada, the United States and Australia points to the impact of adverse childhood experiences – including abuse, domestic violence and time spent in foster care and residential schools – on mental health, risky sexual behaviours, and high rates of STTBIs (Negin, Aspin, Gadsden, & Reading, 2015).

**Infectious diseases and neuropsychiatric conditions**

The relationship between infectious diseases and neuropsychiatric conditions is an emerging area of study and, to date, researchers have tended to focus on biology – the role of inflammation and cytokines – rather than on the “moderating, mediating and confounding effects of … biosocial variables”, such as sex and gender, race and ethnicity, and socioeconomic status (Davydov, Stewart, Ritchie, & Chaudieu, 2010; Public Health Agency of Canada, 2014a). Factors other than biology clearly affect this relationship because not every boy or girl who contracts an infectious disease – or whose mother develops an infection during pregnancy – develops a neuropsychiatric condition or mood disorder (Committee on Psychosocial Aspects of Child and Family Health, Committee on Early Childhood, Adoption, and Dependent Care, and Section on Developmental and Behavioral Pediatrics et al., 2011; J. P. Shonkoff et al., 2012). One study on toxic stress concluded that, “outcomes vary considerably among children exposed to similar environments, underscoring the role of resilience factors” (Johnson et al., 2013).

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1 For more information, please see Considerations for Indigenous child and youth population mental health promotion in Canada in this Collection.
The effect of good mental health

Research on the determinants of infectious diseases and mental health is also small, but “rich and rapidly growing” (J. Shonkoff, 2010). Studies on the relationship between good mental health and immune responses are intriguing because they suggest that promoting mental health among female and male infants and young boys and girls can have tremendous benefits in the immediate term as well as across the lifespan (J. P. Shonkoff et al., 2012). As with the research on neuropsychiatric conditions and infection, this work tends to focus on biological rather than social and economic systems (Davey et al., 2010; Dhabhar, 2014; Fagundes et al., 2013; Marsland et al., 2006), but some literature implicitly or explicitly addresses the impact of social and economic inequities on mental health and infectious diseases. For example, one team of researchers reported that prenatal maternal stress, in the form of poverty, poor housing

and community violence, can reduce innate and adaptive immunity in infants (Wright et al., 2010). Other studies have pointed to the importance of adequate caregiving and nurturing in early life: “Young children with caregivers who are available and responsive to their emotional and material needs develop immune systems that are better equipped to deal with initial exposures to infections and to keep dormant infections in check over time” (Johnson et al., 2013; Shirtliff, Coe, & Pollak, 2009). Research with Indigenous youth in Canada has likewise suggested that “cultural connectedness,” including speaking traditional languages and living by traditional culture, “may protect against HIV and Hepatitis C infection, and buffer the effects of historical and lifetime trauma” (Pearce et al., 2015).

For more information, please see Environmental influences on population mental health promotion for children and youth, in this Collection.

For more information, please see Healthy public policies and population mental health promotion for children and youth, in this Collection.

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INTERVENTIONS

Given the limited research on the determinants of infectious diseases and their links to child and youth mental health, it is not surprising that promising strategies and practices in this area are rare. A few studies include recommendations for interventions but these tend to be quite general in nature and most of them focus on HIV. For example, one study with HIV-positive African, Caribbean and Black women in Canada suggested individual counselling to build resilience and coping skills, campaigns to challenge social norms and values leading to stigma and discrimination, and competency care training for health care professionals (Logie et al., 2013). Similarly, research with girls and boys perinatally infected with HIV stresses the importance of supportive caregiving relationships in fostering coping and resilience (Bhana et al., 2016; Fielden et al., 2006; Laughton, Cornell, Boivin, & Van Rie, 2013; Mellins & Malee, 2013).

One American program, the Collaborative HIV/AIDS Mental Health Program (CHAMP), may be a promising practice to promote mental health among vulnerable populations of children and adolescents infected or affected by HIV (McKay et al., 2014). It consists of a 10-session family program that supports positive parenting and better self-esteem, peer relationships, and coping in youth. Clinical trials have consistently demonstrated improvements in both family relationships and youth mental health among those participating in the program. It could be valuable to explore the feasibility of adapting the CHAMP program for the public health and Canadian contexts.

PUBLIC HEALTH ROLES

While the nature of the threats posed by infectious diseases has changed in the last century, particularly in the developed world, the prevention and control of infectious diseases remains a cornerstone of public health (Public Health Agency of Canada, 2013). As researchers uncover new links among infectious diseases, mental health and illness and the determinants of health, it will be important for the public health sector to incorporate this new knowledge in their work.

While there are few models to guide the development of an expanded role for public health practitioners and policymakers in child and youth mental health promotion, the American Academy of Pediatrics (APP) has described a promising approach to paediatric practice, the “eco-bio-developmental framework”, that might prove useful in the realm of public health (Johnson et al., 2013; J. Shonkoff, 2010; Committee on Psychosocial Aspects of Child and Family Health, Committee on Early Childhood, Adoption, and Dependent Care, and Section on Developmental and Behavioral Pediatrics et al., 2011). This framework encourages practitioners to consider how biological factors, such as genetic endowment and immune responses, interact with social and physical environments, such as poverty, neglect and abuse, to exert a profound influence on physical and mental development in children and youth and into adulthood. The framework also underscores the critical role that clinicians can play in translating knowledge into practice, establishing cross-sectoral collaborations, and advocating for changes in policies, programs and systems. According to an APP position paper, pediatricians are uniquely placed “to lead an invigorated, science-based effort at transforming the way our society invests in the development of all children, particularly those who face significant adversity” (Johnson et al., 2013).

Public health policy makers and practitioners are similarly well-positioned to identify at-risk girls and boys, educate stakeholders, foster and support collaboration, and to help transform policies and programs. As a start, clinicians could work to ensure that infectious diseases are considered and addressed in mental health initiatives and best practice.

vii For more information, please see Healthy public policies and population mental health promotion for children and youth in this Collection.
guidelines. For example, the Centre for Addictions and Mental Health has published guidelines on child and youth mental health promotion that could be strengthened by incorporating evidence on the role of infection in risk and resilience for diverse populations of girls and boys (Centre for Mental Health and Addictions, 2014). The reverse is also true: mental health considerations could be included in best practice guidelines on infectious diseases. For example, the Canadian Paediatric Society publishes “position papers and practice points” on a variety of infectious diseases that affect children and youth, including Lyme disease, tuberculosis, STBBIs, and infections in neonates (http://www.cps.ca/documents/tag/infectious-diseases). Information on the mental health and illness implications of these diseases would strengthen these guidelines.

In keeping with public health roles to advance health equity (National Collaborating Centre for Determinants of Health, 2013), policy makers and practitioners could also contribute to a broader vision of burden of disease, and new indicators that capture the relationship between mental health and infectious diseases – locally, regionally, nationally and globally (Isfeld-Kiely & Balakumar, 2015; National Collaborating Centre for Infectious Diseases, 2016). Further, they could advocate for and contribute to policy and structural changes on the determinants of mental health and infectious disease among children and youth. In these ways, public health policy makers and practitioners could promote mental health as both an individual and public good, and as a crucial component in the management of infectious diseases.

For more information, please see Healthy public policies and population mental health promotion for children and youth in this Collection.
Currently, there appear to be no organizations or networks specifically dedicated to advancing understanding or addressing the impact of the determinants of infectious diseases and child and youth mental health. But many organizations and networks have mandates that relate either to child and youth mental health or to infectious diseases. Public health practitioners have an opportunity to bring together these organizations and networks to consider how they might work together to advance understanding of and action on the determinants of infectious diseases and child and youth mental health.

Resources on the determinants of infectious diseases and mental health are also limited in number and those that do exist tend to focus on STBBIs, but there are some resources that could be helpful. For instance, in 2014, the Public Health Agency of Canada released a report on STBBIs among youth that discussed the linkages between the determinants, infectious diseases and both mental health and illness. Examples from this report could be used to raise awareness among infectious diseases public health practitioners about the determinants of infectious diseases and mental health in children and youth. The eco-bio-developmental framework mentioned earlier in this paper could be used to educate public health practitioners about the impact of toxic stress on child and youth mental health and infectious diseases. The APP’s policy statement envisioning a new health promotion role for pediatricians might also help public health practitioners to consider new ways to promote child and youth mental health.
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