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Drug-Related Morbidity and Mortality in Maine: Lost Productivity from 2015 to 2020

Angela Daley
University of Maine, angela.daley@maine.edu

Prianka Maria Sarker
University of Maine, prianka.sarker@maine.edu

Liam Sigaud
University of Maine, liam.sigaud@maine.edu

Marcella H. Sorg
University of Maine, mhsorg@maine.edu

Jamie A. Wren
University of Maine, jamie.a.wren@maine.edu

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Cover Page Footnote

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Drug-Related Morbidity and Mortality in Maine:

Lost Productivity from 2015 to 2020

by Angela Daley, Prianka Maria Sarker, Liam Sigaud, Marcella H. Sorg, and Jamie A. Wren

Abstract

In this article, we characterize drug-related morbidity and mortality in Maine between 2015 and 2020, as well as the impact on labor market and nonmarket productivity. We find that prevalence of drug misuse and the number of drug-related deaths have increased across time, and both are lower among females vs males. Drug-related morbidity is concentrated among individuals aged 18–25, while mortality is concentrated among those aged 25–54. Lost productivity has increased across time and is lower among females vs males. In 2019, lost productivity was $271 million (annual) from morbidity and $565 million (lifetime) from mortality. These estimates reflect the lost value to Maine that occurs when individuals cannot fully contribute to the labor market or nonmarket activities. On balance, our study provides important information about the drug epidemic in Maine, which may be helpful to decision makers as they design and evaluate relevant policies and programs.

INTRODUCTION

Drug misuse and overdose deaths are a critical public health challenge in the United States. More than 70,000 Americans died from a drug-involved overdose in 2019 alone—a number that has increased four-fold since 1999. This increase was initially driven by deaths involving pharmaceutical opioids, followed by an increase in heroin involvement as of 2010. Starting in 2013, there was an increase in deaths caused by nonpharmaceutical synthetic opioids, particularly fentanyl and its analogs. Mirroring the national crisis, Maine has experienced a substantial increase in overdose deaths since 1997 (Sorg and Greenwald 2003; Sorg et al. 2016). For example, the number of overdose deaths in Maine increased by 33 percent between 2019 and 2020 (from 380 to 504 deaths), and most of these deaths were caused by opioids combined with other drugs or alcohol (Sorg 2021). The per capita overdose death rate in Maine has ranked among the highest in the nation for the last several years.[1]

Drug misuse and overdose deaths have far-reaching consequences for the individuals and their families and communities, including poor physical and mental health, reduced quality of life, lost productivity, increased accidents and crime, and higher social welfare and health care costs (US DHHS 2016). Florence et al. (2021) estimated the economic impact of these consequences to be $1,021 billion in 2017, or $3,140 per person in the United States.[2] The most recent Maine-based study was conducted by Rogers et al. (2013), before the surge in drug misuse and overdose deaths due to fentanyl, using 2010 data. According to their study, which considered both alcohol and drugs, the impact was estimated to be $1.4 billion, or $1,057 per person in Maine. A more recent study by Luo et al. (2021), which used national cost estimates and state-level case counts, estimated the impact of the opioid epidemic in Maine to be $6.8 billion in 2017. This amounts to $5,099 per Mainer, the sixth highest per capita cost in the nation. In the study by Luo et al. (2021), a large share of the cost was attributable to reduced quality of life from opioid use disorder and the value of life lost due to overdose deaths, followed by lost productivity. Lost productivity reflects the negative impact on society when individuals cannot fully contribute to the labor market and to nonmarket activities such as household work, care giving, and volunteering.

In this article, we provide a current Maine-based analysis of drug-related morbidity (ill health) and mortality. Specifically, we examine the prevalence of drug misuse, the number of drug-related deaths, and years of potential life lost, as well as the impact on market and nonmarket productivity. Our study spans the years 2015 to 2019, as well as

2020 for drug-related mortality. This period was characterized by a surge in drug misuse and overdose deaths in Maine (Sorg 2021). We present estimates across time, rather than in a single-year snapshot or aggregate of multiple years. We further differentiate by sex and age group to provide insight into the distributional effects of the drug epidemic.

Our goal with this study is to assist decision makers by characterizing the drug epidemic in Maine and measuring the impact on productivity—information that is important when targeting and evaluating interventions. It should be reiterated that, other than reduced quality of life and the value of life lost (both of which are difficult to measure), lost productivity is the largest economic cost of drug-related morbidity and mortality (Florence et al. 2021; Luo et al. 2021; Rogers et al. 2013). We recognize, however, that it co-occurs with other substantial costs, including those related to accidents and crime, social welfare programs, and health care, in addition to the far-reaching emotional toll (Verhaeghe et al. 2017).

DATA AND METHODOLOGY

In general, we use a *human capital* approach to estimate lost productivity from drug-related morbidity and mortality in Maine. This approach, which has been widely used in previous studies, measures the lost value to society that occurs when individuals cannot fully contribute to market and nonmarket activities (Goodchild et al. 2018; Verhaeghe et al. 2017). For example, individuals may be less likely to participate in the labor market, or they may be less productive due to absenteeism, problems with concentration and memory, impaired judgment, or interpersonal challenges.[3] This loss of productivity negatively affects their earnings, as well as the productivity of their employers and the economy as a whole. Of course, drug-related morbidity and mortality also affect nonmarket activities, such as household work, care giving, and volunteering. The effect on nonmarket activities should be considered when estimating the lost value to society, otherwise the analysis will not accurately reflect the contributions of children, students, retirees, and others who are less likely to be in the labor market.

Morbidity

Before estimating lost productivity from drug-related morbidity, we consider the prevalence of illicit drug use disorder (IDUD), which is defined by the National Survey on Drug Use and Health as dependence on, or misuse of, prescription psychotherapeutics, marijuana, cocaine, crack, heroin, hallucinogens, inhalants, or methamphetamine. The prevalence data span the years 2015–2016 to 2018–2019 and are given by age group (12–17, 18–25, 26+) with 95 percent confidence intervals (SAMHSA 2017a; 2018a; 2019a; 2020a). These data are not available by sex at the state level, so we calculate sex-specific prevalence using the proportion of IDUD cases in the United States that are female and male, respectively (SAMHSA 2017b; 2018b; 2019b; 2020b) and state population estimates from the US Census Bureau.[4]

Our goal with this study is to assist decision makers by characterizing the drug epidemic in Maine and measuring the impact on productivity

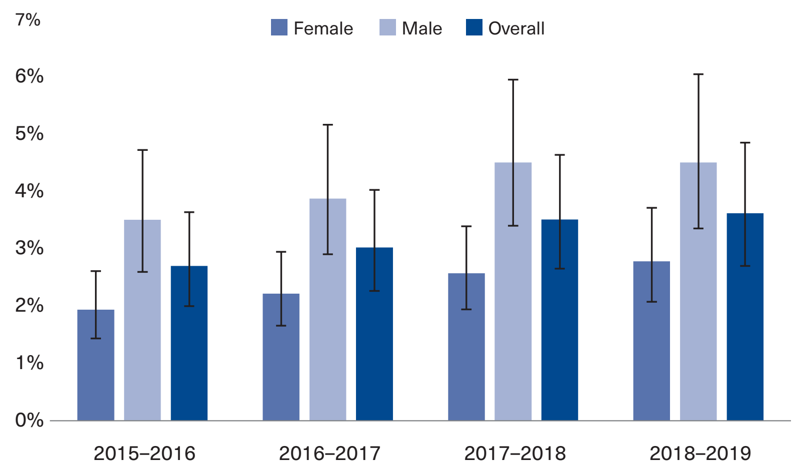
After characterizing drug-related morbidity in Maine, we estimate the economic impact using data on annual market, nonmarket, and total productivity per person in the United States, disaggregated by sex and age group (Grosse et al. 2019). Coinciding with these data, the US Department of Justice finds that drug misuse reduces productivity by 18 percent among females and 17 percent among males (NDIC 2011). Thus, similar to past studies, we use this information to calculate the annual lost productivity per person (Florence et al. 2021; McDowell Group 2020). We adjust the estimates to 2019 dollars using the annual average consumer price index (CPI-U) from the US Bureau of Labor Statistics. Also, following Rogers et al. (2013), we multiply the estimates by 0.9216 to reflect differences in median household income between Maine and the United States during our study period. Finally, to aggregate estimates to the state level, we multiply the annual lost productivity per person by the number of IDUD cases for each sex and age group. When calculating lost market productivity, we further multiply by 0.6097 to account for the fact that only 60.97 percent of the Maine population had labor market productivity during our study period.[5]

Mortality

Before estimating lost productivity from drug-related mortality, we consider the number of deaths and years of potential life lost. Our data include accidental, suicidal, and undetermined causes of death that were directly or partially attributable to drugs, as determined by the medical examiner (Sorg 2021). The data were extracted locally from the medical examiner's records, prior to analysis by the National Center for Health Statistics, which sorts vital records by state according to residency. Therefore, our data include all drug-related deaths that occurred in Maine regardless of whether they were residents. As such, the data reflect *occurrent* deaths rather than *resident* deaths. They are given by sex and age group (0–18, 19–24, 25–34, 35–44, 45–54, 55–64, 65+) from 2015 to 2020. We present the number of drug-related deaths as a crude rate per 100,000 population. Moreover, to calculate the years of potential life lost, we multiply the number of deaths in each sex and age group by the corresponding average life expectancy, weighted by the age distribution of the population.[6]

After describing drug-related mortality in Maine, we consider the economic impact using data on lifetime productivity per person in the United States, disaggregated by sex and age (Grosse et al. 2019). In the data, lifetime productivity is discounted at a rate of 3 percent per year, which is consistent with recent literature (Florence et al. 2021) and recommended in the United States (Sanders et al. 2016). However, as lower bound estimates, we also consider a version of the data in which lifetime productivity is discounted at a rate of 7 percent per year. Likewise, the data account for a productivity growth rate of 0.5 percent per year. They are also available with a 1 percent growth rate, which we consider as upper bound estimates. Similar to our morbidity estimates, we adjust all data to 2019 dollars using the annual average CPI-U, and we multiply by 0.9216 to reflect differences in median household income between Maine and the United States. Finally, to calculate lifetime lost productivity at the state level, we multiply the per person estimates by the number of drug-related deaths for each sex and age group.[7]

FIGURE 1: **Prevalence of Illicit Drug Use Disorder by Sex and Overall from 2015–2016 to 2018–2019**



Note: The bars show 95 percent confidence intervals.

RESULTS

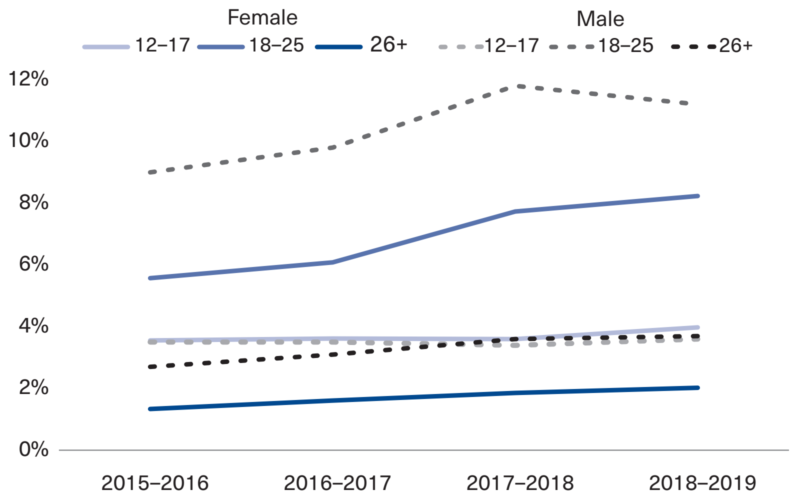
Morbidity

As can be seen in Figure 1, drug-related morbidity is consistently lower among females compared to males, although it increased across time for both.[8] In 2018–2019, the prevalence of IDUD was 2.8 percent among females and 4.5 percent among males. It was 3.6 percent overall (the 95 percent confidence interval ranges from 2.7 to 4.9 percent).

Disaggregating by age group, Figure 2 shows that drug-related morbidity is considerably higher among individuals aged 18–25, regardless of sex. We also find that upward trends in drug-related morbidity are driven by this age group. During our study period, the prevalence of IDUD increased from 5.6 to 8.2 percent among females aged 18–25, and from 9.0 to 11.2 percent among males aged 18–25. It is also interesting to note that sex differences are more pronounced in this age group, while the prevalence of IDUD is similar among females and males aged 12–17.

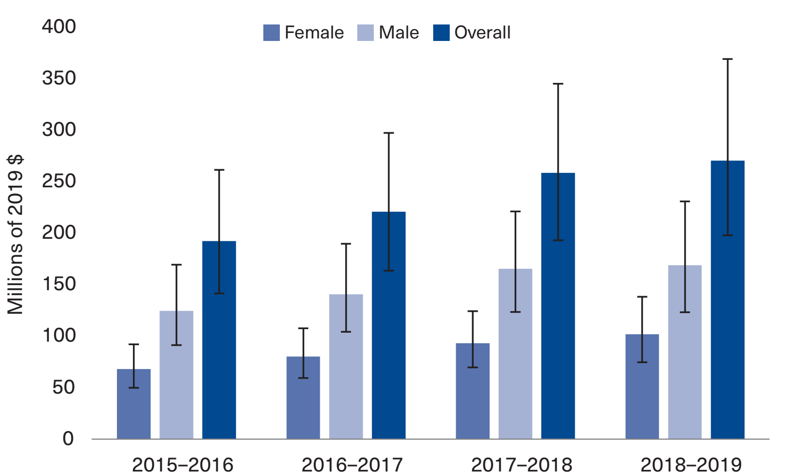
Figure 3 depicts the impact of drug-related morbidity on annual productivity, considering both market and nonmarket activities. We find that lost productivity is consistently lower among females compared to males, although it increased across time for both.[9] In 2018–2019, lost productivity was approximately $102 million among females and $169 among males. It was approximately $271

FIGURE 2: **Prevalence of Illicit Drug Use Disorder by Sex and Age Group from 2015–2016 to 2018–2019**



Note: 95 percent confidence intervals are available upon request.

FIGURE 3: **Annual Lost Productivity Due to Drug-Related Morbidity by Sex and Overall from 2015–2016 to 2018–2019**



Note: Annual lost productivity includes both market and nonmarket activities. The bars show 95 percent confidence intervals.

million overall (the 95 percent confidence interval ranges from $198 million to $369 million). This reflects the annual lost value to Maine when individuals cannot fully contribute to market and nonmarket activities due to drug-related morbidity.

In Table 1, we further differentiate between market, nonmarket, and total productivity and we provide estimates by sex and age group. In 2018–2019, lost productivity among females was approximately $40 million in market activities and $62 million in nonmarket activities. Among males, it was $105 million in market activities and $64 million in nonmarket activities. Thus, in Maine overall, annual lost productivity was $145 million in market activities (i.e., individuals with drug-related morbidity were less likely to participate in the labor market or were less productive) and $126 million in nonmarket activities, such as household work, care giving, and volunteering. We also find that lost productivity is largely attributable to individuals aged 26+. This finding is expected because, even though they have a relatively low prevalence of drug-related morbidity, these individuals are in their most productive years. Our data are not available for more granular age groups among individuals aged 26+.

Mortality

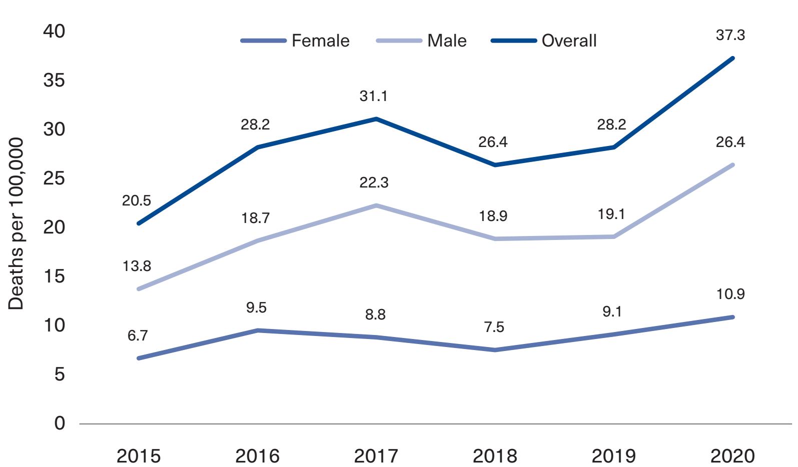
Figure 4 shows that drug-related mortality is lower among females vs males, but it follows an upward trend for both. During our study period, the number of deaths increased by 62.7 percent among females (from 6.7 to 10.9 deaths per 100,000 population) and 91.3 percent among males (from 13.8 to 26.4 deaths per 100,000 population). There was a notable decline in drug-related mortality among males in 2018 and an increase in 2020, which coincides with the COVID-19 pandemic. In 2020, drug-related mortality

TABLE 1: **Annual Lost Productivity (2019 $) Due to Drug-Related Morbidity by Sex and Age Group from 2015–2016 to 2018–2019**

	Female				Male			
	2015–2016	2016–2017	2017–2018	2018–2019	2015–2016	2016–2017	2017–2018	2018–2019
Market								
Age 12–17	1,532,359	1,544,849	1,522,661	1,676,085	1,841,669	1,825,231	1,756,336	1,881,311
Age 18–25	3,339,087	3,586,844	4,513,212	4,771,987	6,597,561	7,086,881	8,432,494	7,927,423
Age 26+	21,550,501	26,239,426	30,435,371	33,425,836	68,143,622	77,876,029	91,904,863	94,674,553
Total	26,421,947	31,371,120	36,471,244	39,873,908	76,582,853	86,788,141	102,093,693	104,483,288
Nonmarket								
Age 12–17	3,494,181	3,522,662	3,472,069	3,821,914	2,171,940	2,152,554	2,071,304	2,218,692
Age 18–25	7,613,998	8,178,950	10,291,312	10,881,387	7,780,717	8,357,789	9,944,714	9,349,067
Age 26+	30,381,861	36,992,300	42,907,735	47,123,688	38,028,526	43,459,834	51,288,826	52,834,492
Total	41,490,040	48,693,911	56,671,116	61,826,989	47,981,183	53,970,178	63,304,845	64,402,251
Total								
Age 12–17	5,026,540	5,067,511	4,994,730	5,497,999	4,013,610	3,977,785	3,827,641	4,100,003
Age 18–25	10,953,085	11,765,794	14,804,524	15,653,374	14,378,278	15,444,671	18,377,208	17,276,490
Age 26+	51,932,362	63,231,726	73,343,106	80,549,524	106,172,148	121,335,863	143,193,689	147,509,045
Total	67,911,987	80,065,031	93,142,360	101,700,897	124,564,036	140,758,319	165,398,538	168,885,538

Note: 95 percent confidence intervals are available upon request.

FIGURE 4: **Number of Drug-Related Deaths per 100,000 Population by Sex and Overall from 2015 to 2020**



in Maine was 37.3 deaths per 100,000 population.

In Figure 5, we further differentiate by age group. We find that drug-related deaths are concentrated among individuals aged 25–64 vs individuals aged 0–24 or 65+.

Figure 6 shows that females lost fewer years of potential life from drug-related deaths than males did. Moreover, there was a notable decline in 2018, especially for males, followed by an increase during the COVID-19 pandemic. In 2020, there were 18,634 years of potential life lost from drug-related deaths in Maine (5,535 among females and 13,099 among males). These years of potential life lost were concentrated among individuals aged 25–54, who represent a large share of drug-related deaths and would otherwise have considerable life expectancy.

FIGURE 5: **Age Distribution of Drug-Related Deaths per 100,000 Population by Sex from 2015 to 2020**

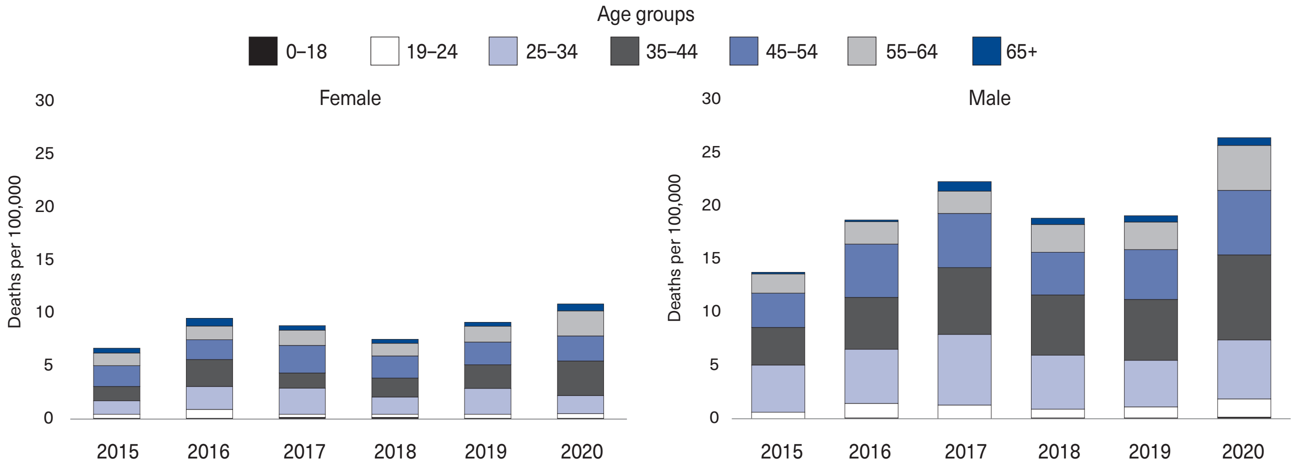


FIGURE 6: **Years of Potential Life Lost from Drug-Related Deaths by Age Group and Sex from 2015 to 2020**

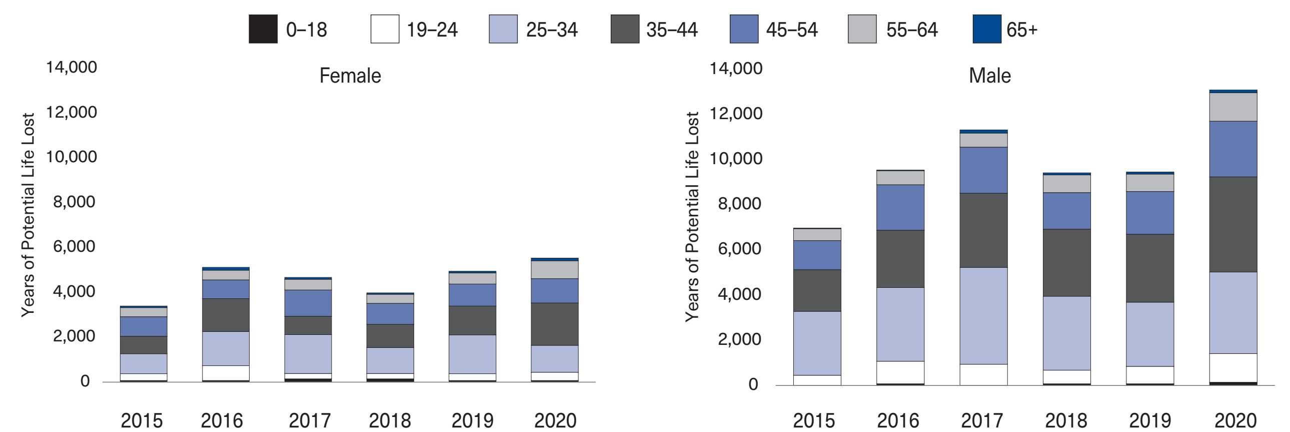


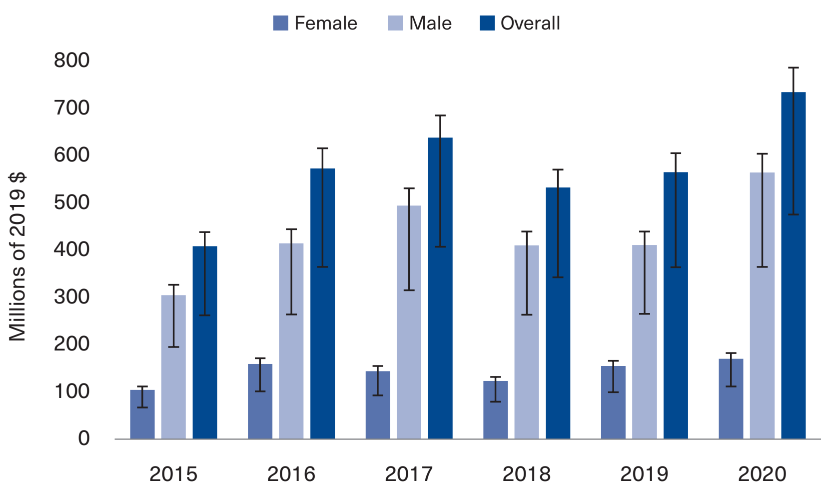
Figure 7 depicts the impact of drug-related mortality on market and nonmarket productivity. We find that lost productivity is considerably lower among females vs males in all years. In Maine overall, lost productivity has increased across time, except in 2018, which corresponds to the reduction in drug-related mortality among males. In 2020, lifetime lost productivity was approximately $734 million; by varying the discount and growth rates, the lower and upper bounds are $475 million and $786 million, respectively. These estimates represent the lost value to Maine in terms of market and nonmarket activities, not just in 2020, but over what would have been the remaining lifetimes of those who died that year.

As can be seen in Table 2, lifetime lost productivity in Maine is largely attributable to individuals aged 25–54. For example, they accounted for more than 80 percent of lost productivity in 2020 ($605 million of $734 million). This is due to the age distribution of drug-related deaths (Figure 5) and because they are individuals in their most productive years.

CONCLUSION

In this article, we provide an up-to-date analysis of drug-related morbidity and mortality in Maine, along with the impact on productivity. Our study covers the

FIGURE 7: **Lifetime Lost Productivity Due to Drug-Related Mortality by Sex and Overall from 2015 to 2020**



Note: Lifetime lost productivity includes both market and nonmarket activities. Productivity data from Grosse et al. (2019) are based on a 3 percent discount rate and 0.5 percent growth rate. In this figure, the bars show how the results change when these parameters are varied. The lower bound estimates are based on a 7 percent discount rate and 0.5 percent growth rate. The upper bound estimates are based on a 3 percent discount rate and 1 percent growth rate.

period from 2015 to 2020, when there was a surge in drug misuse and overdose deaths (Sorg 2021). Indeed, we find that prevalence of illicit drug use has increased over time, and it was consistently lower among females compared to males. The number of drug-related deaths followed a similar pattern, except there was a reduction among males in 2018, followed by a large increase in 2020, the first year of the COVID-19 pandemic. It is also interesting that the increase in drug-related morbidity is driven by individuals aged 18–25, while the increase in mortality is driven by those aged 25–54.

In terms of economic impact, we find that lost productivity from drug-related morbidity and mortality has increased across time for both females and males, and it was consistently lower among females. In 2019, lost productivity was $271 million (annual) from morbidity and $565 million (lifetime) from mortality, reflecting the lost value to Maine as individuals could not fully contribute to the labor market and nonmarket activities. This total of $836 million is considerably higher than lost productivity in 2010 and 2017 (Rogers et al. 2013; Luo et al. 2021). However, we urge caution when comparing these estimates because data and methodology have evolved since Rogers et al., and Luo et al. focus exclusively on opioids. We also remind readers that our study emphasizes lost productivity; we do not consider other relevant costs, such as reduced quality of life or the value of life lost due to overdose deaths. Considering a wide array of costs, Luo et al. find that the impact of the opioid epidemic in Maine was approximately $6.8 billion in 2017. So, our lost productivity estimates are just a fraction of the overall impact.

Several limitations should be noted. First, we do not have data on the prevalence of IDUD in 2019–2020. Moreover, by focusing on prevalence in a given period, we do not capture the impact of drug-related morbidity over an individual's lifetime, although we recognize that lost productivity may begin to accumulate before diagnosis and perpetuate after recovery. Finally, we do not consider the impact of drug-related incarceration on productivity, nor do we consider lost productivity among individuals who care for those who misuse drugs (Reinhart et al. 2018).

As we stated earlier, our goal is to assist decision makers by characterizing drug-related morbidity and mortality in Maine, and the impact on productivity, to help policymakers target and evaluate relevant policies and programs. Future work should incorporate other costs (e.g., reduced quality of life, the value of life lost, accidents and crime, social welfare programs, health care) and continue to consider differences by sex and age. Future work should also track drug-related morbidity and mortality, as well as the economic impact, in a comparable way across time. This is necessary to monitor the evolution of the drug epidemic in Maine and to evaluate policies and programs that are intended to address it.

TABLE 2: **Lifetime Lost Productivity (2019 $) Due to Drug-Related Mortality by Sex and Overall from 2015 to 2020**

	2015	2016	2017	2018	2019	2020
Female						
Age 0–18	1,396,479	1,396,479	2,792,957	2,792,957	1,396,479	1,396,479
Age 19–24	8,911,435	19,605,157	7,129,148	7,129,148	8,911,435	10,693,722
Age 25–34	29,897,032	51,000,820	58,035,416	38,690,277	58,035,416	40,448,926
Age 35–44	25,997,881	49,107,109	27,442,208	34,663,842	43,329,802	63,550,377
Age 45–54	26,463,558	25,445,729	35,624,020	28,499,216	29,517,045	32,570,533
Age 55–64	9,787,669	10,399,398	11,622,856	9,787,669	12,234,586	19,575,337
Age 65+	1,231,393	2,052,322	1,231,393	1,026,161	1,026,161	1,847,090
Total	103,685,447	159,007,014	143,877,999	122,589,270	154,450,924	170,082,464
Male						
Age 0–18	0	1,584,637	0	1,584,637	1,584,637	3,169,274
Age 19–24	16,451,634	37,016,177	34,959,723	22,620,997	28,790,360	47,298,449
Age 25–34	126,006,176	145,227,457	190,077,112	145,227,457	126,006,176	160,177,342
Age 35–44	87,521,539	121,040,426	156,421,474	141,524,191	143,386,351	201,113,324
Age 45–54	56,313,585	87,744,424	89,054,042	70,719,386	82,505,951	107,388,698
Age 55–64	17,923,664	20,910,941	20,910,941	26,138,677	26,138,677	42,568,702
Age 65+	486,929	486,929	2,921,571	1,947,714	1,947,714	2,434,643
Total	304,703,527	414,010,991	494,344,864	409,763,059	410,359,865	564,150,431
Overall						
Age 0–18	1,396,479	2,981,116	2,792,957	4,377,594	2,981,116	4,565,753
Age 19–24	25,363,069	56,621,335	42,088,871	29,750,145	37,701,795	57,992,171
Age 25–34	155,903,208	196,228,277	248,112,528	183,917,734	184,041,592	200,626,268
Age 35–44	113,519,420	170,147,535	183,863,682	176,188,032	186,716,153	264,663,700
Age 45–54	82,777,143	113,190,153	124,678,062	99,218,603	112,022,996	139,959,231
Age 55–64	27,711,333	31,310,339	32,533,798	35,926,345	38,373,262	62,144,039
Age 65+	1,718,322	2,539,251	4,152,965	2,973,875	2,973,875	4,281,733
Total	408,388,974	573,018,005	638,222,863	532,352,329	564,810,789	734,232,894

Note: Lifetime lost productivity includes both of market and nonmarket activities. Productivity data from Grosse et al. (2019) are based on a 3 percent discount rate and 0.5 percent growth rate. Lower and upper bounds of the estimates presented in this table are available upon request. The lower bound estimates are based on a 7 percent discount rate and 0.5 percent growth rate. The upper bound estimates are based on a 3 percent discount rate and 1 percent growth rate.

ACKNOWLEDGMENTS

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NOTES

1 Drug overdose numbers are from the following Centers for Disease Control and Prevention websites: https://www.cdc.gov/opioids/basics/epidemic.html and https://www.cdc.gov/nchs/pressroom/sosmap/drug_poisoning_mortality/drug_poisoning.htm.

2 Population estimates used throughout this article come from the following US Census Bureau table: "Annual Estimates of the Resident Population for the United States, Regions, States, the District of Columbia, and Puerto Rico: April 1, 2010 to July 1, 2019; April 1, 2020; and July 1, 2020 (NST-EST2020)." https://www.census.gov/programs-surveys/popest/technical-documentation/research/evaluation-estimates/2020-evaluation-estimates/2010s-state-total.html.

3 This information comes from the Canadian Centre for Occupational Health and Safety: https://www.ccohs.ca/oshanswers/psychosocial/substance.html.

4 We calculate sex-specific prevalence of IDUD as follows:

Female prevalence of IDUD = [(Number of IDUD cases * Proportion of cases that are female)/Female population] * 100

Male prevalence of IDUD = [(Number of IDUD cases * Proportion of cases that are male)/Male population] * 100

5 Prevalence of IDUD is given for individuals aged 12–17, 18–25 and 26+. However, productivity data from Grosse et al. (2019) are given for those aged 15–24, 25–34, 35–44, 45–54, 55–64, 65–74 and 75–99. Thus, when studying individuals aged 12–17 and 18–25, we use the productivity of those aged 15–24. Likewise, when studying individuals aged 26+, we use the average productivity of those aged 25–34, 35–44, 45–54, 55–64, 65–74, and 75–99, weighted by the age distribution of the population.

To calculate annual lost productivity per person, we multiplied the annual productivity per female by 0.18 and the annual productivity per male by 0.17. Then, to calculate annual lost productivity for each sex and age group, we multiplied the annual lost productivity per person by the number of IDUD cases.

The CPI-U is available here: https://beta.bls.gov/dataViewer/view/timeseries/CUUR0000SA0.

The difference in median household income comes from the US Census Bureau: https://www.census.gov/quickfacts/fact/table/US,ME/INC110219.

The employment-to-population ratio was taken from the US Bureau of Labor Statistics: https://data.bls.gov/timeseries/LASST230000000000006.

6 We calculate the number of drug-related deaths as a crude rate per 100,000 population as follows:

Number of deaths per 100,000 population = (Number of deaths/Population) * 100,000

To calculate the years of potential life lost for each sex and age group, we multiplied the number of deaths by the corresponding average life expectancy, weighted by the age distribution of the population. Information about life expectancy comes from the 2017 Actuarial Life Table: https://www.ssa.gov/OACT/STATS/table4c6.html.

7 Grosse et al. (2019) provide data on lifetime productivity per person by sex and age. We use the sex-specific average for each age group, weighted by the age distribution of the population.

Discount rates are used to convert future economic value into present terms. For example, a discount rate of 3 percent per year implies that $1.03 a year from now equals $1.00 today.

To calculate lifetime lost productivity for each sex and age group, we multiplied lifetime productivity per person by the number of deaths.

8 The 95 percent confidence intervals overlap for females and males in all years except 2017–2018. They also overlap across time for females and males, respectively. Based on this information, we cannot infer whether differences are statistically significant, although it remains a possibility (Austin and Hux 2002). SAMHSA only reports means and confidence intervals.

9 Recall that annual lost productivity is a function of the number of IDUD cases (Endnote 5). Thus, the 95 percent confidence intervals on annual lost productivity merely reflect those reported in the SAMHSA prevalence data. Again, the 95 percent confidence intervals overlap for females and males in all years, and across time. It cannot be inferred whether differences are statistically significant, although it remains a possibility (Austin and Hux 2002).

REFERENCES

Austin, Peter C., and Janet E. Hux. 2002. "A Brief Note on Overlapping Confidence Intervals." *Journal of Vascular Surgery* 36(1): 194–195. https://doi.org/10.1067/mva.2002.125015.

Bouchery, Ellen E., Henrick J. Harwood, Jeffrey J. Sacks, Carol J. Simon, and Robert D. Brewer. 2011. "Economic Costs of Excessive Alcohol Consumption in the U.S., 2006." *American Journal of Preventive Medicine* 41(5):516-524. https://doi.org/10.1016/j.amepre.2011.06.045.

Florence, Curtis, Feijun Luo, and Ketra Rice. 2021. "The Economic Burden of Opioid Use Disorder and Fatal Opioid Overdose in the United States, 2017." *Drug and Alcohol Dependence* 218:108350. https://doi.org/10.1016/j.drugalcdep.2020.108350.

Goodchild, Mark, Nigar Nargis, and Edouard Tursan d'Espaignet. 2018. "Global Economic Cost of Smoking-Attributable

Diseases." *Tobacco Control* 27:58–64. https://doi.org/10.1136/tobaccocontrol-2016-053305.

Grosse, Scott D., Kurt V. Krueger, and Jamison Pike. 2019. "Estimated Annual and Lifetime Labor Productivity in the United States, 2016: Implications for Economic Evaluations." *Journal of Medical Economics* 22(6): 501–508. https://doi.org/10.1080/13696998.2018.1542520.

Luo, Feijun, Mengyao Li, and Curtis Florence. 2021. "State-Level Economic Costs of Opioid Use Disorder and Fatal Opioid Overdose–United States, 2017." M*orbidity and Mortality Weekly Report* 70(15): 541–546. https://www.cdc.gov/mmwr/volumes/70/wr/mm7015a1.htm.

McDowell Group. 2020. *The Economic Costs of Drug Misuse in Alaska, 2019 Update.* Anchorage: Alaska Mental Health Trust Authority. https://alaskamentalhealthtrust.org/alaska-mental-health-trust-authority/resources/.

NDIC (National Drug Intelligence Center) 2011. *The Economic Impact of Illicit Drug Use on American Society.* Washington DC: US Department of Justice. https://www.justice.gov/archive/ndic/index.htm.

Reinhart, Marcia, Lauren M. Scarpati, Noam Y. Kirson, Cody Patton, Nina Shak, and Jennifer G. Erensen. 2018. "The Economic Burden of Abuse of Prescription Opioids: A Systematic Literature Review from 2012 to 2017." *Applied Health Economics and Health Policy* 16:609–632. https://doi.org/10.1007/s40258-018-0402-x.

Rogers, Anne L., Marcella H. Sorg, and Jamie A. Wren. 2013. *The Cost of Alcohol and Drug Abuse in Maine, 2010.* Report prepared for the Maine Office of Substance Abuse and Mental Health, Department of Health and Human Services. https://digitalcommons.library.umaine.edu/ant_facpub/21.

SAMHSA (Substance Abuse and Mental Health Services Administration). 2017a. *2015–2016 National Survey on Drug Use and Health: Model-Based Prevalence Estimates (50 States and the District of Columbia).* Rockville, MD: SAMHSA. https://www.samhsa.gov/data/report/2015-2016-nsduh-state-prevalence-estimates-pdf-tables-printing.

SAMHSA (Substance Abuse and Mental Health Services Administration). 2017b. *Results from the 2016 National Survey on Drug Use and Health: Detailed Tables*. Rockville, MD: SAMHSA. https://www.samhsa.gov/data/report/results-2016-national-survey-drug-use-and-health-detailed-tables.

SAMHSA (Substance Abuse and Mental Health Services Administration). 2018a. *2016–2017 National Survey on Drug Use and Health: Model-Based Prevalence Estimates (50 States and the District of Columbia).* Rockville, MD: SAMHSA. https://www.samhsa.gov/data/report/2016-2017-nsduh-state-prevalence-estimates.

SAMHSA (Substance Abuse and Mental Health Services Administration). 2018b. *Results from the 2017 National Survey on Drug Use and Health: Detailed Tables.* Rockville, MD: SAMHSA. https://www.samhsa.gov/data/report/2017-nsduh-detailed-tables.

SAMHSA (Substance Abuse and Mental Health Services Administration). 2019a. *2017–2018 National Survey on Drug Use and Health: Model-Based Prevalence Estimates (50 States and the District of Columbia).* Rockville, MD: SAMHSA. https://www.samhsa.gov/data/report/2017-2018-nsduh-state-prevalence-estimates.

SAMHSA (Substance Abuse and Mental Health Services Administration). 2019b. *Results from the 2018 National Survey on Drug Use and Health: Detailed Tables.* Rockville, MD: SAMHSA. https://www.samhsa.gov/data/report/2018-nsduh-detailed-tables.

SAMHSA (Substance Abuse and Mental Health Services Administration). 2020a. *2018–2019 National Survey on Drug Use and Health: Model-Based Prevalence Estimates (50 States and the District of Columbia).* Rockville, MD: SAMHSA. https://www.samhsa.gov/data/report/2018-2019-nsduh-state-prevalence-estimates.

SAMHSA (Substance Abuse and Mental Health Services Administration). 2020b. *Results from the 2019 National Survey on Drug Use and Health: Detailed Tables.* Rockville, MD: SAMHSA. https://www.samhsa.gov/data/report/2019-nsduh-detailed-tables.

Sanders, Gillian D., Peter J. Neumann, Anirban Basu, Dan W. Brock, David Feeny, Murray Krahn, Karen M. Kuntz, et al. 2016. "Recommendations for Conduct, Methodological Practices, and Reporting of Cost-effectiveness Analyses: Second Panel on Cost-Effectiveness in Health and Medicine." *Journal of the American Medical Association* 316(10): 1093–1103. https://doi.org/10.1001/jama.2016.12195.

Sorg, Marcella H. 2021. *Maine Drug Death Report for 2020.* Orono: Margaret Chase Smith Policy Center. https://digitalcommons.library.umaine.edu/mcspc_healthsafety/16/.

Sorg, Marcella H., and Margaret Greenwald. 2003. "Patterns of Drug-Related Mortality in Maine, 1997–2002." *Maine Policy Review* 12(1): 84–95. https://digitalcommons.library.umaine.edu/mpr/vol12/iss1/9.

Sorg, Marcella H., Margaret Greenwald, and Jamie A. Wren. 2016. "Patterns of Drug-Induced Mortality in Maine, 2015 Update." *Maine Policy Review* 25(1):34–46. https://digitalcommons.library.umaine.edu/mpr/vol25/iss1/8.

US DHHS (Department of Health and Human Services, Office of the Surgeon General). 2016. *Facing Addiction in America: The Surgeon General's Report on Alcohol, Drugs, and Health.* Washington, DC: US DHHS. https://addiction.surgeongeneral.gov/

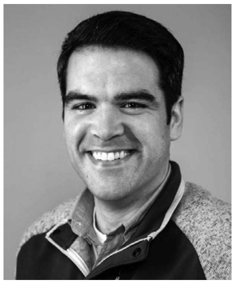
Verhaeghe, Nick, Delfine Lievens, Lieven Annemans, Freya Vander Laenen, and Koen Putman. 2017. "Methodological Considerations in Social Cost Studies of Addictive Substances: A Systematic Literature Review." *Frontiers in Public Health* 4:295. https://doi.org/10.3389/fpubh.2016.00295.

Angela Daley is an assistant professor in the School of Economics at the University of Maine. She is an applied microeconomist who studies the relationship between economic well-being and health, as well as the role of policy in mitigating disparities. She focuses on vulnerable populations, including rural and Arctic communities, racial/ethnic minority groups, and those who are economically insecure.

Prianka Maria Sarker is a graduate student and research assistant in the School of Economics at the University of Maine. She is interested in applied microeconomic research, with an emphasis on health economics and policy analysis. Her current work focuses on the impact of public policy on food insecurity, as well as gender and racial/ethnic disparities in the impact of tobacco control policy.

Liam Sigaud is a research assistant at the Mercatus Center, a not-for-profit academic institute in Arlington, Virginia. This study was conducted while he was a graduate student and research assistant at the University of Maine, from which Liam holds a master's degree in economics. His research focuses on applied microeconomics and the impact of public policy on labor markets and health.

Marcella H. Sorg is a medical and forensic anthropologist specializing in health policy, particularly as it concerns public health, public safety, and the investigation of death and injury. She directs the Rural Drug and Alcohol Research Program at the University of Maine's Margaret Chase Smith Policy Center, which monitors epidemiological indicators of substance use, particularly drug-related deaths.



Jamie A. Wren is a research associate at the Margaret Chase Smith Policy Center, where he oversees data on drug-related and violence-related deaths in Maine. His research interests include suicidality in rural areas, opioid-related mortality, skeletal impacts of substance use, and forensic death investigation.