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Hospitalisation rates and associated factors in community-based cohorts of HIV- infected and - uninfected gay and bisexual men

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Abstract

Objectives—There is evidence that HIV-positive (HIV+ve) patients are suffering from a greater burden of morbidity as they age due to non-AIDS-related complications. To- date it has been difficult to determine what part of this excess risk is due to the health effects of HIV, its treatment, or to lifestyle factors common to gay and bisexual men (GBM). We calculated overall and cause-specific hospitalisation rates and risk factors for hospitalisations in HIV-negative (HIV-ve) and HIV+ve cohorts of GBM and compare these with rates in the general male population.

Methods—We conducted a record linkage study, linking two cohorts of HIV-ve ($n=1325$) and HIV+ve ($n=557$) GBM recruited in Sydney, New South Wales (NSW), Australia with the NSW hospital discharge data register. We compared rates of hospitalisation in the two cohorts and risk factors for hospitalisation using random-effects Poisson regression methods. Hospitalisation rates for each cohort were further compared with those in the general male population using indirect standardisation.

Results—We observed 2,032 hospitalisations in the HIV-ve cohort during 13,016 person-years (PYs) [crude rate: 15.6/100PYs (95%CI:14.9-16.3)] and 2,130 hospitalisations in the HIV+ve cohort during 5,571 PYs [crude rate:38.2/100PYs (95%CI:36.6-39.9)]. HIV+ve individuals had an

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increased risk of hospitalisation compared with the HIV-ve individuals [adjusted-IRR: 2.34(95%CI:1.91-2.86)] and the general population [SHR:1.45(95%CI:1.33-1.59)]. Hospitalisation rates were lower in the HIV-ve cohort compared with the general population [SHR:0.72(95%CI: 0.67-0.78)]. The primary causes of hospitalisation differed between groups.

Conclusions—HIV+ve GBM continue to experience excess morbidity compared with HIV-ve GBM men and the general population. HIV-ve GBM had lower morbidity compared with the general male population suggesting that GBM identity does not confer excess risk.

Keywords

HIV; hospitalization; homosexuality; cohort studies; medical record linkage

Introduction

Attention to gay and bisexual men's (GBM) health was heightened by the advent of the HIV/AIDS epidemic, firstly as a key population identified as being at risk of infection (1) and then as a major force in the HIV/AIDS response (2). GBM continue to shoulder a disproportionate amount of HIV disease burden in high income countries including Australia. While only around 1.6% of Australian males identify as gay or homosexual and 0.9% as bisexual (3), they make up 88% of people with diagnosed new HIV infection(4). The widespread use of combination antiretroviral therapy (cART) in Australia and other industrialized countries since the mid-1990s has resulted in a marked reduction in morbidity and mortality of HIV positive (HIV+ve) people, including GBM (5). However, there is evidence that as HIV+ve patients age and have extended exposure to cART they are suffering from a greater burden of morbidity due to non-AIDS-related complications (6). Despite attention to GBM's health in relation to HIV transmission, acquisition, infection and disease progression, there is a dearth of systematically collected and detailed information on the health of GBM. From the available information on GBM's health related behaviour, there are indications that GBM could be at risk for worse health outcomes compared with the general population. While country specific, there is evidence that they experience significant perceptions of stigma, discrimination and homophobia (7), have high rates of smoking, alcohol, and drug use (8, 9) and are exposed to a range of sexual-behaviour related health risks (9, 10). Although the long-term implications of these factors are not well understood, they have been reported to include increased risk of psychiatric morbidity and suicide(11, 12), increased self-reported physical disability and chronic conditions (13, 14), increased health service utilisation (15), sexually transmitted infections (STIs) and their sequelae (16, 17), cancer (18, 19) and mortality (20, 21). However in most studies of HIV+ve GBM's health it is difficult to discriminate between effects arising from men's health related behaviours and those related to HIV infection.

In this study, we aimed to assess overall and cause-specific hospitalisation rates in HIV-ve and HIV+ve cohorts of GBM and compare these to each other and with rates in the general male population. We hypothesised that rates would be significantly higher in the HIV+ve cohort than the HIV-ve cohort and that rates in both cohorts would be higher than rates in the general male population. We also hypothesised that the primary causes of hospitalisation would differ between the two groups.

Methods

Study design

Our study cohort included participants recruited to the Health in Men (HIM) (HIV-ve) and Positive Health (pH) (HIV+ve) studies who provided informed consent for their study data to be used for data linkage. Both studies have been described in detail elsewhere (22, 23). Briefly, men were recruited from Sydney, New South Wales (NSW), Australia using similar community-based methods. The majority of participants in both studies were recruited through gay community events and venues. Other sources of recruitment included direct recruitment from participants in other relevant studies, personal networking, 'snowballing' through friends and acquaintances, direct referrals from medical practitioners, gay press and HIV-positive publications (24, 25). Participants were interviewed face-to-face annually. Enrolment in HIM occurred from 2001 to 2004 and active follow-up ceased in 2007. Enrolment in pH occurred from 1998 to 2006 and follow up ceased in 2007. The serostatus of participants in both cohorts was confirmed by serological testing at intake and in HIV-ve participants through annual testing thereafter. All participants in both studies either had sexual contact with at least one man during the previous 5 years or self-identified as gay, homosexual, queer or bisexual. In both studies the majority of participants identified as gay, homosexual or queer (24, 26). Data collected common to both studies included demographics, sexual and drug use behaviour, STIs and STI testing, gay community involvement, general self-reported health and use of health care services. In the HIV+ve cohort, information on the use of cART, CD4+ T-cell count (CD4) and viral load (VL) as well as frequency of VL and CD4 testing were also collected.

Individual consent for data linkage was optional and was collected in addition to consent to participate in the study. Only data from participants who consented to data linkage were included in this analysis (93% of HIM and 74% of pH participants). Ethics approval was granted by the University of New South Wales (NSW) and the NSW Population and Health Services Research Ethics Committee.

Data sources

Data linkage was performed on all consenting participants. Probabilistic linkage methods (27) were used to link individuals to the data sources described below.

The NSW Admitted Patient Data Collection (APDC) includes all inpatient admissions (episodes of care) from all public (including psychiatric), private and repatriation hospitals, private day procedure centres and public nursing homes in NSW, Australia. Diagnosis fields are coded according to the 10th revision of the International Classification of Disease-Australian Modification (ICD-10-AM). Patient name has only been recorded since 1 July 2000, so we restricted analysis to admissions from 1 July 2000 to the most recent available data at time of analysis (30 June 2012).

The Registry of Births, Deaths and Marriages (RBDM) which reports fact of death was used to censor person-years of observation. Fact of death was available from 01 January 1998 to 30 June 2013.

The HIV administrative database is a register of HIV, notified to the NSW department of Health by laboratories, hospitals, and medical practitioners. In addition to annual serological testing in the HIM cohort, seroconversions were identified through linkage of participants to the HIV registry. HIV/AIDS notifications were available from 01 January 1993 to 31 December 2012.

First name, surname, address, postcode, date of birth and date of last contact were used to probabilistically link participants from the study cohorts to the APDC and RBDM registries using *ChoiceMaker* software (ChoiceMaker Technologies Inc., New York, US). Deterministic linkage was used to link participants to the HIV/AIDS notifications using two-character surname and given name codes, date of birth, sex and postcode. Linkage was conducted by the NSW Centre for Health Record Linkage, independent of the study investigators. Full details of the linkage process are outlined at (<http://www.cherel.org.au/how-record-linkage-works>).

Outcomes

Hospital admission was defined as an episode of care ending with hospital discharge, death or transfer to another type of care. All-cause and cause specific hospital admission rates were compared between the two cohorts and to the general male NSW population. Hospitalisation rates for the general male NSW population from the NSW APDC were obtained from the NSW Ministry of Health website (<http://www.healthstats.nsw.gov.au>). The ICD-10-AM chapter heading for the primary diagnosis field was used to describe the principal reason for admission. Full details of categorisation are outlined at (<http://apps.who.int/classifications/icd10/browse/2015/en>). AIDS-defining illnesses were categorised according to the Centers for Disease Control and Prevention (CDC) (28) definition and included candidiasis, coccidioidomycosis, cryptococcosis, cryptosporidiosis, cytomegalovirus, encephalopathy, herpes simplex, histoplasmosis, isosporiasis, Kaposi's Sarcoma, Burkitt's lymphoma, immunoblastic lymphoma, primary lymphoma of the brain, *Mycobacterium tuberculosis*, other mycobacterial diseases, penicilliosis, *Pneumocystis jiroveci pneumonia* (PJP), recurrent bacterial pneumonia, progressive multifocal leukoencephalopathy, salmonella septicaemia, toxoplasmosis, and HIV wasting syndrome. Due to the extremely high frequency of admissions with a principal diagnostic code of extracorporeal dialysis (Z49.1) we excluded them from analysis for the two cohorts (n admissions=396). Further, we excluded duplicate and nested admissions (admissions within the date range of another admission) in the two cohorts so that there was only one principal diagnostic code for each admission (n admissions=55). No data cleaning was undertaken for hospital admissions for the NSW male population however duplicate and nested admissions have been previously shown by Gidding, H.F. (2012) to be a small overall percentage of total admissions (0.22% duplicates; 0.09% nested admissions)(29).

Statistical Methods

Time at risk commenced at entry into the study cohort or opening of database for hospital admissions (1 July 2000), whichever was latest. Incidence rates of events were determined using person-years (PYs) methods with data right censored at death or the close of database

(30 June 2012). Data from HIV-ve participants who seroconverted (n=51) were excluded from analysis.

Age- and year-adjusted incidence rate ratios (IRR) for hospitalisation were calculated to compare HIV+ve and HIV-ve cohorts using random-effects Poisson regression methods to take into account within-person variation for repeated measures (30). The incidence of hospital admissions in the HIV-ve cohort and the HIV+ve cohort were compared with the incidence of hospital admissions in the general NSW male population by calculating standardised hospitalisation ratios (SHRs). The number of hospitalisations was compared with expected number using rates for the NSW male population by 10 year age group and by year to adjust for age and year of admission. To account for correlation between hospitalisations in the same individual, 95% confidence intervals (CIs) for the SHRs were calculated using the method by Stukel et al. (31). Participants who attended the hospital for the same primary diagnosis greater than 20 times during the course of observation contributed only one hospitalisation for this primary diagnosis in the calculation of SHRs to enable better interpretation and reduce the influence of outliers. These exclusions are summarized in the footnotes for Table 2.

Risk factors for hospitalisation within each cohort were assessed using random-effects Poisson regression methods. The following covariates were considered as fixed effects (reported at entry into the cohort): country of birth, ethnicity, highest level of education, occupation, employment, income, ever having had an STI (excluding HIV), presence of antibodies to hepatitis C, self-reported general health and use of mental health counselling services, Kessler 6 score of psychological distress, frequency of exercise (only in HIV-ve), smoking and alcohol consumption, recreational and injecting drug use, number of male partners, reported unprotected anal intercourse, experiences of discrimination and harassment and gay community involvement (32). Recreational drug use included use of cannabis; amyl nitrate; Viagra or other erection medications; cocaine; amphetamines or methamphetamines; MDMA or other forms of MDA; psychedelics or hallucinogens (lysergic acid diethylamide(LSD), mescaline, or phencyclidine(PCP)); downers (barbiturates, tranquilisers or sedatives), rohypnol (flunitrazepam) or ketamine; and heroin or other opiates (including methadone). Participants reported how frequently they used each drug and an aggregate measure was generated which categorised drug use as occasionally (1-24 times/year), more frequently (25-48 times/year), often (49-72 times/year) and very often (more than 73 times/year). Age and year were included as time-dependent covariates in the models. Antiretroviral use, and self-reported CD4, VL and frequency of CD4 and VL testing were also evaluated as fixed covariates in the HIV+ve cohort. Covariates were entered into a multivariate model if they had a p-value of less than 0.10 in the univariate analyses. The multivariate model was determined using a backwards step-wise approach with a two-sided statistical significance ($p < 0.05$) with *a priori* inclusion of age and year. The log-likelihood ratio statistic was used to assess contribution to the model. Missing data were excluded in tests for trend for ordinal categorical covariates or tests for homogeneity for nominal categorical covariates.

Cox proportional hazard models were used to calculate age- and year-adjusted HR for mortality between the two cohorts. Age- and year-specific mortality rates within the cohorts

were compared to those in the general male population of NSW and summarised as standardised mortality ratios (SMRs). The number of deaths was compared with expected number using rates for the NSW male population by 5 year age group and by year.

Analyses were performed using STATA (version 13; StataCorp LP, College Station, Texas, USA) and SAS (version 9.3; SAS Institute INC., North Carolina, USA).

Results

The study population included 1,325 HIV-ve GBM and 557 HIV+ve GBM (Table 1). Compared with the HIV-ve cohort, the HIV+ve cohort was older, was more likely to be receiving disability pensions or to be unemployed, to have lower incomes, have been exposed to hepatitis C, to be smokers and injecting drug users and to self-report poorer health. HIV+ve participants were less likely to have university-level education.

Comparison of hospitalisations in the HIV+ve and HIV-ve cohorts

We observed 2,032 hospitalisations in the HIV-ve cohort during 13,025 PYs [crude rate: 15.6/100 PYs (95% CI 14.9-16.3)], and 2,130 hospitalisations in the HIV+ve cohort during 5,580 PYs [crude rate: 38.2/100 PYs (95%CI 36.6-39.9)] (Table 2). HIV+ve individuals had an increased risk of hospitalisation compared with the HIV-ve individuals [adjusted IRR: 2.34 (95%CI 1.91-2.86); p-value<0.0001].

Of the major diagnostic groups, HIV+ve compared to HIV-ve GBM were more likely to be hospitalised for all diagnostic groupings apart from endocrine disorders and musculoskeletal disease for which there was no difference between the two groups (Table 2). After adjusting for other risk factors (including socio-demographic and risk behaviour), there were no differences seen between HIV+ve and HIV-ve GBM for hospitalisations due to mental disorders, genitourinary diseases and other cancers (including in situ, benign or uncertain neoplasm). After adjusting for other risk factors, hospitalisations due to non-AIDS-defining infectious diseases, malignant non-AIDS-defining cancers, blood and immune diseases, nervous and sense disorders, cardiovascular diseases, non-AIDS-defining respiratory diseases, digestive system diseases, skin diseases, symptoms and abnormal findings, injuries and poisonings and other factors influencing health were all significantly higher in the HIV +ve group compared to the HIV-ve group.

Comparison of hospitalisations in the HIV+ve cohort and Australian male population

After adjusting for age and year, hospital admission rates were 45.1% higher in the HIV+ve cohort [SHR 1.45 (95% CI 1.33-1.59)] compared with the general male population (Table 2). The greatest excess was in hospitalisations for non-AIDS defining infectious diseases [SHR 5.54 (95% CI 3.50-8.76)], non-AIDS defining respiratory diseases [SHR 2.06 (95%CI 1.30-3.26)], digestive system diseases [SHR 1.50 (95% CI 1.15-1.95)] and symptoms and abnormal findings [SHR 1.91 (95% CI 1.15-3.17)]. The most frequent primary diagnosis in symptoms and abnormal findings was for pain in throat and chest [N=48] and abdominal and pelvic pain [N=41] (Appendix A).

Risk factors for hospitalisation in the HIV+ve cohort included having lower than a university-level education [tertiary diploma/trade certificate: IRR 1.84 (95% CI 1.32-2.54); completed high school: 1.60 (1.10-2.31); < 10 years of high school: 2.18 (1.37-3.46)] (Table 3). Self-reporting excellent or good (compared with poor) health was associated with a decreased risk of hospitalisation [IRR 0.41 (95% CI 0.20-0.83); 0.43 (0.22-0.86); respectively]. Using recreational drugs often and very often (compared with never) was associated with a decreased risk of hospitalisation [IRR 0.38 (95% CI 0.22-0.64); 0.37 (0.16-0.82); respectively], however weekly use of 2 or more drugs was associated with an increased risk of hospitalisation [IRR 2.60 (95% CI 1.19-5.69)]. Having a recent CD4 count of 100-200, 351-500, 501-750 and over 750 (compared with <100) was associated with a decreased risk of hospitalisation [IRR 0.33 (95% CI 0.15-0.74); 0.28 (0.15-0.54); 0.36 (0.19-0.68); 0.30 (0.15-0.58); respectively].

Comparison of hospitalisations in the HIV-ve cohort and Australian male population

After adjusting for age and year, hospital admission rates were 27.6% lower in the HIV-ve cohort [SHR 0.72 (95% CI 0.67-0.78)] than in the general male population (Table 2). The greatest discrepancy was seen in hospitalisations for non-AIDS defining malignant cancers [SHR 0.51 (95% CI 0.30-0.85)], blood and immune diseases [SHR 0.28 (95% CI 0.11-0.58)], mental disorders [SHR 0.43 (95% CI 0.29-0.64)] and musculoskeletal diseases [SHR 0.56 (95% CI 0.38-0.81)].

Risk factors for hospitalisation in the HIV-ve cohort included receiving a pension or social security benefit (compared with full-time employment) [IRR 4.99 (95% CI 2.88-8.64)], having previously had a STI [IRR 1.23 (95% CI 1.01-1.51)] and having injected drugs in the past 6 months [IRR 2.61 (95% CI 1.64-4.17)] (Table 4). Increasing involvement in the gay community was associated with an increased risk of hospitalisation [p-value for trend<0.001]. Being born in Central or South America or the Caribbean or Asia (compared with Australia) was associated with a decreased risk of hospitalisation [IRR 0.48 (95% CI 0.23-1.01); 0.41 (0.26-0.65), respectively], as was reporting health as excellent, very good or good (compared to poor/fair) [IRR 0.46 (95% CI 0.34-0.64); 0.38 (0.28-0.52); 0.42 (0.30-0.59), respectively].

Mortality

A total of 14 deaths were observed in 13,025 PYs in the HIV-ve cohort [crude rate of 0.11/100 PYs (95% CI 0.06-0.18)]. There was no difference observed in terms of mortality between the HIV-ve cohort and the general population [SMR 0.61 (95% CI 0.33-1.02)]. 46 deaths were observed in 5,580 PYs in the HIV+ve cohort [crude rate of 0.82/100 PYs (95% CI 0.62-1.10)]. The mortality rate in the HIV+ve cohort was three times higher than the general population [SMR 3.07 (95% CI 2.25-4.09)]. HIV+ve individuals had an increased risk of mortality compared with the HIV-ve individuals [adjusted RR of 6.54 (95% CI 3.43-12.47)].

Discussion

We found higher rates of hospitalisation in the HIV+ve cohort of GBM compared with the HIV-ve cohort and the general male population. After adjusting for other risk factors, our HIV+ve participants were almost two and a half times as likely to be hospitalised as their HIV-ve counterparts, and hospitalisation rates in the HIV+ve cohort were 45% higher than in the general population. In the HIV+ve cohort, rates of hospitalisation for non-AIDS-defining infectious diseases, non-AIDS-defining respiratory diseases, and digestive system diseases were all higher compared with the HIV-ve cohort and compared with the general male population. In the HIV+ve cohort rates of hospitalisation for non-AIDS-defining cancers, blood and immune diseases, cardiovascular diseases and injuries and poisonings were all significantly higher compared with the HIV-ve cohort but not when compared with the general population. This emphasizes the need for data that directly compares morbidity in HIV infected and uninfected gay and bisexual men.

Admission rates in the HIV+ve cohort (41 (95%CI 39-43)) were slightly lower compared with those previously described by Falster *et al.* (59 (57-61)) in a predominantly male homosexual clinic-based HIV+ve cohort, the Australian HIV Observational Database (AHOD) (33). We also found the SMR in the HIV+ve cohort (3.1 (95%CI 2.3-4.1)) was slightly lower than that described in the AHOD cohort by McManus *et al.* (3.5 (3.0-4.0)) (34). It is likely that this discrepancy is due to the different recruitment methods employed by the different cohorts, that is community- versus clinic-based respectively. We also found many hospitalisations to be for non-AIDS-related diseases in the HIV+ve cohort. This accords with previous studies conducted in Australia (33) and elsewhere (35, 36).

Our finding of lower rates of hospitalisation in the HIV-ve cohort is somewhat surprising. However, recent studies examining mortality by sexual orientation are in support of the conclusion of no excess morbidity in HIV-ve GBM compared to the general male population. Studies conducted by Frisch *et al.* (21) and Cochran and Mays (20, 37) demonstrated all-cause mortality risk in men who have sex with men (MSM) was similar to that of their heterosexual counterparts, contradicting the belief that minority sexual orientation shortens lives. Furthermore, Cochran and Mays (20) also found no increase in suicide-related mortality in MSM consistent with our findings of lower rates of mental health-related hospitalisation in HIV-ve GBM. While our HIV-ve cohort demonstrated higher levels of smoking, alcohol and recreational drug use than found in the comparable general male population(38), this cohort was also more likely to have favourable socioeconomic indicators, such as higher income and education levels, which have been shown to be health protective and prevalent in other cohorts of GBM (39).

Unsurprisingly, poorer socioeconomic indicators in both cohorts were shown to be significantly associated with an increased likelihood of hospitalisation, as was poorer self-reported health. In the HIV+ve cohort, indicators of more advanced HIV at baseline were found to be associated with an increased likelihood of hospitalisation, consistent with previous findings (33). Contrary to expectation, 'often' and 'very often' recreational drug use was found to be protective in the HIV+ve cohort. However it is likely that problematic drug use is not being reflected in this measure, as indicators of very heavy drug use, such as

using 2 or more drugs weekly in the HIV+ve cohort were found to be associated with an increased likelihood of hospitalisation. Being born in Central or South America or the Caribbean or Asia (compared with Australia) was associated with a decreased risk of hospitalisation. This is consistent with previous findings in the general population which have shown that overseas born immigrants have tend to have lower hospitalisation rates for most diagnoses in Australia(40). These inequalities have previously largely been explained by the 'healthy migrant effect', which ensures that, for the most part, only those migrants in good health migrate to Australia.(40, 41)

Our study had some limitations that should be considered when interpreting our results. With regards to the HIV+ve cohort, CD4 and VL data were only available as baseline measures and may have change substantially over the course of observation. We unfortunately did not have access to cause of death information for our cohorts which would have been of interest and sample size precluded us from undertaking a more detailed analysis of individual primary diagnoses. Furthermore we were unable to examine visits to HIV specialists in addition to hospitalisation in the HIV+ve cohort and thus could not enumerate pre-hospitalisation medical intervention that may be substantial in this group. It is also possible that differences in access to care could have impacted rates of hospitalisation seen in this study. Certainly it is likely that the HIV+ve cohort would be more greatly integrated into medical follow-up in the general practice setting, which was on post-hoc examination supported by our data (22% of HIV+ve GBM had no regular doctor vs. 2% of HIV+ve GBM). Whether or not this would impact participants' likelihood of seeking care in a hospital setting is unknown in this study. All residents in Australia have access to Medicare which enables them to receive hospital care free of charge; however discrimination and stigma and poorer health seeking behaviour could have contributed to lower hospital rates seen in the HIV+ve cohort.

An additional limitation could have arisen from behaviours which predisposed HIV+ve men to becoming HIV-infected contributing to higher hospitalisation rates among HIV+ve compared to HIV+ve men. However, the availability of rich behavioural and demographic data collected in our study cohorts enabled us to adjust for some of the potential confounding, as well as being able to investigate behavioural and health covariates as predictors of outcomes.

Consistent with other registry linkage studies, error could have arisen from participant migration outside of the registry region. Unfortunately it is impossible to estimate the impact of this on missing linkages as relevant linkage validation subsets with known outcomes were not available. Further, we were unable to exclude gay and bisexual men from the general population estimates. However, the proportion of men identifying as gay or bisexual is low in the general Australian male population (1.6 and 0.9% respectively) and would only have biased our relative estimates towards the null. While method of recruitment in both cohorts was similar and is a strength of the study, the representativeness of the cohort to the wider HIV+ve and HIV+ve homosexual population is unknown. Representative samples of gay and other homosexually active men are impossible to attain as the population cannot be enumerated (24). Despite these limitations, investigation of baseline characteristics in both

cohorts showed similarity to those described in other cohorts of HIV+ve and HIV-ve GBM in Australia (39).

Conclusions

In summary, our findings show that while HIV+ve GBM still experience excess morbidity, excess risk is not being contributed by sexual orientation per se. Further, our data suggest that concerns regarding sexually-oriented morbidity in self-identifying GBM may be unfounded.

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Appendix A

Most frequent primary diagnoses by ICD-10 Chapter heading in 1325 HIV-ve and 557 HIV+ve gay and bisexual men recruited in Sydney, Australia, 2000-2012

	HIV-ve			HIV+ve	
	Primary Diagnosis	N Hospitalisations	% of hospitalisations for chapter	Primary Diagnosis	N H
Infectious diseases (Non-AIDS defining)	Anogenital (venereal) warts	15	31.25	Other gastroenteritis and colitis of infectious and unspecified origin	29
	Viral and other specified intestinal infections	9	18.75	Anogenital (venereal) warts	14
	Gastroenteritis and colitis of unspecified origin	8	16.67	Zoster [herpes zoster]	9
Malignant cancers (Non-AIDS defining)	Other malignant neoplasms of skin	18	28.13	Other malignant neoplasms of skin	25
	Malignant neoplasm of prostate	18	28.13	Multiple myeloma and malignant plasma cell neoplasms	23
	Malignant melanoma of skin	5	7.81	Hodgkin lymphoma	9
	Malignant neoplasm of testis	5	7.81	Malignant neoplasm of anus and anal canal	7
Other cancers	Benign neoplasm of colon, rectum, anus and anal canal	27	62.79	Benign neoplasm of colon, rectum, anus and anal canal	20

	HIV-ve			HIV+ve	
	Primary Diagnosis	N Hospitalisations	% of hospitalisations for chapter	Primary Diagnosis	N H
	Benign lipomatous neoplasm	5	11.63	Benign neoplasm of colon, rectum, anus and anal canal	8
	Melanoma in situ	3	6.98	Carcinoma in situ of skin	6
				Benign lipomatous neoplasm	6
Blood & immune diseases	Agranulocytosis	5	71.43	Other anaemias	10
				Purpura and other haemorrhagic conditions	8
				Iron deficiency anaemia	7
Endocrine diseases	Type 1 diabetes mellitus	22	32.35	Testicular dysfunction	6
	Disorders of porphyrin and bilirubin metabolism	11	16.18	Other disorders of fluid, electrolyte and acid-base balance	6
	Type 2 diabetes mellitus	10	14.71	Type 1 diabetes mellitus	5
Mental disorders	Mental and behavioural disorders due to use of alcohol	27	25.96	Bipolar affective disorder	35
	Mental and behavioural disorders due to multiple drug use and use of other psychoactive substances	15	14.42	Mental and behavioural disorders due to use of alcohol	17
	Schizophrenia	15	14.42	Depressive episode	12
Nervous & sense disorders (Non-AIDS defining)	Sleep disorders	33	27.97	Sleep disorders	18
	Other cataract	19	16.10	Epilepsy	9
	Mononeuropathies of upper limb	10	8.47	Other polyneuropathies	9
Cardiovascular diseases	Haemorrhoids	51	33.12	Acute myocardial infarction	21
	Atrial fibrillation and flutter	27	17.53	Haemorrhoids	19
	Chronic ischaemic heart disease	14	9.09	Oesophageal varices	16
Respiratory diseases (Non-AIDS defining)	Other disorders of nose and nasal sinuses	19	23.46	Pneumonia, organism unspecified	34
	Chronic sinusitis	11	13.58	Other chronic obstructive pulmonary disease	15
	Pneumonia, organism unspecified	9	11.11	Asthma	9
Digestive system diseases	Inguinal hernia	50	10.80	Other specified diseases of anus and rectum e.g. Proctitis NOS	30
	Gastro-oesophageal reflux disease	43	9.29	Other noninfective gastroenteritis and colitis	28
	Acute appendicitis	32	6.91	Gastro-oesophageal reflux disease	24
Skin diseases	Cellulitis	18	40.91	Cellulitis	15
	Follicular cysts of skin and subcutaneous tissue	5	11.36	Cutaneous abscess, furuncle and carbuncle	6
				Follicular cysts of skin and subcutaneous tissue	4

	HIV-ve			HIV+ve	
	Primary Diagnosis	N Hospitalisations	% of hospitalisations for chapter	Primary Diagnosis	N H
Musculoskeletal diseases	Internal derangement of knee	28	20.90	Dorsalgia	18
	Dorsalgia	15	11.19	Osteoporosis without pathological fracture	15
	Gonarthrosis [arthrosis of knee]	9	6.72	Osteonecrosis	12
Genitourinary diseases	Calculus of kidney and ureter	25	22.12	Other disorders of urinary system	22
	Other disorders of bladder	13	11.50	Calculus of kidney and ureter	16
	Hyperplasia of prostate	11	9.73	Urethral stricture	15
Symptoms & abnormal findings	Pain in throat and chest	50	28.90	Pain in throat and chest	48
	Abdominal and pelvic pain	45	26.01	Abdominal and pelvic pain	41
	Headache	13	7.51	Headache	22
Injury & poisoning	Poisoning by antiepileptic, sedative-hypnotic and antiparkinsonism drugs (predominantly benzodiazepines)	21	10.10	Poisoning by antiepileptic, sedative-hypnotic and antiparkinsonism drugs (predominantly benzodiazepines)	14
	Complications of procedures, not elsewhere classified	21	10.10	Complications of procedures, not elsewhere classified	12
	Fracture of lower leg, including ankle	11	5.29	Fracture of forearm	11
	Poisoning by psychotropic drugs, not elsewhere classified	11	5.29		
Other factors infl. health	Care involving use of rehabilitation procedures	63	31.03	Other medical care (predominantly chemotherapy session for neoplasm)	60
	Family history of malignant neoplasm	39	19.21	Family history of malignant neoplasm	26
	Follow-up examination after treatment for conditions other than malignant neoplasms	26	12.81	Care involving use of rehabilitation procedures	25

Abbreviations: N=Number; Infl.=Influencing

References

1. Altman LK. New homosexual disorder worries health officials. The New York Times 1982. May 11.1982
2. Kippax, S.; Connell, RW.; Dowsett, GW.; Crawford, J. Social Aspects of AIDS. London, United Kingdom: Taylor & Francis Ltd; 1993. Aids in Australia. Chapter 2. Sustaining Safe Sex: Gay Communities Respond to AIDS; p. 9-19.
3. Smith AM, Rissel CE, Richters J, Grulich AE, de Visser RO. Sex in Australia: sexual identity, sexual attraction and sexual experience among a representative sample of adults. Australian and New Zealand journal of public health. 2003; 27(2):138–45. [PubMed: 14696704]
4. The Kirby Institute. Sydney, NSW. Vol. 2052. The Kirby Institute; UNSW: 2014. HIV, viral hepatitis and sexually transmissible infections in Australia.

5. Mocroft A, Ledergerber B, Katlama C, Kirk O, Reiss P, d'Arminio Monforte A, et al. Decline in the AIDS and death rates in the EuroSIDA study: an observational study. *Lancet*. 2003; 362(9377):22–9. [PubMed: 12853195]
6. Deeks SG, Phillips AN. HIV infection, antiretroviral treatment, ageing, and non-AIDS related morbidity 2009. 2009 Jan 26;16:12–39.
7. Mays VM, Cochran SD. Mental Health Correlates of Perceived Discrimination Among Lesbian, Gay, and Bisexual Adults in the United States. *American Journal of Public Health*. 2001; 91(11): 1869–76. [PubMed: 11684618]
8. Daskalopoulou M, Rodger A, Phillips AN, Sherr L, Speakman A, Collins S, et al. Recreational drug use, polydrug use, and sexual behaviour in HIV-diagnosed men who have sex with men in the UK: results from the cross-sectional ASTRA study. *The Lancet HIV*. 2014; 1(1):e22–e31. [PubMed: 26423813]
9. Rosario M, Corliss HL, Everett BG, Reisner SL, Austin SB, Buchting FO, et al. Sexual Orientation Disparities in Cancer-Related Risk Behaviors of Tobacco, Alcohol, Sexual Behaviors, and Diet and Physical Activity: Pooled Youth Risk Behavior Surveys. *American Journal of Public Health*. 2013; 104(2):245–54. [PubMed: 24328632]
10. Zablotska IB, Kippax S, Grulich A, Holt M, Prestage G. Behavioural surveillance among gay men in Australia: methods, findings and policy implications for the prevention of HIV and other sexually transmissible infections. *Sex Health*. 2011; 8(3):272–9. [PubMed: 21851766]
11. King M, Semlyen J, Tai SS, Killaspy H, Osborn D, Popelyuk D, et al. A systematic review of mental disorder, suicide, and deliberate self harm in lesbian, gay and bisexual people. *BMC Psychiatry*. 2008; 8:70. [PubMed: 18706118]
12. Sandfort TG, de Graaf R, Bijl RV, Schnabel P. Same-sex sexual behavior and psychiatric disorders: findings from the Netherlands Mental Health Survey and Incidence Study (NEMESIS). *Archives of general psychiatry*. 2001; 58(1):85–91. [PubMed: 11146762]
13. Conron KJ, Mimiaga MJ, Landers SJ. A population-based study of sexual orientation identity and gender differences in adult health. *Am J Public Health*. 2010; 100(10):1953–60. [PubMed: 20516373]
14. Fredriksen-Goldsen KI, Kim HJ, Barkan SE, Muraco A, Hoy-Ellis CP. Health disparities among lesbian, gay, and bisexual older adults: results from a population-based study. *Am J Public Health*. 2013; 103(10):1802–9. [PubMed: 23763391]
15. Wang J, Hausermann M, Vounatsou P, Aggleton P, Weiss MG. Health status, behavior, and care utilization in the Geneva Gay Men's Health Survey. *Preventive medicine*. 2007; 44(1):70–5. [PubMed: 16997357]
16. Jin F, Prestage GP, Imrie J, Kippax SC, Donovan B, Templeton DJ, et al. Anal sexually transmitted infections and risk of HIV infection in homosexual men. *Journal of acquired immune deficiency syndromes (1999)*. 2010; 53(1):144–9. [PubMed: 19734801]
17. Engels EA, Atkinson JO, Graubard BI, McQuillan GM, Gamache C, Mbisa G, et al. Risk factors for human herpesvirus 8 infection among adults in the United States and evidence for sexual transmission. *The Journal of infectious diseases*. 2007; 196(2):199–207. [PubMed: 17570106]
18. Frisch M, Smith E, Grulich A, Johansen C. Cancer in a population-based cohort of men and women in registered homosexual partnerships. *American journal of epidemiology*. 2003; 157(11): 966–72. [PubMed: 12777359]
19. Boehmer U, Miao X, Ozonoff A. Cancer survivorship and sexual orientation. *Cancer*. 2011; 117(16):3796–804. [PubMed: 21557209]
20. Cochran SD, Mays VM. Mortality Risks Among Persons Reporting Same-Sex Sexual Partners: Evidence From the 2008 General Social Survey-National Death Index Data Set. *Am J Public Health*. 2014:e1–e7.
21. Frisch M, Bronnum-Hansen H. Mortality among men and women in same-sex marriage: a national cohort study of 8333 Danes. *Am J Public Health*. 2009; 99(1):133–7. [PubMed: 19008504]
22. Rawstorne P, Fogarty A, Crawford J, Prestage G, Grierson J, Grulich A, et al. Differences between HIV-positive gay men who 'frequently', 'sometimes' or 'never' engage in unprotected anal intercourse with seroconcordant casual partners: positive Health cohort, Australia. *AIDS care*. 2007; 19(4):514–22. [PubMed: 17453592]

23. Jin F, Prestage GP, Mao L, Kippax SC, Pell CM, Donovan B, et al. Transmission of herpes simplex virus types 1 and 2 in a prospective cohort of HIV-negative gay men: the health in men study. *The Journal of infectious diseases*. 2006; 194(5):561–70. [PubMed: 16897652]
24. Mao, L.; Van De Ven, PG.; Prestage, G.; Jin, F.; Grulich, AE.; Crawford, J., et al. Baseline data UNSW. Sydney: National centre in HIV Social Research; 2002. Health in Men.
25. Prestage, G.; Song, A.; Grierson, J.; Race, K.; Grulich, A.; Kippax, S. positive HEALTH: Method and Sample 1998-1999. Sydney, Australia: National Centre in HIV Social Research; 2000.
26. Prestage, G.; Kippax, SC.; Grulich, AE.; Race, K.; Grierson, JW.; Song, A. Positive Health: Method and Sample. Sydney, Australia: University of NSW; 2001.
27. Jaro MA. Probabilistic linkage of large public health data files. *Statistics in medicine*. 1995; 14(5-7):491–8. [PubMed: 7792443]
28. Centers for Disease Control and Prevention (CDC). Morbidity and Mortality Weekly Report: Revised Surveillance Case Definitions for HIV Infection Among Adults, Adolescents, and Children Aged <18 Months and for HIV Infection and AIDS Among Children Aged 18 Months to <13 Years — United States. 2008; 2008
29. Gidding HF. Analysing linked APDC records: Unraveling the meaning of key variables and identifying invalid records [Internet]; 2009. Podcast. Jul 30.2009
30. Andersen PK, Gill RD. Cox's Regression Model for Counting Processes: A Large Sample Study. *The Annals of Statistics*. 1982; 10(4):1100–20.
31. Stukel TA, Glynn RJ, Fisher ES, Sharp SM, Lu-Yao G, Wennberg JE. Standardized rates of recurrent outcomes. *Statistics in medicine*. 1994; 13(17):1781–91. [PubMed: 7997711]
32. Fogarty, A.; Mao, L.; Zablotska Manos, I.; Santana, HR.; Prestage, G.; Rule, J., et al. The Health in Men and Positive Health cohorts: A comparison of trends in the health and sexual behaviour of HIV-negative and HIV-positive gay men, 2002-2005. Sydney: National Centre in HIV Social Research; 2006.
33. Falster K, Wand H, Donovan B, Anderson J, Nolan D, Watson K, et al. Hospitalizations in a cohort of HIV patients in Australia, 1999-2007. *AIDS (London, England)*. 2010; 24(9):1329–39.
34. McManus H, O'Connor CC, Boyd M, Broom J, Russell D, Watson K, et al. Long-Term Survival in HIV Positive Patients with up to 15 Years of Antiretroviral Therapy. *PLoS ONE*. 2012; 7(11):e48839. [PubMed: 23144991]
35. Buchacz K, Baker RK, Moorman AC, Richardson JT, Wood KC, Holmberg SD, et al. Rates of hospitalizations and associated diagnoses in a large multisite cohort of HIV patients in the United States, 1994–2005. *AIDS (London, England)*. 2008; 22(11):1345–54.10.097/QAD.0b013e328304b38b
36. Luz PM, Bruyand M, Ribeiro S, Bonnet F, Moreira RI, Hessemfar M, et al. AIDS and non-AIDS severe morbidity associated with hospitalizations among HIV-infected patients in two regions with universal access to care and antiretroviral therapy, France and Brazil, 2000-2008: hospital-based cohort studies. *BMC infectious diseases*. 2014; 14(1):278. [PubMed: 24885790]
37. Cochran SD, Mays VM. Sexual orientation and mortality among US men aged 17 to 59 years: results from the National Health and Nutrition Examination Survey III. *Am J Public Health*. 2011; 101(6):1133–8. [PubMed: 21493941]
38. Australian Bureau of Statistics. National Health Survey: Health Risk Factors 2001. Canberra, Australia: 2001. 4812.0
39. Holt M, Lee E, Prestage GP, Zablotska I, de Wit J, Mao L. The converging and diverging characteristics of HIV-positive and HIV-negative gay men in the Australian Gay Community Periodic Surveys, 2000-2009. *AIDS care*. 2013; 25(1):28–37. [PubMed: 22639958]
40. Singh, M.; de Loopier, M. Australian health inequalities: birthplace. Canberra: AIHW; 2002. Available from: <http://www.aihw.gov.au/publication-detail/?id=6442467357> [cited 2015 12.06.15]
41. Kennedy S, McDonald JT, Biddle N. The Healthy Immigrant Effect and Immigrant Selection: Evidence from Four Countries. SEDAP Research Paper No164. 2006

Table 1
Baseline characteristics of the 1325 HIV-ve and 557 HIV+ve gay and bisexual men recruited in Sydney NSW, Australia

	HIV-ve		HIV+ve	
	N	%	N	%
Number of participants	1325	-	557	-
Total follow-up (years)	13016	-	5571	-
Mean follow-up (years)	9.8	-	10	-
Linked to at least 1 Hospital Record	666	50.30%	396	71.10%
Number of Hospitalisations	2032	-	2130	-
Number of Deaths	14	1.10%	46	8.30%
Age (years), median (IQR)	35.3	29.6 to 42.0	40.9	36.0 to 46.7
Ethnicity				
Anglo-Australian/Anglo-Celtic	985	74.30%	424	76.10%
Country of birth				
Australia	913	68.90%	392	70.40%
Education				
university or postgraduate	688	51.90%	200	35.90%
Employment				
unemployed/disability pension	83	6.30%	158	28.40%
Income				
<500 per week/<26,000 per year	266	20.10%	267	47.90%
Exposure to Hepatitis C				
Yes	52	3.90%	69	12.40%
Self-Reported Health				
poor/fair	113	8.50%	140	25.10%
Gay community involvement				
low	393	29.70%	-	-
Daily Smoker				
yes	386	29.10%	277	49.10%
Number of drinks per day				
5 to 8	242	18.30%	68	12.20%
>9	62	4.70%	31	5.60%
Illicit Drug Use (past 6 months) *				
Yes	1061	80.10%	481	86.40%
Injected drugs in last 6months				
yes	50	3.80%	89	16.00%
Any unprotected anal intercourse (past 6 months)				
Yes	832	62.80%	141	25.30%
HIV viral load (log copies/ml), median (IQR)	-	-	4.5	3.6 to 5.9
Last CD4 cell count				
less than 100	-	-	26	4.70%

	HIV-ve		HIV+ve	
	N	%	N	%
100 to 200	-	-	28	5.00%
201 to 350	-	-	91	16.00%
>350	-	-	354	63.60%
Antiretroviral Therapy History				
never taken	-	-	87	15.60%
currently taking	-	-	413	74.20%
past but now stopped	-	-	47	8.40%

*includes amyl nitrate, cannabis, cocaine, meth/amphetamines, MDMA or other MDA, psychedelics, hallucinogens, downers (barbiturates, tranquilisers or sedatives), Rohypnol or ketamine, heroin or other opiates and GHB.

Abbreviations: N, Number; IQR, Interquartile Range; ml, millilitres;

Table 2
Comparing rates of hospitalisation by primary reason for admission in 1325 HIV+ve and 557 HIV+ve gay and bisexual men recruited in Sydney NSW, Australia, 2000-2012

	HIV-ve		HIV+ve		HIV+ve v. HIV-ve		Cohort v. NSW	
	N	Rate p. 100 PYs (95%CI)	N	Rate p. 100 PYs (95%CI)	IRR (95% CI) ⁺	Adjusted IRR (95%CI) [#]	HIV-ve v. NSW Population SHR (95% CI) ⁺	HIV+ve v. NSW Population SHR (95% CI) ⁺
Total	2032	15.6 (14.9-16.3)	2130	38.2 (36.6-39.9)	2.81 (2.39-3.32)	2.34 (1.91-2.86)	0.72 (0.67-0.78)	1.45 (1.33-1.59)
Infectious diseases (Non-AIDS defining)	48	0.4 (0.3-0.5)	94	1.7 (1.4-2.1)	4.08 (2.63-6.36)	4.29 (2.42-7.60)	1.30 (0.69-2.47)	5.54 (3.50-8.76)
-AIDS-defining Illness ^o	4	0.0 (0.0-0.1)	91	1.6 (1.3-2)	89.99 (28.01-289.1)	33.91 (7.00-164.29)		
Malignant cancers (Non-AIDS defining) [*]	64	0.5 (0.4-0.6)	109	2.0 (1.6-2.4)	7.92 (3.96-15.81)	3.99 (1.70-9.32)	0.51 (0.3-0.85)	1.28 (0.66-2.49)
-AIDS-defining Illness ^o %	0		8	0.1 (0.1-0.3)				
Other cancers ^{&}	43	0.3 (0.2-0.4)	44	0.8 (0.6-1.1)	1.92 (1.07-3.43)	1.19 (0.56-2.56)	0.69 (0.1-4.68)	1.16 (0.57-2.35)
Blood & immune diseases	7	0.1 (0-0.1)	30	0.5 (0.4-0.8)	13.71 (4.43-42.41)	26.06 (3.90-173.94)	0.28 (0.11-0.58)	2.18 (0.39-12.09)
Endocrine diseases	68	0.5 (0.4-0.7)	35	0.6 (0.5-0.9)	1.73 (0.67-4.42)	3.65 (0.94-14.21)	1.58 (0.99-2.52)	1.44 (0.72-2.88)
Mental disorders ^{**}	104	0.8 (0.7-1)	130	2.3 (2-2.8)	3.16 (1.67-5.98)	1.49 (0.65-3.44)	0.43 (0.29-0.64)	1.33 (0.84-2.11)
Nervous & sense disorders (Non-AIDS defining) ^{**}	118	0.9 (0.8-1.1)	103	1.8 (1.5-2.2)	1.78 (1.20-2.63)	1.77 (1.06-2.96)	0.73 (0.45-1.17)	1.10 (0.62-1.97)
-AIDS-defining Illness ^o %	0		3	0.1 (0-0.2)				
Cardiovascular diseases	154	1.2 (1-1.4)	143	2.6 (2.2-3)	1.63 (1.12-2.37)	2.28 (1.39-3.76)	0.68 (0.45-1.02)	0.99 (0.65-1.49)
Respiratory diseases (Non-AIDS defining)	81	0.6 (0.5-0.8)	112	2.0 (1.7-2.4)	3.02 (1.96-4.64)	2.83 (1.58-5.11)	0.72 (0.38-1.38)	2.06 (1.3-3.26)
AIDS-defining Illness ^o %	0		4	0.1 (0-0.2)				
Digestive system diseases	463	3.6 (3.2-3.9)	357	6.4 (5.8-7.1)	1.60 (1.31-1.95)	1.56 (1.21-2.02)	0.99 (0.81-1.21)	1.50 (1.15-1.95)
Skin diseases	44	0.3 (0.3-0.5)	41	0.7 (0.5-1)	2.22 (1.29-3.82)	2.05 (1.03-4.07)	0.64 (0.3-1.36)	1.35 (0.52-3.51)
Musculoskeletal diseases [^]	134	1.0 (0.9-1.2)	108	1.9 (1.6-2.3)	1.28 (0.87-1.91)	1.42 (0.78-2.60)	0.56 (0.38-0.81)	0.88 (0.48-1.6)
Genitourinary diseases	113	0.9 (0.7-1)	106	1.9 (1.6-2.3)	1.96 (1.24-3.09)	1.46 (0.79-2.67)	0.88 (0.62-1.24)	1.47 (0.94-2.3)
Symptoms & abnormal findings	173	1.3 (1.1-1.5)	236	4.2 (3.7-4.8)	2.71 (2.06-3.55)	2.80 (1.95-4.02)	0.75 (0.53-1.08)	1.91 (1.15-3.17)
Injury & poisoning	208	1.6 (1.4-1.8)	148	2.7 (2.3-3.1)	1.67 (1.19-2.32)	1.68 (1.09-2.58)	0.66 (0.41-1.06)	1.17 (0.70-1.94)

	HIV-ve		HIV+ve		IRR (95% CI) ⁺	HIV+ve v. HIV-ve Adjusted IRR (95%CI) [#]	Adjusted P-value [#]	Cohort v. NSW Male Population	
	N	Rate p. 100 PYs (95%CI)	N	Rate p. 100 PYs (95%CI)				HIV-ve v. NSW Population SHR (95% CI) ⁺	HIV+ve v. NSW Population SHR (95% CI) ⁺
Other factors infl. Health ^x	203	1.6 (1.4-1.8)	224	4.0 (3.5-4.6)	2.82 (1.95-4.09)	2.53 (1.53-4.21)	0.0003	0.65 (0.3-1.38)	1.24 (0.81-1.92)
Missing	3		4						

^{*}3 HIV-ve high frequency individuals (those with >20 hospital admissions for same primary diagnosis) only contributed 1 hospitalisation to observed #

[^]4 HIV+ve high frequency individuals (those with >20 hospital admissions for same primary diagnosis) only contributed 1 hospitalisation to observed #

^xHospital admissions with a principal diagnostic code of extracorporeal dialysis (n=396) were excluded

[&]Other cancers include in situ neoplasms, benign neoplasms and neoplasms of uncertain or unknown behaviour

^oAIDS-defining illnesses included candidiasis, coccidioidomycosis, cryptococcosis, cryptosporidiosis, cytomegalovirus, encephalopathy, herpes simplex, histoplasmosis, isosporiasis, Kaposi's Sarcoma, Burkitt's lymphoma, immunoblastic lymphoma, primary lymphoma of the brain, *Mycobacterium tuberculosis*, other mycobacterial diseases, penicilliosis, *Pneumocystis jirovecii pneumonia* (PJP), recurrent bacterial pneumonia, progressive multifocal leukoencephalopathy, salmonella septicaemia, toxoplasmosis, and HIV wasting syndrome

[%]Could not compare cohorts as too few cases

⁺Adjusted for age and year of diagnosis

[#]Adjusted for age, year of diagnosis, ethnicity, country of birth, level of education, injected drug use, recreational drug use, smoking, number of drinks regularly consumed, unprotected anal intercourse and hepatitis C status

Abbreviations: N=Number; PYs=Person-years; SHR=Standardised Hospitalisation Ratio; IRR=Incidence Rate Ratio; 95%CI=95% Confidence Interval; Infl.=Influencing; NSW=New South Wales

Table 3
Predictors of hospitalisation among 557 HIV+ve gay and bisexual men recruited in Sydney NSW, Australia, 2000-2012

Risk Factor	Person Years	N Hospitalisations	Incidence rate p. 100 PYs (95%CI)	Multivariate adjusted IRR ^c	95%CI	p-value	p-value for homogeneity or trend
Age^d							
18-34	426	168	39.5 (33.9 to 45.9)	1			<0.001 ^b
35-44	1893	566	29.9 (27.5 to 32.5)	0.66	0.52 to 0.85	<0.01	
45-54	2245	947	42.6 (39.9 to 45.4)	0.73	0.55 to 0.98	0.03	
55-64	827	497	60.1 (55.0 to 65.6)	0.95	0.68 to 1.33	0.76	
65+	209	100	47.9 (39.4 to 58.3)	0.93	0.59 to 1.49	0.77	
Highest level of education							
University	2014	575	28.5 (26.3 to 31.0)	1			0.001
Tertiary diploma/Trade Certificate	1311	625	47.7 (44.1 to 51.6)	1.84	1.32 to 2.54	<0.01	
Completed high school	940	374	39.8 (36.0 to 44.0)	1.6	1.10 to 2.31	0.01	
10 years of high school	797	342	42.9 (38.6 to 47.7)	1.42	0.96 to 2.12	0.08	
< 10 years of high school	518	362	70 (63.0 to 77.4)	2.18	1.37 to 3.46	<0.01	
Self-Reported General Health							
poor	162	96	59.1 (48.4 to 72.2)	1			0.044
fair	1205	602	50 (46.1 to 54.1)	0.55	0.27 to 1.11	0.1	
good	2891	1137	39.3 (37.1 to 41.7)	0.43	0.22 to 0.86	0.02	
excellent	1270	395	31.1 (28.2 to 34.3)	0.41	0.20 to 0.83	0.01	
missing	51	48	93.7 (70.6 to 124.4)	1.98	0.54 to 7.29	0.3	
Use of recreational drugs							
never	738	417	56.5 (51.3 to 62.2)	1			0.001
occasionally	1182	539	45.6 (41.9 to 49.6)	0.84	0.55 to 1.28	0.74	
regularly	2591	1047	40.4 (38.0 to 42.9)	0.8	0.52 to 1.22	0.21	
often	873	235	26.9 (23.7 to 30.6)	0.38	0.22 to 0.64	<0.01	
very often	195	40	20.5 (15.0 to 27.9)	0.37	0.16 to 0.82	0.05	
Weekly drug use							
None	3615	1582	43.8 (41.7 to 46.0)	1			0.018
1 drug	1784	609	34.1 (31.5 to 36.9)	0.86	0.62 to 1.19	0.36	

Risk Factor	Person	Years	N Hospitalisations	Incidence rate p. 100 PYs (95%CI)	Multivariate adjusted IRR ^c	95%CI	p-value	p-value for homogeneity or trend
2 drugs or more	180		87	48.4 (39.2 to 59.7)	2.6	1.19 to 5.69	0.02	
Recent CD4 count								
less than 100	233		157	67.5 (57.7 to 79.0)	1			0.001
100-200	297		121	40.7 (34.1 to 48.7)	0.33	0.15 to 0.74	0.01	
201-350	875		554	63.3 (58.3 to 68.8)	0.59	0.30 to 1.14	0.12	
351-500	1042		353	33.8 (30.5 to 37.6)	0.28	0.15 to 0.54	<0.01	
501-750	1360		529	38.9 (35.7 to 42.3)	0.36	0.19 to 0.68	<0.01	
over 750	1183		355	30 (27.1 to 33.3)	0.3	0.15 to 0.58	<0.01	
missing	590		209	35.4 (30.9 to 40.6)	0.29	0.14 to 0.58	<0.01	
Financial Year^a								
July 2000-July 2003	1020		475	46.6 (42.6 to 51.0)	1			0.006 ^b
Aug 2003-July 2006	1428		522	36.4 (33.5 to 39.8)	0.95	0.83 to 1.09	0.48	
Aug 2006-July 2009	1586		624	39.3 (36.4 to 42.5)	1.11	0.96 to 1.27	0.15	
July 2009-July 2012	1545		657	42.5 (39.4 to 45.9)	1.21	1.04 to 1.41	0.02	

^aTime-dependent covariate^bp value for test for trend^cAge and financial year were an *a priori* inclusion

Abbreviations: N=number; PYs=person years; CI=Confidence Interval; IRR=incidence rate ratio

Predictors of hospitalisation among 1325 HIV-ve gay and bisexual men recruited in Sydney NSW, Australia, 2000-2012**Table 4**

Risk Factor	Person Years	N Hospitalisations	Incidence rate p.100 Pys (95% CI)	Multivariate adjusted IRR ^c	95%CI	p-value	p-value for homogeneity or trend
Age^a							
18-34	3703	421	11.4 (10.3 to 12.5)	1			<0.001 ^b
35-44	5057	700	13.8 (12.9 to 14.9)	1.45	1.22 to 1.73	<0.01	
45-54	2952	539	18.3 (16.8 to 19.9)	1.4	1.12 to 1.73	<0.01	
55-64	1064	338	31.8 (28.6 to 35.3)	1.78	1.37 to 2.31	<0.01	
65+	249	209	83.9 (73.3 to 96.1)	3.02	2.06 to 4.44	<0.01	
Country of birth							
Australia	9016	1681	18.6 (17.8 to 19.6)	1			0.001
Europe/Russia/Middle East	1629	223	13.7 (12.0 to 15.6)	0.8	0.61 to 1.05	0.11	
New Zealand/Pacific Islands/New Guinea	837	95	11.3 (9.3 to 13.9)	0.7	0.48 to 1.03	0.07	
Canada/USA	366	102	27.9 (23.0 to 33.9)	1.27	0.78 to 2.09	0.34	
Central/South America, Caribbean	225	19	8.4 (5.4 to 13.2)	0.48	0.23 to 1.01	0.05	
Asia	724	47	6.5 (4.9 to 8.6)	0.41	0.26 to 0.65	<0.01	
Africa	188	29	15.4 (10.7 to 22.2)	1.2	0.59 to 2.44	0.61	
Other, DK, NA, Missing	40	8	20.2 (10.1 to 40.3)	1.34	0.30 to 5.95	0.7	
Employment							
Full-time	9853	1563	15.9 (15.1 to 16.7)	1			<0.001
Part-Time	1472	211	14.3 (12.5 to 16.4)	0.99	0.74 to 1.31	0.93	
Unemployed	523	59	11.3 (8.7 to 14.6)	0.79	0.5 to 1.26	0.33	
Student	537	60	11.2 (8.7 to 14.4)	0.98	0.61 to 1.58	0.94	
Pension/Social security benefits	277	254	91.8 (81.2 to 103.9)	4.99	2.88 to 8.64	<0.01	
Sex work	29	2	6.9 (1.7 to 27.7)	0.62	0.07 to 5.8	0.67	
Other (including missing)	334	58	17.4 (13.4 to 22.5)	0.8	0.46 to 1.4	0.44	
Self-Reported General Health							
poor/fair	1126	372	33.3 (29.8 to 36.6)	1			<0.001
good	4120	770	18.7 (17.4 to 20.1)	0.46	0.34 to 0.64	<0.01	
very good	5264	731	13.9 (12.9 to 14.9)	0.38	0.28 to 0.52	<0.01	

Risk Factor	Person Years	N Hospitalisations	Incidence rate p.100 Pys (95% CI)	Multivariate adjusted IRR ^c	95% CI	p-value	p-value for homogeneity or trend
excellent	2503	334	13.3 (12.0 to 14.9)	0.42	0.3 to 0.59	<0.01	
Ever reported as having had any STI (other than HIV)							
No	4336	591	13.6 (12.6 to 14.8)	1			0.042
Yes	8689	1616	18.6 (17.7 to 19.5)	1.23	1.01 to 1.51	0.04	
Injected drugs in last 6 months							
Never	12554	2018	16.1 (15.4 to 16.8)	1			0.001
Yes	442	180	40.7 (35.1 to 47.1)	2.61	1.64 to 4.17	<0.01	
Missing	28	9	32.4 (16.9 to 62.3)	0.97	0.8 to 1.17	0.73	
Gay community involvement							
low	3850	622	16.2 (14.9 to 17.5)	1			<0.001 ^b
moderate	3783	621	16.4 (15.2 to 17.8)	1.1	0.87 to 1.38	0.43	
high	2948	405	13.7 (12.5 to 15.1)	1.19	0.93 to 1.53	0.17	
very high	2444	559	22.9 (21.1 to 24.9)	1.63	1.26 to 2.12	<0.01	
Financial Year^a							
July 2000-July 2003	1253	216	17.2 (15.1 to 19.7)	1			<0.001
Aug 2003-July 2006	3866	543	14 (12.9 to 15.3)	0.81	0.69 to 0.95	0.01	
Aug 2006-July 2009	3965	675	17 (15.8 to 18.4)	0.94	0.8 to 1.1	0.46	
July 2009-July 2012	3941	773	19.6 (18.3 to 21.0)	1.05	0.89 to 1.23	0.58	

^aTime-dependent covariate^bp value for test for trend^cAge and financial year were an *a priori* inclusion

Abbreviations: N= number; PYs=person years; CI=Confidence Interval; IRR=incidence rate ratio; STI=Sexual Transmitted Infection; NA=Not Applicable; DK=Doesn't Know