Deaths in the Cook County Jail: 10-Year Report, 1995–2004

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ABSTRACT *The aims of this study were to describe causes of death during the 10-year period between 1995 and 2004 in a large urban jail in Chicago; to compare disease specific mortality rates between the jail population and the general population; to explore demographic and incarceration characteristics of the inmates who died in the jail by cause of death; and to examine gender difference in demographic characteristics, incarceration patterns, and causes of death. A total of 178 deaths occurring in the jail over a 10-year period (1995–2004) were reviewed. Age-adjusted disease-specific mortality rates were computed for the jail population and compared with the rates in the US general population. Cause of death, demographic variables, and incarceration related factors were retrieved from multiple computerized databases. Descriptive analyses were performed to examine demographic and incarceration-related patterns by cause of death and gender. Heart disease was the most frequent cause of death in the jail population, followed by cerebrovascular disease and suicide. Mortality rates for heart diseases, infectious/inflammatory conditions and suicide were higher for jail inmates than the general population. Black inmates accounted for the majority of deaths due to illnesses and homicide, and a much higher proportion of white and Hispanic inmates were involved in suicide deaths. Deaths due to drug overdose or withdrawal were disproportionately higher among female inmates compared with male inmates. Consistent review of mortality rates and causes of deaths in jail can be a useful tool to better understand health issues and needs of jail inmates. Surveillance of acute and chronic illnesses and strategic reengineering of jail health care is a key to quality improvement for incarcerated populations for whom the jail system becomes their primary care provider.*

KEYWORDS *Cause of death, Inmates, Jail, Mortality.*

INTRODUCTION

Mortality data can provide valuable information on health issues that inmates bring to a jail setting. By comparing mortality rates between the jail population and the general population, inmates' unique needs and health risks can be highlighted. A disproportionately high number of inmates present multiple health issues due to their social, economic, environmental, and behavioral risk factors. Substance abuse, infectious diseases such as tuberculosis (TB), sexually transmitted diseases (STDs),

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Human Immunodeficiency Virus (HIV)/Acquired Immune Deficiency Syndrome (AIDS), and mental/psychological problems are known to be prevalent in this population.^{1–3} When examining disease-specific mortality rates, earlier studies showed that HIV/AIDS was the most frequent cause of death in prisons, and many other studies reported that suicide rates in incarcerated populations were higher than the rates in the general population, the rate in jails being three times higher than the rate in prisons.⁴ However, more recently, deaths due to HIV infection have decreased both in inmate populations as well as in the general population. It has been reported that suicide and homicide rates in local jails and state prisons also have declined over the last 20 years.⁴ As such, it appears timely to reevaluate the changing mortality profile in this population.

Health care in jails has primarily focused on addressing prevention of the potential transmission of infectious diseases and acute health issues. The public health implications of infectious diseases among inmates have long been recognized. Often individuals incarcerated in jails require immediate medical attention for conditions such as injuries, drug intoxication or withdrawal. However, many individuals with chronic illness are also incarcerated. These individuals may be incarcerated without their medications, and depending on the institution, evaluation by a physician and reinstitution of medication can take several days. Chronic conditions are often treated with an episodic urgent care approach that does not result in optimal care for this growing number of inmates with chronic health problems. Chronic health needs of inmates have not been extensively explored. Yet, chronic conditions among inmates are coming more into focus because incarcerated populations are aging.⁵ The National Commission on Correctional Health Care (NCCHC)⁶ estimated rates of chronic diseases in incarcerated populations because there are no reported prevalence rates of chronic illness for incarcerated populations.

The purpose of this study is to better understand patterns of deaths among inmates in a large urban jail and to explore resulting policy implications in planning jail health services. Specific aims of the study are (1) to describe causes of death during the 10-year study period between 1995 and 2004 in the Cook County Department of Corrections (CCDOC), Cermak Health Services (CHS), (2) to examine the disease specific mortality rates in this jail population and to compare these with the rates in the US general population, (3) to compare demographic and incarceration characteristics of the inmates who died in the jail by cause of death, and (4) to examine gender difference in demographic characteristics, incarceration patterns, and causes of death.

BACKGROUND

According to definitions of the Bureau of Justice Statistics (BJS),⁷ jails hold inmates before or after adjudication, those who are sentenced usually less than one year, those with pending allegation, trial, conviction, or sentencing, or those who are returning to custody following violation of probation or parole. Prisons on the other hand confine inmates who have been those who have been convicted of a felony offense and sentenced to one year or more.

Many previous mortality studies in correctional settings often focused on suicide deaths, partly because suicide has been one of the most frequent causes of death in the incarcerated populations. Salive and colleagues⁸ reviewed male deaths between 1979 and 1987 in a prison in Maryland, and concluded that mortality

rates due to suicide in the prison population were higher than rates in the general population, although the all-cause mortality rate for the prison population was lower than the rate for the general population. A study of 128 deaths between 1971 and 1976 in New York prisons also found that external causes accounted for the majority of deaths, with suicide being the leading cause of death.⁹ This high rate of suicide deaths in incarcerated populations was observed in overseas studies.^{10–14} For example, suicide was the most common cause of death in a Finnish prison.¹⁵

Inmates who committed suicide tended to be younger. Salive and colleagues¹⁶ reported that the relative risk of committing suicide among inmates who were between the ages of 25 and 34 was significantly higher than any other age group. In NY facilities, 21% of inmate suicide deaths fell between the ages of 25 and 29, and 26% were between the ages of 30 and 34.¹⁷ In a Finnish study, inmates between the ages of 21 and 29 accounted for 49.5% of all suicide deaths.¹⁵ In an Australian study, the majority of suicide deaths were between the ages of 20 and 24.¹⁸ A more recent report, however, found that in 2002, the youngest inmates, younger than 18 years, had the highest suicide rate (101 per 100,000 inmates per year) followed by the oldest inmates, older than 55 years (58 per 100,000 inmates per year).⁴

Nationally, blacks were less likely to commit suicide in correctional facilities. In NY corrections,^{9,19} blacks accounted for only 23.7% of suicide cases, and in the Maryland prison system, whites were twice as likely as other racial groups to commit suicide.^{16,20} The Bureau of Justice Statistics (BJS) reported that in local jails, the suicide rate for black inmates was 16 for every 100,000 per year compared with the rate of 30 per 100,000 per year for Hispanics and 96 per 100,000 per year for white inmates.⁴

The suicide rates have been much higher for jail populations than for the general population, as well as for prison populations. According to BJS, the jail suicide rate in 2002 (47 per 100,000 inmates) was more than five times higher than the rate in the general population (8.9 per 100,000),²¹ and three times higher than the rate in prisons (14 per 100,000).⁴ Although the rate of suicide deaths is still higher in incarcerated populations than in the general population, recent suicide rates in correctional facilities, both jails and prisons, have decreased in the US. According to a BJS report, jail suicide rates have declined since 1983 from 129 per 100,000 to 47 per 100,000 in 2002.⁴ Homicide rates in jails were relatively steady over the last 20 years: 5 per 100,000 in 1983 and 3 per 100,000 in 2002. The rates of suicides and homicides also have noticeably declined in prisons. The suicide rate in state prisons was 34 in 1980 and dropped to 14 in 2002; the homicide rate in state prisons was 54 in 1998 and decreased to 4 per 100,000 in 2002.

Recent studies reported that HIV/AIDS related mortality has been decreasing in correctional facilities as the death rate due to HIV/AIDS has declined in the general population, consistent with the introduction of Highly Active Antiretroviral Therapy (HAART). The NY correctional services reported that during 1990 and 1995, the mortality rate due to HIV/AIDS was on average 36.4 in every 100,000 inmates, which had decreased to 8.6 in 1997.²² BJS reported that in local jails, the mortality rate for AIDS was 20 in 1988 and decreased to 8 in 2002; in state prisons, the rate was 100 in 1995 and dropped to 20 in 2002.⁴

All-cause mortality in state prisons, on the other hand, showed a slight increase from 233 in 1980 to 246 per 100,000 in 2002.⁴ The overall increase in mortality in prisons over the last two decades may be in part due to the increase in chronic illness among the population. BJS summarized that by 2002, 52% of all deaths in jails were due to illnesses. In the Atlanta–Fulton County correctional facilities in

Georgia, between 1974 and 1985, the majority of deaths among inmates were due to natural causes.²³ Salive and colleagues¹⁶ also reported that over 68% of all deaths in the Maryland prison system over the 11-year study period was due to illnesses.

Deaths from heart diseases were prominent among inmates. In Ontario correctional systems, cardiovascular diseases were the most frequent nonviolent cause of death among inmates between 1990 and 1999.¹² In the NY study, heart disease was the most common cause of death other than suicide, followed by cerebrovascular diseases.⁹ In Maryland state prisons, for the period of 1979–1987, circulatory system diseases were the most frequent cause of death.⁸

Hollander, Vignona, and Burstein argue that one of the reasons for a high mortality rate for heart disease is because a disproportionately high number of inmates abuse substances such as alcohol, tobacco, and predominantly cocaine.^{24,25} The inmates who died of heart diseases were especially among younger ethnic minorities compared to the deaths due to heart diseases in the general population.¹² It has been reported that there is an increased risk of heart disease among young cocaine users, without specific risk factors.^{26,27} Cocaine use and the combination of cocaine and smoking and/or alcohol increases the risk of myocardial infarction, sudden death from cardiac arrest, and other aneurysms.²⁴

SETTING: COOK COUNTY JAIL

The Cook County Department of Corrections (CCDOC)—Cook County Jail—is the largest single-site county pre-detention facility in the US, and primarily holds pretrial offenders.²⁸ Among CCDOC detainees, an estimated 20% are released within 3 days, and 47% return home within a week, and the average length of stay is 51 days.²⁹ The total number of CCDOC incarcerations grew from 77,103 in 1992 to 100,071 in 1998. Approximately 850,000 detainees entered CCDOC from 1995 to 2004,³⁰ and on average 277 new inmates were admitted daily to CCDOC.³¹ CCDOC was occupied at 113.9% in 1995 and 106.1% of capacity in 2004, housing over 9,000 inmates daily between 1995 and 2004.^{28,30} The proportion of female inmates, although still small, had grown from 12.5% of the incarcerated population in 1992 to 14.4% in 1998. Cermak Health Services (CHS), the health care service facility at CCDOC, offers health services to inmates.³¹ CHS screens inmates for various illnesses at intake and treats their health issues through sick calls, specialty clinics, and the emergency room. In 2005, a total of 83,462 incarcerations were made, and screened by emergency medical technicians at intake. Of those, 37.4% of male and 56.7% of female inmates were seen by a physician or a physician assistant for one or more health issues during the intake screening.

METHODS

We reviewed all deaths in CCDOC between 1995 and 2004. The CHS mortality and morbidity committee reviews deaths in the jail. The actual causes of death were based on the Medical Examiner's reports, which were based on their autopsy results. All causes of death during the 10-year period were coded using the International Classification of Diseases (ICD) 9th edition, which was implemented by the Centers for Disease Control and Prevention (CDC) to categorize the causes of mortality for the US general population.^{32,33} Mortality Data from the National

Vital Statistics System (NVSS) was used to compare mortality rates for the general population with the rates in the jail. NVSS is the official vital statistics collected and managed by the National Center for Health Statistics. Age adjusted cause-specific mortality rates for the general population were obtained from the *National Vital Statistics Reports*.³²

On average, 9,878 inmates resided in the jail on any given day in a year and 97,473 inmates were incarcerated per year. The inmate's age was categorized into CDC's 10-year age intervals. Computing mortality rates in incarcerated populations, an appropriate denominator is difficult, since the population is constantly moving in and out of the correctional system. Although there have been discussions about using the total number of incarcerations as the denominator instead of an average daily census, we utilized average daily census, since the rates based on the total number of incarcerations lack a time component and thus do not represent true mortality rates. Overall and cause-specific mortality rates in the jail were calculated using the average daily census of each year. We then compared the rates between the jail and the general populations. The standardized mortality ratios (SMR) were computed (the observed mortality rates for CHS over the expected mortality rates for the US population), using the average daily census.

Additional variables including demographics (age, gender, ethnicity, marital status, and education level) and incarceration related variables (number of incarcerations, length of stay in jail, and type of charge) were retrieved from the Correctional Institution Management Information System, the Cook County Jail information system, and were used to describe this population. Causes of death were recategorized into three groups: illness related death, infectious/inflammatory related death, and non-illness related death. We compared the frequency and percent of demographic and incarceration-related characteristics by cause of death. Analysis of variance tests and chi-square tests were used to examine the associations between demographic and incarceration-related characteristics and cause of death.

RESULTS

Between 1995 and 2004, there were a total of 178 deaths in CHS. Table 1 summarizes the average daily census, the total number of incarcerations, and number of deaths for each year. The annual population-adjusted death rates were calculated using the average daily census. Table 2 summarizes the causes of death in CHS during the study period by major disease categories. Overall, 53.4% of deaths were due to illnesses such as heart diseases, cerebrovascular diseases, malignant neoplasms, and chronic respiratory disease; 19.7% were associated with infectious/inflammatory diseases including HIV/AIDS, pneumonia, and septicemia; and 27.0% accounted for non-illness related deaths such as suicide, drug overdose/withdrawal, and homicide. The most frequent cause of death was heart-related (18.0%), followed by cerebrovascular diseases (10.7%). Eleven (6.2%) deaths were associated with malignant neoplasm, including lung cancer, sarcoma, rectal cancer, and leukemia. In 16 deaths (9.0%), HIV/AIDS was reported as a primary cause of death. However, an additional 12 inmates, whose primary cause of death was not HIV/AIDS, were HIV positive. Pneumonia ($n=8$) and septicemia ($n=8$) each accounted for 4.5% of all deaths. There were 19 suicide cases, 10.7% of all deaths, and eight homicide cases, 4.5% of all deaths, during the 10-year period. Deaths related to drug overdose or withdrawal accounted for 6.7% of all deaths ($n=12$). There were two perinatal related deaths; both were by ruptured ectopic pregnancy.

TABLE 1. Age-adjusted CHS mortality rate, 1995–2004

Year	Number of deaths	Number of incarcerations per year	Average daily census per year	Mortality rate ^a
1995	13	87,420	8,751	148.55
1996	26	86,115	9,035	287.77
1997	14	96,130	9,153	152.96
1998	28	100,780	9,475	295.51
1999	12	99,609	9,492	126.42
2000	20	98,769	9,953	200.94
2001	20	101,971	10,642	187.93
2002	13	101,457	11,082	117.31
2003	8	96,842	10,664	75.02
2004	24	105,641	10,536	227.79
Total	178	974,734	98,783	180.19

^aMortality rates per 100,000 inmates per year calculated using the average daily census as the denominator.

TABLE 2. Distribution of cause of death in CHS

Cause of Death	Female	Male	Total	Total (%)
Illness				
Heart disease	4	28	32	18.0
Cerebrovascular	0	19	19	10.7
Malignant neoplasms	0	11	11	6.2
Chronic respiratory disease	0	6	6	3.4
Liver disease	1	5	6	3.4
GI bleeding	0	5	5	2.8
Diabetes	0	3	3	1.7
PE	0	3	3	1.7
Hypertension	1	1	2	1.1
Aortic aneurysm	0	1	1	0.6
Other	0	7	7	3.9
Subtotal	6	89	95	53.4
Infectious/inflammatory				
HIV/AIDS	0	16	16	9.0
Pneumonia	0	8	8	4.5
Septicemia	1	7	8	4.5
Meningitis	0	3	3	1.7
Subtotal	1	34	35	19.7
Non-Illness/Other				
Suicide	1	18	19	10.7
Drug overdose and withdrawal	7	5	12	6.7
Homicide	0	8	8	4.5
Unintentional injury	1	3	4	2.2
Ruptured ectopic pregnancy	2	0	2	1.1
Missing	1	2	3	1.7
Subtotal	12	36	48	27.0
Total	19	159	178	100.0

The population-adjusted death rates exhibited year-to-year fluctuations, without a distinct trend over time (Table 1). The age-adjusted mortality rate was highest in 1998 (296 per 100,000 inmates per year) and lowest in 2003 (75 per 100,000 inmates per year). The gender distribution of deaths roughly resembled the distribution in the total jail population; 159 (89.3%) were male inmates and 19 (10.7%) were female inmates (Table 2). The mean age at death was 40.4 years old among male inmates and 37.4 years old among female inmates. As the majority of inmates in CCDOC were blacks, the majority of inmates who died in the jail were black inmates; 73.6% blacks, 18.0% whites, and 6.2% Hispanics. Among females, blacks accounted for 78.9% and whites accounted for 21.1% of the total female deaths.

We compared demographic and incarceration related variables by cause of death (Table 3). Inmates who died of non-illness related causes were younger than those who died of illness-related and infectious/inflammatory diseases. The mean age of the non-illness deaths was 35.0 years old, whereas the mean age was 42.2 years old for the illness-related deaths and 41.1 years old for the infectious/inflammatory causes. Overall, a higher percent of females accounted for non-illness deaths (24.4%) compared with the percent of female cases in the illness-related deaths (6.3%) and in the infectious/inflammatory deaths (2.9%).

While blacks accounted for 70% of all incarcerations in CCDOC during the study period, 62% of the infectious/inflammatory related deaths, 66% of the non-illness related deaths, and over 83% of the illness-related deaths were black

TABLE 3. Demographic comparison by type of death and length of stay in jail by cause of death

	Total	Illness	Infection/Inflammatory	Non-illness	<i>p</i>
	Mean (SD)				
Age	40.0 (12.4)	42.2 (12.6)	41.1 (11.9)	35.0 (1.3)	.005*
No. of incarcerations	3.2 (2.5)	3.3 (2.7)	2.5 (2.0)	3.3 (2.4)	.27*
	<i>n</i> (%)				
Female	19 (10.7)	6 (6.3)	1 (2.9)	11 (24.4)	.001
Ethnicity					
Black	131 (73.6)	78 (83.9)	21 (61.8)	29 (65.9)	.059
White	32 (18.4)	11 (11.8)	10 (29.4)	11 (25.0)	
Hispanics	11 (6.3)	4 (4.3)	3 (8.8)	4 (9.1)	
Married	34 (20.2)	21 (23.1)	3 (9.7)	10 (23.3)	.25
Education					
<9 years	24 (14.6)	12 (13.6)	4 (12.9)	7 (16.7)	.43
9–12 years	83 (50.6)	50 (56.8)	14 (45.2)	17 (40.5)	
>12 years	57 (34.8)	26 (29.5)	13 (41.9)	18 (42.9)	
Length of stay in jail					
Within 2 days	26 (15.0)	13 (14.1)	1 (2.9)	12 (27.3)	.04
3–7 days	17 (9.8)	10 (10.9)	1 (2.9)	5 (11.4)	
8–31 days	25 (14.5)	11 (12.0)	7 (20.6)	6 (13.6)	
After 31 days	105 (60.7)	58 (63.0)	25 (73.5)	21 (47.7)	
Type of charge					
Drug charges	52 (29.7)	31 (32.6)	9 (25.7)	12 (26.7)	.16
Minor crimes	73 (41.7)	41 (43.2)	18 (51.4)	14 (31.1)	
Violent crimes	50 (28.6)	23 (24.2)	8 (22.9)	19 (42.2)	

*ANOVA, otherwise chi-square tests.

inmates. Blacks were underrepresented particularly in suicide cases: 52.6% of the suicide deaths were blacks, 15.8% Hispanics, and 31.6% whites.

There was no statistical difference in number of incarcerations, marital status, level of education, or type of charge by type of death. Over 14% of illness deaths, 3% of infectious/inflammatory disease deaths and over 27% of non-illness related deaths occurred within 2 days after incarceration (Table 3). Sixty-three percent of illness-related deaths, 74% of infectious/inflammatory disease deaths and 48% of non-illness related deaths occurred a month after incarceration. At the time of death, male inmates tended to stay longer in the jail with a median of 80 days (mean of 172.4 days) compared with a median of 1 day (mean of 86.2 days) in jail among female inmates (data not shown). Overall, 61% of all deaths occurred after a month of stay in jail. Over 63% of female deaths and only 9% of male deaths occurred within 2 days after incarceration, on the other hand, more than 26% of female deaths and about 65% of male deaths occurred after a month of stay in jail (Figure 1).

Table 4 shows the comparison of disease-specific mortality rates and SMRs between CHS and the general population. Overall, the age-adjusted all-cause mortality rate in CHS (521.0 per 100,000 inmates per year) was lower than the rate in the US general population (845.3 per 100,000 per year). The mortality rates for most of illness-related causes were lower for the CHS inmates than for the general population. Heart disease was the most frequent cause of death both in CHS and in the general population. The mortality rate for heart disease was significantly higher

FIGURE 1. Length of stay at the time of death, percent deaths within gender.

TABLE 4. Age-adjusted mortality rates per 100,000/year in the US and CHS

Cause of death	US Mortality rate ^a	CHS Mortality rate ^b	SMR ^c
All cause	845.3	521.0	0.62**
Illness Death			
Heart diseases	240.8	312.1	1.30**
Malignant neoplasms	193.5	34.4	0.18**
Cerebrovascular diseases	56.2	23.7	0.42**
Chronic respiratory diseases	43.5	4.5	0.10**
Diabetes	25.4	2.5	0.10**
Liver diseases	9.4	8.8	0.94
Hypertension	7.0	1.4	0.20*
Aortic aneurysm	5.2	0.7	0.13*
Pulmonary embolism	3.1	2.0	0.65
Gastrointestinal bleeding	2.8	3.8	1.36
Infections/Inflammatory Illness Death			
Pneumonia	22.6	35.2	1.56**
Septicemia	11.7	16.6	1.42
HIV	4.9	10.3	2.10*
Meningitis	0.2	1.6	8.00**
Non-Illness/Other Death			
Unintended Injury	36.9	24.3	0.66*
Suicide	10.9	14.8	1.36
Drug overdose or withdrawal	9.0	11.5	1.28
Homicide	6.1	4.3	0.70
Ruptured ectopic pregnancy ^d	12.0	1.2	0.10**

* $p < .05$; ** $p < .01$, otherwise not significant.

^aAge-adjusted cause-specific mortality rates per 100,000 per year, retrieved from the NVSS by the NCHS.

^bAge-adjusted cause-specific mortality rates per 100,000 inmates per year calculated using the average daily census as a denominator.

^cSMR = [Observed Deaths (the rate in CHS) / Expected Deaths (the rate in the general population)].

^dFemale only, 12 per 1,000 live births.

for the CHS inmates than for the general population. SMR between CHS and the general population was not statistically significant for liver disease. The mortality rates for pulmonary embolism and gastrointestinal bleeding did not significantly differ between the CHS inmates and the general population.

The rates for most of infectious/inflammatory diseases were higher in the jail inmates than in the general population. SMR for septicemia between the inmates and the general population was not statistically significant. The mortality rates for pneumonia and HIV were significantly higher for the inmates than in the general population. Among the non-illness related causes of death, the mortality rates for unintended injury and ruptured ectopic pregnancy were significantly lower for the inmates than for the general population; the rates for suicide, drug overdose/withdrawal, and homicide were not significantly different between the inmates and the general population.

Causes of death were quite different between males and females (Figure 2). Among the male deaths, the leading causes of death were heart disease (18%), cerebrovascular disease (12%), suicide (11%), and HIV/AIDS (10%). Among the female deaths, however, drug overdose or withdrawal (37%) was the most frequent cause of death, followed by heart disease (21%) and perinatal-ruptured ectopic

FIGURE 2. Percent deaths by cause of death by gender.

pregnancy (11%). A nearly 12 times higher percentage (37%) of female deaths than of male deaths (3%) was related to drug overdose/withdrawal.

The majority of inmates who committed suicide did so by hanging (89.5%); two suicide cases were by fall and ingestion of a toxic chemical. There was only one female suicide death: she was charged with first-degree murder and had never been incarcerated before. She was a 40-year-old African American single woman with no child. She stayed in the jail for more than 2 years and committed suicide by fall. There was no homicide death in female inmates.

DISCUSSION

Overall, there was no distinct trend in the population-adjusted death rates over time. Although the fluctuation in the year-by-year rates seems significant, it may be more likely due to the relatively small number of deaths. The all-cause mortality rate in the jail was lower than the rate in the general population. Speculations have been made on reasons for the lower mortality rates in correctional settings.^{8,9} Incarceration may offer a protected environment where potential deaths due to violent activities in the community, risky health behaviors, or unintended injuries may be prevented. There may also be a selection effect whereby incarceration more frequently occurs among healthy individuals than among persons who are ill within a similar age group. Our study results in part support these suppositions: most of illness related death rates, unintended injuries and homicide deaths were higher in the general population. In addition, constant monitoring and universal access to health care in the jail might have improved health outcomes for those who are sick who do not have such access in the community.

Heart disease was the most frequent cause of death, followed by cerebrovascular diseases and suicide. One possible explanation for the increased deaths associated with heart and cerebrovascular diseases has been suspected to be the overall aging of jail inmates.^{5,6} To examine the potential aging effect on high rates of heart and cerebrovascular related deaths, we examined mean and median ages of all incoming inmates, by year, over the study period, utilizing available booking information (1996–2004). There was no distinct pattern in heart related deaths by year (from 16.7% in 1995, 3.1% in 1999, 50% in 2002, and 12.5% in 2004), although the mean age of incoming inmates steadily increased by year from 30.5 (median=29.4) in 1996 to 32.4 (median=31.1) in 2004. The mean age difference was modest (1.9 years), which seems unlikely to have a significant effect on death rates over the study period. Although we did not examine direct associations, a high rate of mortality was associated with heart as well as cerebrovascular diseases among younger inmates, which may be due to the high proportion of substance abusers, especially as a result of cocaine use and the combined use of cocaine and smoking and/or alcohol. The effects of cocaine on cardiovascular health among young ethnic minorities are well studied.^{20–24} Further research will be needed to explore this association between drug use and heart related deaths.

To answer why the heart related mortality rate was high among the inmates who are not in the usual at risk groups, we reviewed in detail the heart related death records. The findings of our record review suggested that some cardiac deaths could be subclassified. Causes of death in this study relied upon the Medical Examiner's reported cause of death. At times, the suspected anatomic cause of death may obscure the etiologic basis of death. For example, we found cases of sudden death reported as heart related deaths: a blow to the chest in a young man preceded one of these sudden deaths; being restrained for 3 consecutive days preceded another sudden death. While the cause of death was reported as cardiovascular, the etiologic basis of death may have been otherwise. In another case, a sudden death ascribed to heart related death was associated with someone whose dominant medical condition was active peptic ulcer disease. Another 86-year-old man with a history of stroke, pressure sores, and bladder cancer died suddenly. In retrospect, we suspected sepsis. Although medical examiners determined these cases to be cardiac deaths largely based on the autopsy findings and their clinical judgment, there may be other etiologic causes. Existing coding schemes may not address these issues. Attention should be paid to more precise determination of the actual etiologic cause of death.

All cases of sudden death were reported as cardiovascular with or without underlying anatomic heart conditions identified at autopsy. The ICD-9 codes defines a sudden death (798.2) as "death occurring in less than 24 hours from onset of symptoms, not otherwise explained; death known not to be violent or instantaneous, for which no cause could be discovered; died without any sign of disease." In these cases, we could not be certain that these deaths were directly associated with preexisting heart conditions, but seemed to occur without immediate causes or signs of disease. Interestingly, none of those sudden deaths with heart conditions but 80% of the cases without heart conditions were reported to have a history of substance use. We realize the need for further research to sort out and subcategorize underlying issues among heart related deaths to better understand reasons for the high rate of mortality in the jail.

Mortality rates due to infectious or inflammatory illnesses were higher in the jail than in the general population. HIV was presented in 9% of deaths, making

HIV the fourth most frequent cause of death in the jail population. Overall, 16% of all deaths were HIV infected inmates. Death rates of pneumonia, septicemia, and meningitis in the jail were higher than in the general population, with 25% of these deaths also HIV infected. While HIV deaths have been declining in the US, HIV is still a major underlying cause of death in the incarcerated population. This result suggests that providing quality HIV care to known HIV patients in the jail is a higher priority. In addition, implementing a systematic HIV screening program is also important to detect and provide care at an earlier stage, since many inmates may not know their HIV status.

The majority of deaths occurred in male inmates, similar to the gender distribution of the inmate population. However, a disproportionately higher percentage of deaths due to drug overdose and withdrawal was observed among female inmates. This result coincides with the fact that over half of female deaths, compared with 28% of male deaths, were incarcerated for drug charges. Female inmates are more likely than male inmates to have history of using drugs as well as to be recent users. We speculate that women may be more vulnerable to dehydration due to drug withdrawal and overdose because of their smaller body mass than men. Although a disproportionate percentage of incarcerated individuals are substance abusers, a national survey in 2000 showed that only 34% of jails provided some form of detoxification programs.³⁴ The study finding—more than 50% of drug overdose/withdrawal occurred within the first 2 days of incarceration and over 69% within a week—indicates that establishing standards for screening and treating drug withdrawal during the intake screening, is critical in reducing potentially preventable deaths. Although it is challenging for care providers with limited resources to quickly identify and provide care for high risk individuals, simple and immediate improvements can be made, such as making drinking water available for detainees, many of whom are going through drug withdrawal and dehydration.

Suicides rates were very low in this study and compare favorably with suicide rates in jails nationwide. Intensive programming exists for suicide prevention at this facility. This study demonstrates the benefits of a suicide prevention program for jails. Blacks accounted for over 75% of illness-related deaths and homicide, but just above 50% of suicide deaths. This result was consistent with the results from previous studies in which white and Hispanic inmates were more likely to commit suicide.^{13,15,19,35} Speculation for this result is that the community notion of incarceration, and the experience of shame and the stigma of incarceration may be different among ethnic groups. It may be also that white and Hispanic inmates are more likely to have mental/psychological illnesses, since previous mental illness has been identified as a risk factor for suicide.^{19,35} Jail suicide may be a reflection of what is happening in the free world. As Tartaro and Lester³⁶ discussed, the suicide rate in correctional settings is closely associated with social integration in the society: this suggests that suicide among inmates needs to be examined within the larger societal context.

Consistent with previous study findings,^{4,9,16,17} an overwhelmingly high percentage of suicide cases in our study were incarcerated for first degree murder. This may explain the guilt and social isolation; and the potential long sentence due to a severe crime may increase hopelessness in the inmates. Additional risk factors identified from previous studies include mental illness, history of suicidal ideation or attempt, substance use, lack of social support/resources, or upcoming court date. Although in CHS, care providers collect information regarding mental status, history of attempted suicide, and other factors affecting potential risk of suicide including

homelessness, marital status, and employment during the intake screening, these critical data elements are not fully utilized, since the current intake screening is in a paper-and-pencil form. Computerizing intake screening information is crucial to overcome this common challenge of linking data from multiple sources to best serve the population.

Overall, more than 60% of deaths occurred among inmates incarcerated longer than a month. Particularly, almost 90% of deaths due to illnesses occurred after a month of stay in jail. This result highlights the importance of consistent health care for inmates with chronic conditions. Currently systematic chronic disease surveillance does not exist, and little is known about the prevalence of chronic illness in incarcerated populations. Chronic conditions of inmates need to be addressed throughout the time of incarceration to improve health outcomes among inmates.³⁷

CONCLUSIONS

Monitoring mortality rates in the jail is a useful tool to plan for quality care to meet the needs of inmates who do not have access to stable primary care in the free world. As the number of inmates with chronic illnesses increases, jail health care should be reengineered to effectively implement the key elements of the chronic care approach: systematic surveillance and monitoring of chronic disease, and continuity of care.

Gender-specific care should be designed to meet different health issues. Although the proportion of females is still small, their health needs are as urgent as those of male inmates. The majority of women in jails are single mothers of dependent children, and women's health status may greatly affect other household members.

Methodological limitations in jail mortality rates include difficulty establishing the true number of person-years, examining the underlying causes of death, and controlling for multifaceted compounding factors from the exposure. Developing computerized databases and linking multiple data sources may help better explore the causes of death in this population with complex health issues.

Despite the fact that inmates are at high risk of multiple health issues, the lower mortality rates observed when compared with the rates in the general population in various illness categories leads us to hypothesize that jail health care has a critical role of providing a safety net for these vulnerable members of our society and improving public health at large.

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REFERENCES

1. Hammett TM, Harmon MP, Rhodes W. The burden of infectious disease among inmates of and releases from US correctional facilities, 1997. *Am J Public Health*. 2002;92:1789–1794.
2. Wu ZH, Baillargeon J, Grady JJ, Black SA, Dunn K. HIV seroprevalence among newly incarcerated inmates in the Texas correctional system. *Ann Epidemiol*. 2001;11:342–346.
3. Glaser JB, Greifinger RB. Correctional health care: a public health opportunity. *Ann Intern Med*. 1993;118(2):139–145.
4. Mumola CJ. *Suicide and homicide in state prisons and local jails*. Washington, DC:

- Bureau of Justice Statistics; 2005. NCJ No. 210036. Available at: <http://www.ojp.usdoj.gov/bjs/abstract/shsplj.htm>. Accessed November 14, 2005.
5. Anno J, Graham C, Lawrence JE, Shansky R. *Correctional Health Care: Addressing the Needs of Elderly, Chronically Ill, and Terminally Ill Inmates*. Washington, DC: National Institute of Corrections; 2004. NIC Accession No. 018735.
 6. National Commission on Correctional Health Care. *The Health Status of Soon-to-be-Released Inmates: A Report to Congress, I & II*. Chicago, IL: National Commission on Correctional Health Care; 2002.
 7. Harrison P, Beck A. *Prison and Jail Inmates at Midyear 2004*. Washington, DC: Bureau of Justice Statistics; 2005. NCJ No. 208801. Available at: <http://www.ojp.usdoj.gov/bjs/abstract/pjim04.htm>. Accessed November 14, 2005.
 8. Salive ME, Smith GS, Brewer TF. Death in prison: changing mortality patterns among male prisoners in Maryland, 1979–87. *Am J Public Health*. 1990;80(12):1479–1480.
 9. Novick LF, Remmlinger E. A study of 128 deaths in New York City correctional facilities (1971–1976): Implications for prisoner health care. *Med Care*. 1978;16(9):749–756.
 10. McDonald D, Thomson NJ. Australian deaths in custody, 1980–1989. *Med J Aust*. 1993;159(9):581–585.
 11. Spinellis CD, Themeli O. Suicide in Greek prisons: 1977 to 1996. *Crisis*. 1997;18(4):152–156.
 12. Wobeser WL, Datema J, Bechard B, Ford P. Causes of death among people in custody in Ontario, 1990–1999. *Can Med Assoc J*. 2002;167(10):1109–1113.
 13. Hayes LM, Blaauw E. Prison suicide: a special issue. *Crisis*. 1996;18:146–147.
 14. Blaauw E, Kerkhof AJ, Hayes LM. Demographic, criminal, and psychiatric factors related to inmate suicide. *Suicide Life-Threat Behav*. 2005;35:63–75.
 15. Joukamaa M. Prison suicide in Finland, 1969–1992. *Forensic Sci Int*. 1997;89(3):167–174.
 16. Salive ME, Smith GS, Brewer TF. Suicide mortality in the Maryland state prison system, 1979 through 1987. *JAMA*. 1989;262:365–369.
 17. Marcus P, Alcabes P. Characteristics of suicides by inmates in an urban jail. *Hosp Community Psychiatry*. 1993;44(3):256–261.
 18. Coffey C, Veit F, Wolfe R, Cini E, Patton GC. Mortality in young offenders: retrospective cohort study. *BMJ*. 2003;327(7428):1376–1381.
 19. Way BB, Miraglia R, Sawyer DA, Beer R, Eddy J. Factors related to suicide in New York state prisons. *Int J Law Psychiatry*. 2005;28(3):207–221.
 20. Salive ME, Smith GS, Brewer TF. Death in prison: changing mortality patterns among male prisoners in Maryland, 1979–87. *Am J Public Health*. 1990;80(12):1479–1480.
 21. Centers for Disease Control and Prevention. Homicide and suicide rates — National violent death reporting system, six states, 2003. *Morb Mort Wkly Rep*. April 22, 2005;54(15):377–380.
 22. Centers for Disease Control and Prevention. Decrease in AIDS-related mortality in a state correctional system—New York, 1995–1998. *Morb Mor Wkly Rep*. January 8, 1999;47(51–52):1115–1117.
 23. Frost R, Hanzlick R. Deaths in custody. Atlanta city jail and Fulton County jail, 1974–1985. *Am J Forensic Med Pathol*. 1988;9(3):207–211.
 24. Hollander JE. Cocaine-associated myocardial infarction. *J R Soc Med*. 1996;89:443–447.
 25. Hollander JE, Vignona L, Burstein J. Predictors of underlying coronary artery disease in cocaine associated myocardial infarction: a meta-analysis of case reports. *Vet Hum Toxicol*. 1997;39:276–280.
 26. Lange RA, Hillis LD. Cardiovascular complications of cocaine use. *N Engl J Med*. 2001;345(19):351–358.
 27. Lange RA, Willard JE. The cardiovascular effects of cocaine. *Heart Dis Stroke*. 1993;2:136–141.
 28. Cook County Sheriff's Department. *Departments*. Chicago, IL: Cook County Sheriff's Department; 1999. Available at: <http://www.cookcountysheriff.org/departments.html>. Accessed November 14, 2005.

29. Isaac Ray Center. *Cermak Health Services*. Available at: http://www.isaacraycenter.com/Cermak_/cermak_.html. Accessed November 14, 2005.
30. John Howard Association. *Court Monitoring Report*. Chicago, IL: John Howard Association; 2005.
31. Rodriguez S. *Report to the Joint Commission Committee of John H. Stroger, Jr. Hospital*. Chicago, IL: Cermak Health Services; 2005.
32. Kochanek KD, Murphy SL, Anderson RN, Scott C. *Deaths: Final data for 2002*. Hyattsville, Maryland: National Center for Health Statistics; 2004. National Vital Statistics Reports. 2004;53(5).
33. The National Center for Health Statistics. *The International Classification of Diseases, Ninth Revision (ICD-9)*. Available at: ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Publications/ICD-9. Accessed June 14, 2005.
34. Substance Abuse and Mental Health Services Administration. *Substance abuse treatment in adult and juvenile correctional facilities*. Rockville, MD: SAMHSA; 2000. Drug and Alcohol Services Information System Series No. S-9. Available at: <http://oas.samhsa.gov/UFDS/CorrectionalFacilities97/index.htm>. Accessed June 16, 2006.
35. Blaauw E, Kerkhof AJ, Hayes LM. Demographic, criminal, and psychiatric factors related to inmate suicide. *Suicide Life-Threat Behav*. 2005;35(1):63–75.
36. Tartaro C, Lester D. An application of Durkheim's theory of suicide to prison suicide rates in the United States. *Death Stud*. 2005;29(5):413–422.
37. Puisis M, Appel H. Chronic disease management. In: Puisis M, ed. *Clinical Practice in Correctional Medicine*. Chicago, IL: Elsevier; 2006:66–88.