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Suicide and HIV as leading causes of death among gay and bisexual men: a comparison of estimated mortality and published research

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Gay and bisexual men experience numerous health disparities relative to heterosexual men, including high rates of HIV and suicidal behavior. Systematic community health assessments could provide direct comparisons of the burden of mortality across diseases and thus facilitate the prioritization of public health activities; however, such assessments have been precluded by the absence of sexual orientation information in vital statistics records. In this context, we used population attributable fraction to derive and compare *indirect* estimates of mortality for both HIV and suicide. Assuming that 2% of Canadian men are gay or bisexual, and that these men are 42 times more likely to die from HIV and 4 times more likely to die from suicide, we estimated that in 2011, suicide resulted in 46 deaths per 100,000 gay and bisexual men, while HIV resulted in 30 deaths per 100,000. Based on these estimates, suicide surpassed HIV as a leading cause of premature mortality for gay and bisexual men in 2007. Despite the large burden of suicide among gay and bisexual men, research attending to the issue in biomedical, psychology, and social science literatures is sparse, with at least 10 times fewer citations than for HIV between 2003 and 2012. We urge researchers, practitioners, and community leaders to broaden the scope of gay and bisexual men's public health priorities to include suicide and other high burden health inequities.

Keywords: gay; HIV/AIDS; suicide; mortality

Introduction

Community health assessments entail the collection, analysis, and interpretation of detailed morbidity and mortality data for a particular community, whether defined by a shared geography, culture, or set of health risks or conditions (Institute of Medicine [IOM], 2002). As a prerequisite to planning and prioritizing public health activities, health assessment and monitoring is foremost in the performance standards of both the US Centers for Disease Control and Prevention (CDC, 2013) and the Public Health Agency of Canada (PHAC, 2010). Gay and bisexual men are a distinct population with significant health disparities compared to heterosexual men, including high rates of HIV and sexually transmitted infections, depression and anxiety, problematic substance use, tobacco and alcohol use, violence, and suicide (IOM, 2011). Epidemiologic evidence of these health inequities is substantial; however, systematic assessments that compare the

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burden of death and disease across specific causes within communities of gay and bisexual men are scarce (Hatzenbuehler et al., 2014). These assessments have been impeded in large part by the lack of sexual orientation data within administrative health records (Meyer, 2001).

In the absence of community health assessments, HIV has remained the *de facto* priority in gay men's health research and practice, and the focus of 52% of indexed biomedical research publications on lesbian, gay, bisexual, and transgender persons during 1980–1999 (Boehmer, 2002). This emphasis is justifiable when we consider the historical and contemporary burden of HIV in this community. In North America, gay men were the first to suffer the HIV epidemic, subsequently becoming the population most affected, as measured by total cases and deaths (Trapence et al., 2012). High rates of infection and rapid disease progression produced an enormous burden of mortality in the early part of the epidemic. By 1990 more than 100,000 persons – mostly gay and bisexual men – had died from AIDS in the USA, making it the second leading cause of death among men 25–44 years of age (CDC, 1991). Though HIV rates decreased in the USA and Canada in the late 1980s and early 1990s (PHAC, 2012; Vu et al., 2002), trends have since increased or become static, with no appreciable recent improvement in any country with a concentrated epidemic (Beyrer, Baral, & van Griensven, 2012). Consequently, gay and bisexual men continue to experience disproportionately high rates of HIV, constituting half of all persons newly infected in the USA and Canada today (Johnson et al., 2013; PHAC, 2012).

Meanwhile, improvements in HIV treatment efficacy have dramatically reduced HIV-related mortality (Weber, Tatoud, & Fidler, 2010). Therefore, gay and bisexual men – with or without HIV – are now more likely to die from causes other than HIV. Few studies have systematically examined mortality patterns among gay and bisexual men with adequate sample size to characterize specific causes of death (Cochran & Mays, 2011). One recent exception used a sample of sexual minority men and women from a major US survey ($n = 914$); comparisons in proportionate mortality between this sample and the general population demonstrate that some of the leading causes of death for sexual minorities are consistent with those for the general population (e.g. cancer and cardiovascular disease), while others are disproportionately higher – in particular, premature mortality due to external causes such as homicide and intentional self-harm (Hatzenbuehler et al., 2014; Hoyert & Xu, 2012). Research attending to these other morbidity and mortality disparities, however, has not kept pace with the shift in health profile of gay and bisexual men that has resulted from advances in HIV treatment (Boehmer, 2002; Meyer, 2001).

Suicide is a significant public health issue and presents an acute threat to the health of sexual minorities (Knox, Conwell, & Caine, 2004). Aspects of the epidemiology of suicide in North America bear noteworthy similarities to those of HIV: HIV and suicide rates are both three times higher in men, both are highest among adults 30 to 59 years of age (CDC, 2012; Hall et al., 2009; Navaneelan, 2012), and both have been theoretically and empirically linked with experiences of psychosocial stress resulting from anti-gay stigma grounded in discrimination, violence, and prejudice (Hatzenbuehler, 2009; Hatzenbuehler et al., 2014; Meyer, 2003). The study of suicide as a health inequity affecting sexual minorities has been limited by several methodological challenges. First, the absence of sexual orientation data on death certificates precludes direct counts of suicide using vital statistics records (Plöderl et al., 2013). Second, autopsy studies have included small samples of gay and bisexual men, which likely undercount the true number of suicides in this population, given challenges in ascertaining sexual orientation

posthumously (Plöderl et al., 2013). Finally, population-based studies of suicide attempts – the best proxy for suicide given the aforementioned limitations – are similarly limited by small sample sizes (Cochran & Mays, 2007; Remafedi, 1999).

In spite of these limitations, the research available consistently shows an increased risk of suicidality among sexual minorities. Two recent meta-analyses of 5 empirical studies in adult men (1997–2003) (King et al., 2008) and 14 studies among youth (<21 years; 1995–2009) (Marshall et al., 2011) estimated that gay and bisexual men are approximately four times more likely to have attempted suicide than heterosexual men. Even if this figure is an overestimate, any increased risk produces a significant burden when multiplied over a large count of deaths. Suicide is indeed among the 10 leading causes of death in Canada (Navaneelan, 2012) and the USA (CDC, 2012) and the second leading cause for young adults, responsible for nearly a quarter of all deaths among men under 35 years of age.

The aim of our present analysis is to derive estimates of annual suicide mortality among gay and bisexual men in Canada and compare these to estimates of HIV-related mortality in the same population. Mortality estimates are then interpreted alongside estimates of the relative attention each of these topics has received in published research on gay and bisexual men. We have focused this analysis on suicide because it is a leading cause of death and represents a particularly severe response to mental distress, which may be associated with experiences as a sexual minority, and we have used mortality as our outcome of interest because it serves as a standardized measure with which to compare HIV and suicide. Our ultimate goal is to use the results of this investigation to broaden the scope and priorities of gay men's health research and practice to include other health threats, especially in light of the fact that in North America, HIV treatment has shifted HIV from an acute infectious disease with high mortality to a chronic disease with effective disease management.

Methods

Mortality estimates

Publicly available Canadian vital statistics data were extracted from the national Birth and Death Databases, Statistics Canada (2013), via CANSIM (<http://www5.statcan.gc.ca/cansim/>; death database number 3233; data release 28 January 2014). The national Death Database is compiled from vital statistics data from all provincial and territorial registries in Canada. Annual mortality counts were examined for two underlying causes of death: HIV disease (ICD-10 codes B20-B24) and suicide (ICD-10 codes X60-X84). Counts were restricted to males for the 11 most recent years of available cause-specific data, from 2000 (when ICD-10 coding was introduced) to 2011. Population estimates for Canadian males, by year, were similarly extracted from CANSIM, Statistics Canada.

We used Levin's (1953) population attributable fraction (PAF) to estimate the proportion of deaths that occurred among gay and bisexual men. Levin's formula is a function of the proportion of the population at risk (p_r) and the relative risk, or in our case, rate ratio (RR) (Levin, 1953):

$$\text{PAF} = [p_r(\text{RR} - 1)] / [1 + p_r(\text{RR} - 1)] \quad (1)$$

Traditionally, PAF is defined as the 'proportional reduction in average disease risk ... that would be achieved by eliminating the exposure(s) of interest from the population' (Rockhill, Newman, & Weinberg, 1998). As implied by this definition, two of the assumptions of PAF are that the exposure is amenable to intervention and that removal

of the exposure will result in a reduction of the outcome. Here we intentionally violate these assumptions, treating sexual minority status not as a modifiable risk factor but rather as a proxy for a collection of experiences associated with gay, bisexual, or related identities and behaviors in the context of societal homophobia and heterosexism. This is consistent with the methods of other researchers who have used PAF to describe the burden of disease related to social factors of interest (Kirkbride et al., 2010; Krieger et al., 2008). In order to compare the relative theoretical burden of the two diseases of interest, we calculated two PAFs, one for HIV and one for suicide, using respective estimates of increased rates of disease among gay and bisexual men (RR_{HIV} and RR_{suicide}). In this approach, PAF serves as a form of indirect standardization, with the estimated proportion of males who are gay or bisexual (p_r) as the reference population.

Estimates for the three parameters, p_r , RR_{HIV} , and RR_{suicide} , were derived from published literature as follows. Meta-analyses, Canadian-specific estimates, and recent estimates were preferentially used where available. p_r was defined based on three overlapping constructs: sexual identity (orientation), same-sex sexual behavior, and same-sex attraction (IOM, 2011). For the remainder of the report we collectively refer to these variables as ‘sexual minority status’, acknowledging that results and interpretation will be contingent upon the construct used.

The Canadian Community Health Survey is a national, population-based serial survey of Canadians; in 2003 (Brennan, Ross, Dobinson, Veldhuizen, & Steele, 2010) and again in 2007–2008 (Pakula & Shoveller, 2013) 2% of male respondents self-identified as gay or bisexual. This is lower than estimates from US surveys (range 3–7%) (IOM, 2011); the issue of undercounting sexual minorities in population-based samples is well documented and likely stems from stigma related to reporting gay or bisexual identity (IOM, 2011; Meyer, 2001). Estimates based on sexual behavior, i.e. men who have sex with men (MSM), were taken from a recent US meta-analysis of seven national surveys (1988–2008) (Purcell et al., 2012). From this analysis, the combined estimated proportion of males who are MSM (within past 5 years) was 4%. Finally, the estimate of p_r for same-sex attraction was obtained from the US National Survey of Family Growth (2006–2008), 7% (Chandra, Mosher, Copen, & Sionean, 2011). Here, any degree of same-sex attraction was used to capture a broader group of men who might be at increased risk of suicide related to perceived stigma.

RR_{HIV} was estimated from a recent meta-analysis in which MSM were 42 times more likely to be living with HIV than other men (95% CI 38–48), based on US national HIV case reports (Purcell et al., 2012). RR_{suicide} was derived from a meta-analysis of five studies (1997–2003; pooled $N = 34,274$) which estimated a 4.3 times (95% CI 2.3–7.9) increased rate of lifetime suicide attempt for gay and bisexual men as compared to heterosexual men; notably these studies differed in definition of sexual minority status – two based on identity, two on sexual behavior, and one on attraction – as well as effect size ($I^2 = 84\%$) (King et al., 2008). This is consistent with a subsequent meta-analysis of increased risk of suicide attempts in sexual minority youth (<21 years of age; OR = 3.2 based on 14 studies published 1995–2009) (Marshal et al., 2011).

Primary analyses were based on $p_r = 0.02$ (sexual identity) for both HIV and suicide estimates – to ensure comparability and because this was the most conservative population size estimate – and RR point estimates from the respective meta-analyses. A range of uncertainty was calculated using the lower and upper limits of confidence intervals from the respective meta-analyses (King et al., 2008; Purcell et al., 2012). Sensitivity analyses were performed using $p_r = 0.04$ (sexual behavior) for HIV, given that MSM who are not gay/bisexual-identified may still be at increased risk of HIV, and $p_r = 0.07$

(attraction) for suicide, in light of studies which have suggested that non-sexually active men who experience same sex attraction may be at increased risk of suicide (King et al., 2008; Marshal et al., 2011).

In primary analyses, annual mortality counts and rates were estimated for both diseases by multiplying PAF by the number of deaths among Canadian males. Temporal trends were tested using chi-square test for trend. Mortality counts from 2011 were used for sensitivity analyses. Population estimates (denominators) for gay and bisexual men were calculated using the corresponding p_r estimate. Analyses required the following assumptions: first, that the RR for increased risk of living with HIV approximates the RR for increased risk of dying from HIV, and likewise that the RR for increased risk of attempting suicide approximates the RR for increased risk of dying from suicide; second, that the RRs and p_r do not vary over time.

Published literature estimation

To estimate the volume of scientific research which attends to each of these causes of mortality among gay and bisexual men we conducted systematic searches of published research outputs in databases pertinent to biomedical (Medline, Embase), nursing (CINAHL), psychology (PsycInfo), and social science (Scopus) disciplines, 2003–2012. Indexed subject headings were used where available (note: Scopus does not include subject headings); otherwise keyword searches were performed. Because our objective was to estimate the scope of published research – rather than to identify a particular body of research findings, as would be the aim of a systematic review – we did not conduct further searches of grey literature or reference lists. Detailed search strategies for the five databases are enumerated in the supplemental online material (Web Appendix). To summarize the relative scope of research outputs for each of the two diseases, ratios were calculated by dividing the number of citations for HIV by the number for suicide.

Results

Mortality estimates

Assuming $p_r = 0.02$, $RR_{HIV} = 42$, and $RR_{suicide} = 4$, 45% of HIV-related deaths and 6% of suicides were estimated to occur among gay and bisexual men. In 2011, 229 Canadian men died from HIV-related causes, while 2780 died from suicide. Applying the PAF (Equation (1)), we estimated that 103 gay and bisexual men died from HIV-related causes, and 157 from suicide, producing an annual HIV mortality rate of 30.3 per 100,000 persons and an annual suicide rate of 46.2 per 100,000 persons.

Between 2000 and 2011, HIV-related deaths in Canada steadily decreased ($p < 0.001$), while suicide trends remained static ($p = 0.17$; Figure 1). Thus, among gay and bisexual men, the suicide rate was lower than the HIV-related mortality rate prior to 2002, approximately equivalent to the HIV-related mortality rate from 2002 to 2007, and has been higher than the HIV-related mortality rate since 2007.

Sensitivity analyses (Table 1) revealed a large range of uncertainty in PAF estimates for suicide (2–33%) relative to those for HIV (43–65%). Varying $RR_{suicide}$ demonstrates that in 2011, the number of deaths among gay and bisexual men is greater for suicide only if $RR_{suicide}$ is greater than or equal to 3. Assuming a larger population at increased risk by sexual minority status, i.e. $p_r = 0.07$ for suicide and $p_r = 0.04$ for HIV, yields an estimated 482 suicides among men attracted to other men and 142 HIV-related

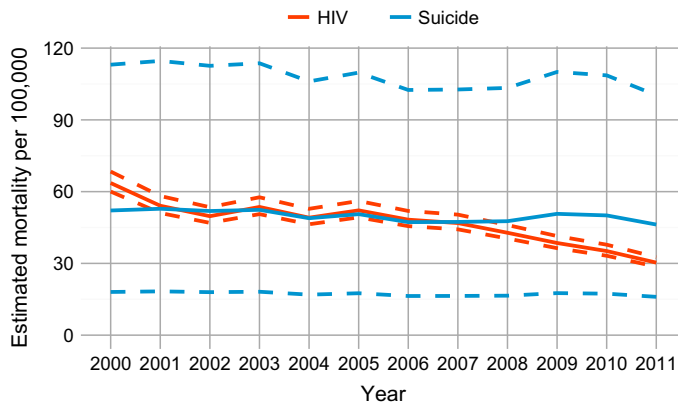


Figure 1. Estimated suicide and HIV-related mortality rates among Canadian gay and bisexual men, 2000–2011.

Notes: All estimates based on assumption that gay and bisexual men constitute 2% of the Canadian male population. Solid lines are based on the best available estimate of increased risk (RR), i.e. the point estimates from the respective meta-analyses. Dashed lines represent a range of uncertainty in estimates, calculated using the lower and upper 95% confidence limits from the meta-analyses. Mortality and population counts obtained from Statistics Canada (2013; CANSIM database).

Table 1. Sensitivity analyses in estimating the proportion, count, and rate of deaths due to suicide and HIV among gay and bisexual men in Canada, 2011.

Outcome	p_e	RR	PAF (%)	Number of deaths among Canadian gay and bisexual men, 2011*	Mortality rate per 100,000 Canadian gay and bisexual men, 2011†
Suicide	0.02	2	2.0	55	16.0
	0.02	4	5.7‡	157‡	46.2‡
	0.02	8	12.3	341	100.3
	0.07	2	6.5	181	15.3
	0.07	4	17.4	482	40.5
	0.07	8	32.9	914	76.8
HIV	0.02	38	42.5	97	28.6
	0.02	42	45.1‡	103‡	30.3‡
	0.02	48	48.5	111	32.6
	0.04	38	59.7	137	20.1
	0.04	42	62.1	142	20.9
	0.04	48	65.3	149	22.0

Notes: p_e = proportion of Canadian male population assumed to be gay or bisexual (0.02), sexually active with other men within the past 5 years (0.04), or attracted to other men (0.07); RR = relative risk, or increased risk for gay/bisexual/same-sex attracted men relative to heterosexual men; PAF = population attributable fraction, or percentage of deaths estimated to have occurred among gay/bisexual/men who have sex with men/same-sex attracted men.

*Calculated by multiplying PAF by the Canadian male population estimate for 2011 (17,015,959).

†Assuming respective estimate of p_e (proportion of male population who are gay/bisexual/sexually active with other men/same-sex attracted).

‡Estimate used for primary analyses.

Mortality and population counts obtained from Statistics Canada (2013; CANSIM database).

deaths among MSM in 2011. Though these estimates do not correspond to the same population, they suggest a burden of mortality attributable to sexual minority status, which is approximately three times higher for suicide than for HIV.

Scope of published literature

Between 2003 and 2012, 124,117 HIV-related citations and 24,079 suicide-related citations were retrieved from Medline, for a ratio of approximately five-to-one (Table 2). When restricted to gay and bisexual men (and related terms), both estimates were reduced substantially, to 4645 HIV-related citations (4% of total citations for that topic) and 114 suicide-related citations (0.5% of total suicide citations), yielding an HIV-to-suicide ratio of approximately forty-to-one. Embase and CINAHL databases similarly included more HIV-related citations than suicide citations; while the ratios of total HIV-to-suicide citations were smaller, when restricted to gay and bisexual men, the ratios were both >50. Psychology and social science databases included comparable numbers of HIV and suicide-related publications; however, when restricted to gay and bisexual men, 12–14 times more citations were identified for HIV than for suicide (Table 2).

Discussion

We estimated that in 2011, more gay and bisexual Canadian men died from suicide (suicide rate of 46 deaths per 100,000) than from HIV-related causes (HIV mortality rate of 30 deaths per 100,000). While we cannot rule out the possibility of having over-estimated the suicide rate, even at the lower limit of our estimates (suicide rate of 16 deaths per 100,000), suicide is a significant cause of premature mortality in this population. Whether the rate of suicide is higher or lower than the rate of HIV mortality, the deficit in research on suicide among gay and bisexual men is disproportionate, with HIV-related citations outnumbering suicide citations forty-to-one in the biomedical literature and ten-to-one in the psychology and social science literatures. The need to correct this disparity is made all the more urgent with the observation that between 2000 and 2011, Canadian HIV mortality dropped steadily, while suicide rates remained static (Figure 1).

Table 2. Number and ratio of citations retrieved by subject area (suicide or HIV) across medical, psychological, nursing, and social science research databases, 2003–2012.

Database	Discipline	HIV		Suicide		HIV: suicide ratio	
		Total	GBM	Total	GBM	Total	GBM
Medline	Biomedical	124,117	4645	24,079	114	5.2	40.7
Embase	Biomedical	190,008	6174	42,415	111	4.5	55.6
CINAHL*	Nursing	9600	220	4029	3	2.4	73.3
PsycInfo	Psychology	21,575	2374	20,332	167	1.1	14.2
Scopus†	Social sciences	15,805	1607	10,993	133	1.4	12.1

Notes: All database searches were limited to 2003–2012. Detailed search strategies, including search terms, are provided in the supplemental online material (Web Appendix). GBM = gay and bisexual men, i.e. those citations which include subject headings or keywords associated with gay and bisexual men.

*Excluding Medline records.

†Restricted to Social Sciences & Humanities only.

Assumptions, limitations, and knowledge gaps

Our calculations depend on several critical assumptions, many of which are in turn contingent upon the quality and volume of published evidence. Importantly, the evidence available to estimate the HIV-related parameters is much greater than that available for suicide (Table 2). Thus, the confidence interval surrounding the rate ratio estimate for suicide is larger, producing a wider range of uncertainty in our mortality estimates. This limitation can only be remedied by increasing research which investigates the suicide disparity between sexual minority and majority populations.

As demonstrated by our sensitivity analyses, the burden of suicide mortality is also influenced by the size of the population at risk. Unfortunately, the suicide literature to date offers little clarity on this question; both meta-analyses combined studies with measures based, varyingly, on sexual orientation, sexual behavior, and same-sex attraction (King et al., 2008; Marshal et al., 2011). Further investigation of this question is critical to public health interventions, as other researchers have noted (Savin-Williams, 2001). If the population is largely the same as that affected by HIV, there are existing programs, venues, and community agencies which can be used to provide culturally competent gay and bisexual suicide prevention services. If, however, the population at increased risk includes non-gay/bisexual-identified men who are attracted to other men, a different strategy is required.

Other assumptions are more difficult to verify and likely have contrasting effects on the suicide mortality estimates we've generated. First, we assumed that the RRs for HIV-related and suicide deaths were equivalent to the estimated RRs for living with HIV and attempting suicide (but surviving), respectively. Given advances in effective HIV treatment, we may expect that any corresponding survival bias would have a greater effect for suicide than for HIV. Whether there is a higher rate of reporting non-life-threatening suicide attempts among sexual minorities has been a source of controversy (Plöderl et al., 2013; Savin-Williams, 2001). Notably, the meta-analysis by Marshal et al. (2011) demonstrated increasing risk of suicidality for sexual minorities with increasing severity of outcome, from suicidal ideation (OR = 1.96), to intent/plans (2.20) to attempts (3.18), to attempts requiring medical attention (4.17). If this trend is real, it would point toward an even higher RR for death from suicide than the one we used in the primary analysis, suggesting we've underestimated the rate of suicide among gay and bisexual men. Second, some studies of increased suicide risk among sexual minorities have suggested that most of the lifetime risk is experienced during adolescence, at a time when suicide attempts are less fatal (Nock et al., 2008; Russell & Toomey, 2012). If this assertion is correct, then we may have overestimated the rate of suicide among gay and bisexual men. Third, misclassification of cause of death may have biased the estimates we obtained from Statistics Canada; such misclassification could affect both causes of death we examined but is a well-described limitation for suicide (Parai, Kreiger, Tomlinson, & Adlaf, 2006; Rhodes et al., 2012) and would likely result in an underestimate.

Mortality is only one measure of the impact of the diseases we examined in our study. Both HIV and suicidality are associated with other significant psychological and social challenges, including stigmatization, isolation, and depression (Joiner, 2007; Smit et al., 2012). Furthermore, management of both diseases often requires ongoing medical care and daily medication (Farnham et al., 2013; Stringer et al., 2013). By using mortality as the outcome, our study allowed for a more standardized comparison of the impact of the two diseases; however, additional analyses to compare the total effects of the two

diseases on quality of life, disability, and health care utilization, would be informative. Such analyses may yield a different conclusion with regard to the estimated burden of the diseases.

In light of these limitations, we conceive of the mortality estimates presented not as precise counts or exhaustive measurements of the impact of the two epidemics, but rather as a theoretical exercise with the purpose of drawing attention to health disparities that affect gay and bisexual men beyond HIV. In the absence of direct methods for tabulating mortality causes among sexual minorities, more work is needed to confirm or challenge our conclusions. Ideally this will include multiple analytic methods and data sources. Such comparative analysis is essential to prioritizing public health programming and advocating for new services, where necessary.

In quantifying the published research on the two topics, we attempted to standardize search terms as much as possible and included keywords which were broadly inclusive of populations of gay and bisexual men. Nonetheless, we likely missed some literature, which was not tagged with homosexuality-specific subject headings and which excluded related terms from the titles and abstracts. We expect that this misclassification may have differentially underestimated the number of suicide-related publications with information about sexual orientation, given that the HIV field on the whole is likely more attuned to the population of gay and bisexual men (or MSM) and thus more likely to include this language in titles, abstracts, and keywords (Beyrer et al., 2012). Lastly, while our search was systematic, it did not include a manual review of the papers retrieved. Such a scoping review, particularly focused on suicide, would be greatly beneficial to the field of research.

Fundamental causes and multiple outcomes

In our analysis, we conceived of sexual minority status as a marker for a set of undefined experiences that produce increased risk of suicidality or HIV. These experiences could be categorized as follows. First, they may be the same risk factors as for heterosexual persons but factors which are more prevalent or have a greater effect among sexual minorities (or, conversely, protective factors with lower prevalence or a lesser effect). Alternatively, there may be entirely distinct risk factors for sexual minorities. Most likely, the total increased risk is explained by a combination of the two. For both HIV and suicide, research has predominantly focused on the first category. For example, HIV researchers commonly investigate behavioral factors like sex with serodiscordant partners, which is more prevalent among gay men, or condom-less sex, which entails greater biologic risk for gay men (Beyrer et al., 2012). Research on suicide and sexual minorities has similarly fixated on common risk factors, such as depression and substance use (Saewyc, 2007). There is fruitful opportunity, however, in examining those factors which fall into the second category, and there is a growing body of scholarship which offers theoretical and methodological guidance for such study.

This body of research situates HIV and suicide (among other diseases) as products of a shared causal pathway starting with societal homophobia – a pervasive stigma which operates as a fundamental cause of disease (Hatzenbuehler, Phelan, & Link, 2013) – and mediated by a minority stress process (Meyer, 2003). Minority stress theory posits that chronic exposure to anti-gay stigma and prejudice leads to psychosocial illnesses, which in turn increase the risk of multiple diseases, including HIV and suicide (Meyer, 2003). The resulting syndemic (Stall et al., 2003) is arguably the most important outcome of interest. As this approach has gained traction, numerous studies of gay and bisexual men

across North America have empirically demonstrated syndemic production (Egan et al., 2011; Ferlatte, Hottes, Trussler, & Marchand, 2014; Halkitis et al., 2013; Herrick et al., 2013; Klein, 2011; Mustanski, Andrews, Herrick, Stall, & Schnarrs, 2014; Mustanski, Garofalo, Herrick, & Donenberg, 2007; Parsons, Grov, & Golub, 2012).

Our analyses suggest two modifications to the syndemic approach. First, given the large burden of suicide and relative inattention to the topic, more studies should investigate suicidal behavior as a component of the syndemic (Ferlatte et al., 2014; Halkitis et al., 2013; Mustanski et al., 2014). While several population-based studies have demonstrated increased risk of suicidal behavior among gay and bisexual men, studies which explore the causal pathways explaining this increased risk are scarce (King et al., 2008; Marshal et al., 2011). By examining social context, experiences of minority stress, and mental health struggles, syndemic studies offer a promising means to this end. Second, definitions of gay and bisexual ‘risk populations’ must be expanded and re-evaluated. While sexual risk is a necessary criterion for studying the HIV epidemic, syndemics may be constituted by an accumulation of psychosocial struggles among men who are not sexually active or do not meet the classic definition of MSM. Moreover, men who *are* sexually active with other men experience a series of threats to their health before, after, and apart from HIV. In short, through the present quantification of the relative burden of multiple health disparities, we join other researchers in a plea to broaden the scope of gay and bisexual men’s health research beyond HIV/AIDS (Boehmer, 2002; Brennan et al., 2010; IOM, 2011; Meyer, 2001).

Implications of the syndemic model on targeted public health efforts are profound. A critical premise of syndemic theory is that gay and bisexual men at highest risk of one disease (e.g. HIV) are at high risk of another (suicide) (Stall, Friedman, & Catania, 2007). Thus, while the predominant prevention models for each of the constituent epidemics (e.g. HIV and suicide) currently remain disease-specific (Beyrer, 2014; Mann et al., 2005), the syndemic model – as applied to stigmatized populations like sexual minorities – justifies a strategy that focuses on the root causes (stigma, and its proximate effects on psychological distress) and conceives of HIV, suicide, and related health struggles as a collective public health problem. Some HIV researchers have accordingly called for a more holistic approach to HIV prevention which accounts for comorbidities, including mental health struggles, as well as preceding stressors related to sexual minority status (Halkitis et al., 2012). In summary, while suicide and HIV may ultimately represent major competing causes of death for gay and bisexual men, the strategies to address the epidemics need not be entirely distinct. An effective response will depend on further explicating the causal pathways that are common to both diseases and identifying interventions which act on these shared causes.

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Supplemental data

Supplemental data for this article can be accessed here: <http://dx.doi.org/10.1080/09581596.2014.946887>

References

- Beyrer, C. (2014). Strategies to manage the HIV epidemic in gay, bisexual, and other men who have sex with men. *Current Opinion in Infectious Diseases*, 27(1), 1–8.
- Beyrer, C., Baral, S., & van Griensven, F. (2012). Global epidemiology of HIV infection in men who have sex with men. *The Lancet*, 380, 367–377.
- Boehmer, U. (2002). Twenty years of public health research: Inclusion of lesbian, gay, bisexual, and transgender populations. *American Journal of Public Health*, 92, 1125–1130.
- Brennan, D. J., Ross, L. E., Dobinson, C., Veldhuizen, S., & Steele, L. S. (2010). Men's sexual orientation and health in Canada. *Canadian Journal of Public Health – Revue Canadienne de Santé Publique*, 101, 255–258.
- Chandra, A., Mosher, W. D., Copen, C., & Sionean, C. (2011). Sexual behavior, sexual attraction, and sexual identity in the United States: Data from the 2006–2008 National Survey of Family Growth. *National Health Statistics Reports*, 36, 1–36.
- Cochran, S. D., & Mays, V. M. (2007). Prevalence of primary mental health morbidity and suicide symptoms among gay and bisexual men. In R. J. Wolitski, R. Stall, & R. O. Valdisseri (Eds.), *Unequal opportunity: Health disparities affecting gay and bisexual men in the United States* (pp. 97–120). New York, NY: Oxford University Press.
- Cochran, S. D., & Mays, V. M. (2011). Sexual orientation and mortality among US men aged 17 to 59 years: Results from the National Health and Nutrition Examination Survey III. *American Journal of Public Health*, 101, 1133–1138.
- Egan, J. E., Frye, V., Kurtz, S. P., Latkin, C., Chen, M., Tobin, K., ... Koblin, B. A. (2011). Migration, neighborhoods, and networks: Approaches to understanding how urban environmental conditions affect syndemic adverse health outcomes among gay, bisexual and other men who have sex with men. *AIDS and Behavior*, 15, 35–50.
- Farnham, P. G., Gopalappa, C., Sansom, S. L., Hutchinson, A. B., Brooks, J. T., Weidle, P. J., ... Rimland, D. (2013). Updates of lifetime costs of care and quality-of-life estimates for HIV-infected persons in the United States. *Journal of Acquired Immune Deficiency Syndromes*, 64, 183–189.
- Ferlatte, O., Hottes, T. S., Trussler, T., & Marchand, R. (2014). Evidence of a syndemic among young canadian gay and bisexual men: Uncovering the associations between anti-gay experiences, psychosocial issues, and HIV risk. *AIDS and Behavior*, 18, 1256–1263.
- Halkitis, P. N., Kupprat, S. A., Hampton, M. B., Perez-Figueroa, R., Kingdon, M., Eddy, J. A., & Ompad, D. C. (2012). Evidence for a syndemic in aging HIV-positive gay, bisexual, and other MSM: Implications for a holistic approach to prevention and healthcare. *Annals of Anthropological Practice*, 36, 365–386.
- Halkitis, P. N., Moeller, R. W., Siconolfi, D. E., Storholm, E. D., Solomon, T. M., & Bub, K. L. (2013). Measurement model exploring a syndemic in emerging adult gay and bisexual men. *AIDS and Behavior*, 17, 662–673.
- Hall, H. I., Geduld, J., Boulos, D., Rhodes, P., An, Q., Mastro, T. D., ... Archibald, C. P. (2009). Epidemiology of HIV in the United States and Canada: Current status and ongoing challenges. *Journal of Acquired Immune Deficiency Syndromes*, 51, S13–S20.
- Hatzenbuehler, M. L. (2009). How does sexual minority stigma 'get under the skin'? A psychological mediation framework. *Psychological Bulletin*, 135, 707–730.
- Hatzenbuehler, M. L., Bellatorre, A., Lee, Y., Finch, B. K., Muennig, P., & Fiscella, K. (2014). Structural stigma and all-cause mortality in sexual minority populations. *Social Science and Medicine*, 103, 33–41.
- Hatzenbuehler, M. L., Phelan, J. C., & Link, B. G. (2013). Stigma as a fundamental cause of population health inequalities. *American Journal of Public Health*, 103, 813–821.
- Herrick, A. L., Lim, S. H., Plankey, M. W., Chmiel, J. S., Guadamuz, T. E., Kao, U., ... Stall, R. (2013). Adversity and syndemic production among men participating in the multicenter AIDS cohort study: A life-course approach. *American Journal of Public Health*, 103, 79–85.
- Hoyert, D. L., & Xu, J. (2012). Deaths: Preliminary data for 2011. *National Vital Statistics Reports*, 61, 1–52. Retrieved from http://www.cdc.gov/nchs/data/nvsr/nvsr61/nvsr61_06.pdf

- Institute of Medicine. (2002). *The future of the public's health in the 21st century*. Retrieved from http://www.nap.edu/catalog.php?record_id=10548
- Institute of Medicine. (2011). *The health of lesbian, gay, bisexual, and transgender people: Building a foundation for better understanding*. Retrieved from <http://www.iom.edu/Reports/2011/The-Health-of-Lesbian-Gay-Bisexual-and-Transgender-People.aspx>
- Johnson, A. S., Beer, L., Sionean, C., Hu, X., Furlow-Parmley, C., Le, B., ... Dean, H. D. (2013). HIV infection – United States, 2008 and 2010. *Morbidity and Mortality Weekly Report. Surveillance Summaries*, 62, 112–119.
- Joiner, T. (2007). *Why people die by suicide* (1st ed., p. 288). Cambridge, MA: Harvard University Press.
- King, M., Semlyen, J., Tai, S. S., Killaspy, H., Osborn, D., Popelyuk, D., & Nazareth, I. (2008). A systematic review of mental disorder, suicide, and deliberate self harm in lesbian, gay and bisexual people. *BMC Psychiatry*, 8, 70.
- Kirkbride, J., Coid, J. W., Morgan, C., Fearon, P., Dazzan, P., Yang, M., ... Jones, P. B. (2010). Translating the epidemiology of psychosis into public mental health: Evidence, challenges and future prospects. *Journal of Public Mental Health*, 9, 4–14.
- Klein, H. (2011). Using a syndemics theory approach to study HIV risk taking in a population of men who use the internet to find partners for unprotected sex. *American Journal of Men's Health*, 5, 466–476.
- Knox, K. L., Conwell, Y., & Caine, E. D. (2004). If suicide is a public health problem, what are we doing to prevent it? *American Journal of Public Health*, 94, 37–45.
- Krieger, N., Rehkopf, D. H., Chen, J. T., Waterman, P. D., Marcelli, E., & Kennedy, M. (2008). The fall and rise of US inequities in premature mortality: 1960–2002. *PLoS Medicine*, 5, e46.
- Levin, M. L. (1953). The occurrence of lung cancer in man. *Acta – Unio Internationalis Contra Cancrum*, 9, 531–541.
- Mann, J. J., Apter, A., Bertolote, J., Beautrais, A., Currier, D., Haas, A., ... Hendin, H. (2005). Suicide prevention strategies. *JAMA: The Journal of the American Medical Association*, 294, 2064–2074.
- Marshal, M. P., Dietz, L. J., Friedman, M. S., Stall, R., Smith, H. A., McGinley, J., ... Brent, D. A. (2011). Suicidality and depression disparities between sexual minority and heterosexual youth: A meta-analytic review. *Journal of Adolescent Health*, 49, 115–123.
- Meyer, I. H. (2001). Why lesbian, gay, bisexual, and transgender public health? *American Journal of Public Health*, 91, 856–859.
- Meyer, I. H. (2003). Prejudice, social stress, and mental health in lesbian, gay, and bisexual populations; conceptual issues and research evidence. *Psychological Bulletin*, 129, 674–697.
- Mustanski, B., Andrews, R., Herrick, A., Stall, R., & Schnarrs, P. W. (2014). A syndemic of psychosocial health disparities and associations with risk for attempting suicide among young sexual minority men. *American Journal of Public Health*, 104, 287–294.
- Mustanski, B., Garofalo, R., Herrick, A., & Donenberg, G. (2007). Psychosocial health problems increase risk for HIV among urban young men who have sex with men: Preliminary evidence of a syndemic in need of attention. *Annals of Behavioral Medicine*, 34, 37–45.
- Navaneelan, T. (2012). *Suicide rates: An overview*. Ottawa: Statistics Canada. Retrieved from <http://www.statcan.gc.ca/pub/82-624-x/2012001/article/11696-eng.htm>
- Nock, M. K., Borges, G., Bromet, E. J., Cha, C. B., Kessler, R. C., & Lee, S. (2008). Suicide and suicidal behavior. *Epidemiologic Reviews*, 30, 133–154.
- Pakula, B., & Shoveller, J. A. (2013). Sexual orientation and self-reported mood disorder diagnosis among Canadian adults. *BMC Public Health*, 13, 209.
- Parai, J. L., Kreiger, N., Tomlinson, G., & Adlaf, E. M. (2006). The validity of the certification of manner of death by Ontario coroners. *Annals of Epidemiology*, 16, 805–811.
- Parsons, J. T., Grov, C., & Golub, S. A. (2012). Sexual compulsivity, co-occurring psychosocial health problems, and HIV risk among gay and bisexual men: Further evidence of a syndemic. *American Journal of Public Health*, 102, 156–162.

- Plöderl, M., Wagenmakers, E.-J., Tremblay, P., Ramsay, R., Kralovec, K., Fartacek, C., & Fartacek, R. (2013). Suicide risk and sexual orientation: A critical review. *Archives of Sexual Behavior*, *42*, 715–727.
- Public Health Agency of Canada. (2010). *Core competency statements – Public health practice*. Retrieved from <http://www.phac-aspc.gc.ca/php-psp/ccph-cesp/stmts-enon-eng.php#a2>
- Public Health Agency of Canada. (2012). *Summary: Estimates of HIV prevalence and incidence in Canada, 2011*. Retrieved from <http://www.phac-aspc.gc.ca/aids-sida/publication/survreport/estimat2011-eng.php>
- Purcell, D. W., Johnson, C. H., Lansky, A., Prejean, J., Stein, R., Denning, P., ... Crepaz, N. (2012). Estimating the population size of men who have sex with men in the United States to obtain HIV and syphilis rates. *The Open AIDS Journal*, *6*, 98–107.
- Remafedi, G. (1999). Suicide and sexual orientation. *Archives of General Psychiatry*, *56*, 885.
- Rhodes, A. E., Khan, S., Boyle, M. H., Wekerle, C., Goodman, D., Tonmyr, L., ... Manion, I. (2012). Sex differences in suicides among children and youth: The potential impact of misclassification. *Canadian Journal of Public Health*, *103*, 213–217.
- Rockhill, B., Newman, B., & Weinberg, C. (1998). Use and misuse of population attributable fractions. *American Journal of Public Health*, *88*, 15–19.
- Russell, S. T., & Toomey, R. B. (2012). Men's sexual orientation and suicide: Evidence for U.S. adolescent-specific risk. *Social Science & Medicine (1982)*, *74*, 523–529.
- Saewyc, E. M. (2007). Contested conclusions: Claims that can (and cannot) be made from the current research on gay, lesbian, and bisexual teen suicide attempts. *Journal of LGBT Health Research*, *3*, 79–87.
- Savin-Williams, R. C. (2001). Suicide attempts among sexual-minority youths: Population and measurement issues. *Journal of Consulting and Clinical Psychology*, *69*, 983–991.
- Smit, P. J., Brady, M., Carter, M., Fernandes, R., Lamore, L., Meulbroek, M., ... Thompson, M. (2012). HIV-related stigma within communities of gay men: A literature review. *AIDS Care*, *24*, 405–412.
- Stall, R., Friedman, M., & Catania, J. A. (2007). Interacting epidemics and gay men's health: A theory of syndemic production among urban gay men. In R. J. Wolitski, R. Stall, & R. O. Valdisseri (Eds.), *Unequal opportunity: Health disparities affecting gay and bisexual men in the United States* (pp. 251–274). New York, NY: Oxford University Press.
- Stall, R., Mills, T. C., Williamson, J., Hart, T., Greenwood, G., Paul, J., ... Catania, J. A. (2003). Association of co-occurring psychosocial health problems and increased vulnerability to HIV/AIDS among urban men who have sex with men. *American Journal of Public Health*, *93*, 939–942.
- Statistics Canada. (2013). *Statistics Canada (CANSIM)*. Vital Statistics – Death Database. Adaptation of these data does not constitute an endorsement by Statistics Canada of this product. Retrieved January 28, 2014, from http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=3233&Item_Id=144261&lang=en
- Stringer, B., van Meijel, B., Eikelenboom, M., Koekkoek, B., Verhaak, P. F. M., Kerkhof, A. J. M. F., ... Beekman, A. T. F. (2013). Perceived need for care and health care utilization among depressed and anxious patients with and without suicidal ideation. *Crisis*, *34*, 192–199.
- Trapence, G., Collins, C., Avrett, S., Carr, R., Sanchez, H., Ayala, G., ... Baral, S. D. (2012). From personal survival to public health: Community leadership by men who have sex with men in the response to HIV. *The Lancet*, *380*, 400–410.
- US Centers for Disease Control and Prevention. (1991). Mortality attributable to HIV infection/AIDS—United States, 1981–1990. *MMWR – Morbidity and Mortality Weekly Report*, *40*, 41–44.
- US Centers for Disease Control and Prevention. (2012). *Suicide statistics*. Retrieved from <http://www.cdc.gov/violenceprevention/suicide/statistics/aag.html>
- US Centers for Disease Control and Prevention. (2013). *The 10 essential public health services*. Retrieved from <http://www.cdc.gov/nphsp/essentialservices.html>

- Vu, M. Q., Steketee, R. W., Valleroy, L., Weinstock, H., Karon, J., & Janssen, R. (2002). HIV incidence in the United States, 1978–1999. *Journal of Acquired Immune Deficiency Syndromes (1999)*, *31*, 188–201.
- Weber, J., Tatoud, R., & Fidler, S. (2010). Postexposure prophylaxis, preexposure prophylaxis or universal test and treat: The strategic use of antiretroviral drugs to prevent HIV acquisition and transmission. *AIDS*, *24*, S27–S39.