

Tracking Trends in the Opioid Epidemic in North Carolina: Early Results from the Opioid Action Plan Metrics

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BACKGROUND Deaths from unintentional opioid overdose have increased markedly over the last decade in North Carolina. In 2017 the state created a North Carolina Opioid Action Plan, which laid out a multisectoral response to the crisis that included the medical community, law enforcement, emergency medical services, and treatment professionals. It also created a website providing county-level data associated with the crisis. Using this publicly available data, we examine trends and associations between opioid-related mortality and strategies to reduce opioid prescriptions, reduce fatality of overdose, and improve treatment and recovery.

METHOD We examine yearly trends from 2010-2017 for statewide unintentional opioid-related death rates, prescription of opioid pills, buprenorphine prescription rates, naloxone administrations, and number of Certified Peer Support Specialists. We compare recent opioid-related death rates for 2015-2017 with an earlier period (2010-2012) at the county level, and examine the association between death rates and rates of the supply, treatment, and recovery metrics.

RESULTS Trends for all metrics increased from 2010-2017, although the number of opioid pills per capita has declined since 2015. Between 2010 and 2017, 84 of the state's 100 counties experienced an increase in opioid-related mortality. County-level mortality was positively associated with opioid prescription rate ($r = +0.12$, $P = 0.24$) and with naloxone administrations ($r = +0.20$, $P = 0.05$). Prescription of buprenorphine was associated with a reduction in opioid mortality ($r = -0.27$, $P = 0.01$). The effect of Certified Peer Support Specialists was not discernable.

LIMITATIONS: Data are available for only eight years and aggregated at the county level. Mortality data are based on death certificates using ICD-10 codes from the North Carolina State Center for Health Statistics, Vital Statistics, which may not capture all opioid-related fatalities. Drug-related deaths may involve multiple non-opioid substances; in addition, determining the intent of the deceased individual may be difficult (suicide versus unintentional). Naloxone administration data only includes data from emergency medical services, not community-administered naloxone, because that data was only available for 2013 and later and is based only on self-reports.

CONCLUSIONS The potential efficacy of buprenorphine is promising and should be further explored. All interventions should be monitored.

From 1999 to 2017, there were more than 13,000 unintentional opioid-related overdose deaths in North Carolina. In 2017, 1,884 people died from opioid-related causes, a 10-fold increase over 1999.

If the current trend continues, by 2021 the state could expect as many as 2,400 deaths per year [1]. In response to this epidemic, the North Carolina legislature established an Opioid and Prescription Drug Abuse Advisory Committee in 2015, which created a North Carolina Opioid Action Plan in 2017 [2]. The Action Plan laid out a broad response to the crisis that included participation from the medical community, law enforcement, emergency medical services, and drug use treatment professionals. The overarching goal for the plan was to reduce the upward trend in unintentional opioid-related deaths in the state. The goal is to reduce the 2,400 projected deaths in 2021 by 20%, which could mean 480 fewer deaths per year [1]. The plan also proposed ongoing public health surveillance to monitor key metrics associated with the crisis, including direct outcomes (opioid-related deaths, emergency department visits, and opioid pills dispensed), ancillary outcomes (number of hepatitis C cases), and treatment and recovery outcomes (individuals served by treatment programs and medication assisted

treatment [MAT]). Under the plan, each metric is assessed quarterly, and the results are publicly available on an Opioid Dashboard section of the North Carolina Department of Health and Human Services web page (<https://injuryfrec.shinyapps.io/OpioidActionPlan/>) [1]. The data dashboard and resource website allow users to track trends and monitor progress on the Opioid Action Plan's metrics. In this paper, we provide an early report of the data available on the Opioid Action Plan website, and examine its utility for tracking the opioid epidemic in North Carolina.

Unintentional opioid-related overdose deaths in North Carolina have risen steadily since 1999 [3]. County-level overdose rates vary across the state, with the highest rates in the far west and the southern coastal counties [4]. The prescription opioid related death rate for North Carolina counties is strongly correlated with the number of pre-

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scriptions dispensed per population [4]. One recent North Carolina study found an inverse relationship between heroin deaths and the proportion of a county that is rural [5], but several national studies have shown that overall opioid use is more common and death rates are higher in rural areas [6, 7]. Research on urban-rural differences in opioid-related deaths shows different results depending on the drug and the method of analysis [8, 9]. Research on opioid-related deaths is also complicated by the multiple drug types and combinations of drugs involved, including prescription opioid analgesics, methadone, heroin, and fentanyl. Overdose deaths may involve one drug or several in combination, as well as alcohol and other substances, and research shows that each drug variant may have distinct use patterns [5]. In general, national research has shown that opioid abuse rates and opioid-related death rates are higher for whites than nonwhites, and higher for men than women, although that can vary depending on the particular drug or drug combination [8].

In North Carolina, the opioid epidemic is statewide, but opioid-related death rates are higher in some counties and for some groups. In order to successfully address the epidemic, broad coordination is required between health care providers, law enforcement, public health, and drug treatment professionals. Many states, like North Carolina, have implemented state-level plans to enhance coordination across sectors [10, 11, 12, 13]. Some states have also implemented public health surveillance plans, as well as public-facing web sites to track progress and share resources with stakeholders affected by the crisis. For North Carolina, good health surveillance data make it possible to monitor progress in specific regions of the state and for particular segments of the epidemic. County-level outcome data on the state's website include opioid-related deaths and opioid-related hospital emergency department visits [1]. Supply data include the number of opioid pills dispensed. Data related to treatment and interventions include the number of Emergency Medical Services (EMS) administrations of naloxone (a drug that can reverse the mortal effect of an overdose), the number of buprenorphine prescriptions dispensed to treat addiction, and the number of Certified Peer Support Specialists by county [1]. The website contains historical county-level data as well as current data. The availability of historical data means it is possible to look for patterns from the past and to compare outcomes between counties. Identification of trends over time and across counties in the state can provide useful information for understanding how the current crisis has unfolded, and what actions to date may have yielded positive results for some counties.

In this paper we track trends and patterns thus far in the opioid epidemic in North Carolina using the publicly available data from the North Carolina Opioid Data Dashboard and Opioid Action Plan website. We examine yearly trends from 2010-2017 for statewide unintentional opioid-related death rates, prescription opioid pills per capita, and buprenorphine

prescriptions per population. We compare early (2010-2012) and late (2015-2017) period death rates at the county level. We also examine the association between county-level opioid-related death rates and county rates of prescription opioid pills, rates of EMS naloxone administrations, rates of buprenorphine prescriptions, and rates of Certified Peer Support Specialists. This study intends to demonstrate how the data may be used to track progress and document the effectiveness of treatments and policy solutions aimed at ameliorating the crisis. Public health surveillance tools are important steps toward developing a knowledge base for guiding and evaluating health policy, particularly for complex conditions such as the opioid crisis that straddle multiple social and policy arenas.

Methods

Data for this study were obtained from the North Carolina Department of Health and Human Services Opioid Data Dashboard [1]. We downloaded a data file directly from the online dashboard containing data by county by quarter for the years 1999-2018. Not all metrics are available for all years. For most metrics, the earliest year for which data are available is 2010. Some data for recent years are provisional, and data are not available for some counties or are suppressed. For this analysis, we used data for 2010-2017 for the number of opioid-related deaths, the number of prescription opioid pills dispensed, the number of buprenorphine prescriptions dispensed, the number of EMS naloxone administrations, and the number of Certified Peer Support Specialists (data were downloaded on September 14, 2018. Updates to provisional data may have been made since then).

The Opioid Data Dashboard compiles data from a number of state sources [14]. Data on opioid-related deaths comes from the North Carolina State Center for Health Statistics, Vital Statistics, so they are derived from death certificate data. Deaths listed as unintentional opioid poisonings are those deaths with a primary cause of death listed as ICD-10 codes X40-X44 along with any mention of opium, heroin, methadone, or a synthetic opioid. Data only include deaths of North Carolina residents, and are based on the county residence in North Carolina, not necessarily the county where the death occurred. Data for the number of prescription opioid pills and the number of buprenorphine prescriptions are derived from the North Carolina Controlled Substance Reporting System (NC CSRS) and based on the patient's county of residence. Data are entered into the NC CSRS at the pharmacy level within 72 hours (or sooner) of a controlled substance being dispensed [15]. Data on EMS naloxone administrations are from the North Carolina Office of Emergency Medical Services Performance Improvement Center dataset, and reflect incidents where EMS first responders administered naloxone for suspected cases of overdose. The incidents are attributed to the county where the naloxone administration occurred, not necessar-

ily the patient’s county of residence. Data on Certified Peer Support Specialists are from the North Carolina Certified Peer Support Specialist Program. Peer Support Specialists in North Carolina are required to be certified through the program. Additional information on data sources is available in a technical notes section on the NC DHHS Opioid Action Plan web site [14].

For our analysis, the quarterly data for each metric were converted to create an annual estimate. For Certified Peer Support Specialists, the quarterly data were averaged to produce an annual estimate. For other metrics, quarterly data were summed to produce an annual number. Then each data metric was converted into an annual rate for a county. Thus, our variables were the number of unintentional opioid-related deaths per 100,000 population in a county (“opioid-related death rate”); the number of opioid pills dispensed per capita (“opioid pills rate”); the number of EMS naloxone administrations per 10,000 population (“EMS naloxone rate”); the number of buprenorphine prescriptions dispensed per 10,000 population (“buprenorphine rate”); and the number of Certified Peer Support Specialists per 10,000 population (“peer support specialist rate”). The number of pills dispensed per capita is a measure of the oversupply of opioids; the latter three variables are measures of harm reduction, treatment, and recovery.

First, we calculated the annual rates and plotted the overall trend in the state-level opioid-related death rate from

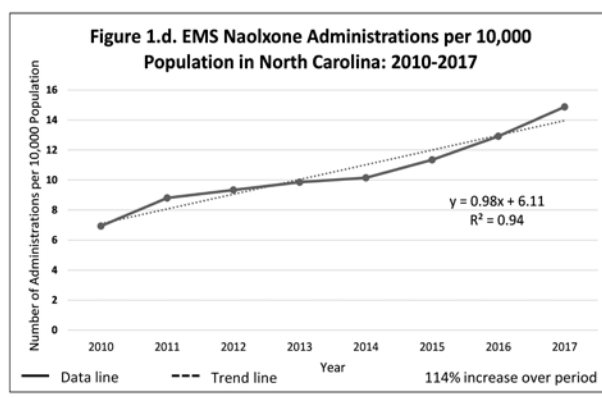
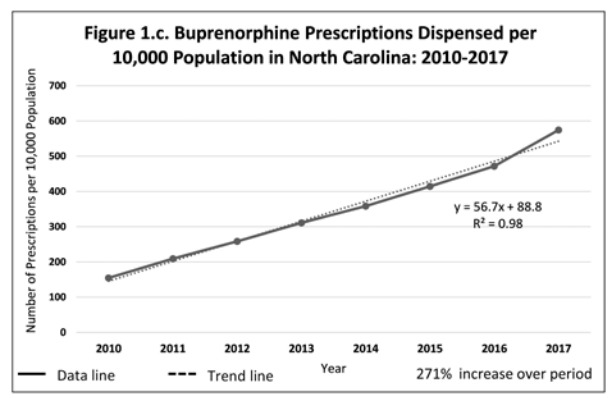
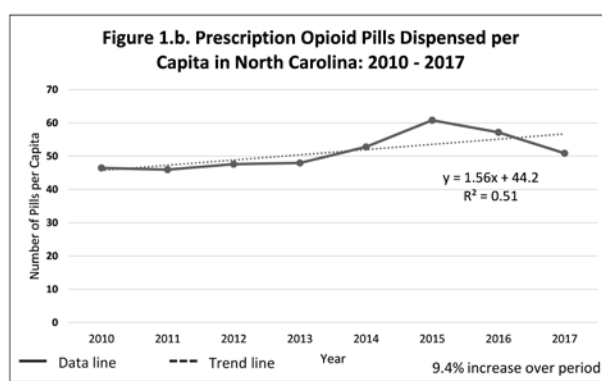
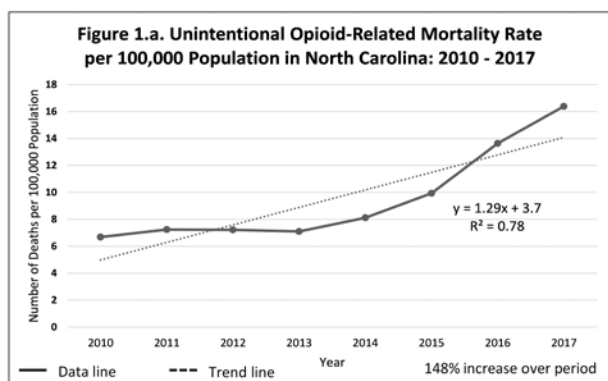
2010-2017, as well as for variables hypothesized to affect opioid deaths: opioid pills rate, buprenorphine rate, EMS naloxone rate, and Peer Support Specialists rate. We assessed the trend over time by running simple linear regressions using the year (i.e., 2010, 2011, through 2017) as the independent variable to assess the trend lines. Second, we calculated a three-year rate (to ensure a sufficient sample size to generate a valid estimate) for each of the variables for 2010-2012 (an early period) and for 2015-2017 (a late period); we examined the number of counties that experienced an increase, decrease, or no change in these five variables from the early period to the late period. We then mapped the variables to reveal county and regional patterns. Finally, we examined the bivariate associations (Pearson product moment correlations) of the changes in each of the four variables with the changes in the opioid-related death rate (change equals the later period value minus the early period value). All analyses were conducted using Stata 13 (College Station, TX: StataCorp LP).

Results

Trends of Opioid-related Death Rate, Opioid Pills Rate, Buprenorphine Rate, EMS Naloxone Rate, and Peer Support Specialist Rate, 2010-2017

The one-year North Carolina statewide opioid-related death rate for 2010 was 6.6 deaths per 100,000; by 2017 the rate was 16.4 deaths per 100,000, an increase of 148%

FIGURE 1.
Opioid-related Death Rates, Intervention and Treatment Trends for North Carolina: 2010-2017



over the eight-year period (trend $P = .003$) (Figure 1a). During this period, the number of prescription opioid pills dispensed statewide increased from 46 per capita in 2010 to 51 per capita in 2017, a 9.4% increase (trend $P = 0.047$) (Figure 1b). While the overall trend for opioid pills dispensed is increasing, there has been a decrease in the most recent three years—the peak was in 2015, with 60 pills per capita, and from there it has come down. The rate of buprenorphine prescriptions per population has increased from 154 per 10,000 population in 2010 to 574 in 2017, a 271% increase (trend $P < 0.001$) (Figure 1c). EMS naloxone administrations increased from 6.9 per 10,000 population to 14.8, a 114% increase (trend $P < 0.001$) (Figure 1d), and the number of Certified Peer Support Specialists increased from .2 to 2.5 per 10,000 population, a 10-fold increase (not depicted in Figure 1).

County-Level Rates Between 2010-2012 and 2015-2017

Between 2010-2012 and 2015-2017, 84 of the state's 100 counties experienced an increase in the opioid-related death rate, and 16 experienced a decrease (Figure 2c). In the early period, 18 counties had a rate that was above 14, double the state rate for 2010-2012 (Figure 2a). Of those 18 counties, most were in the west or southwest of the state. The counties with the top three highest rates were Yancey, Swain, and Cherokee, with rates of 28, 28, and 31, respectively. Almost all of the counties with high rates in the early period were in the west; one notable exception was Brunswick County, which is in the east, and had a rate of 17.8.

By 2015-2017, 47 counties had opioid-related death rates of 14 or higher (double the state death rate from 2010-2012), including a large group of western counties, stretching from Jackson in the southwest corner of the state to Alleghany in the northwest (Figure 2b). Many counties in the western area of the Piedmont had rates above 14, including Stokes, Rowan, and Randolph, all of which had rates above 20. In the east, two clusters of contiguous counties had rates above 20: Brunswick, New Hanover, and Pender in the southeast, and Jones, Craven, and Pamlico in the central coast. Gates County, in the northeast, also had a rate of 23. Two counties in the state had rates above 30: Jones in the east, and Wilkes in the west. Neither of the state's two most populous counties, Wake and Mecklenburg, were in the high-rate group of counties.

Between 2010-2012 and 2015-2017, all 100 North Carolina counties showed an increase in the number of buprenorphine prescriptions dispensed per population, although the size of the increase varied quite a bit. Figure 3 shows North Carolina counties by the level of increase in the number of buprenorphine prescriptions dispensed per population.

Changes in Opioid-related Death Rate and Opioid Pills Rate, EMS Naloxone Rate, Buprenorphine Rate, and Peer Support Specialist Rate Between 2010-2012 and 2015-2017

Using county-level data, we examined correlations between the change in opioid-related death rate and the four intervention variables from the earlier (2010-2012) to

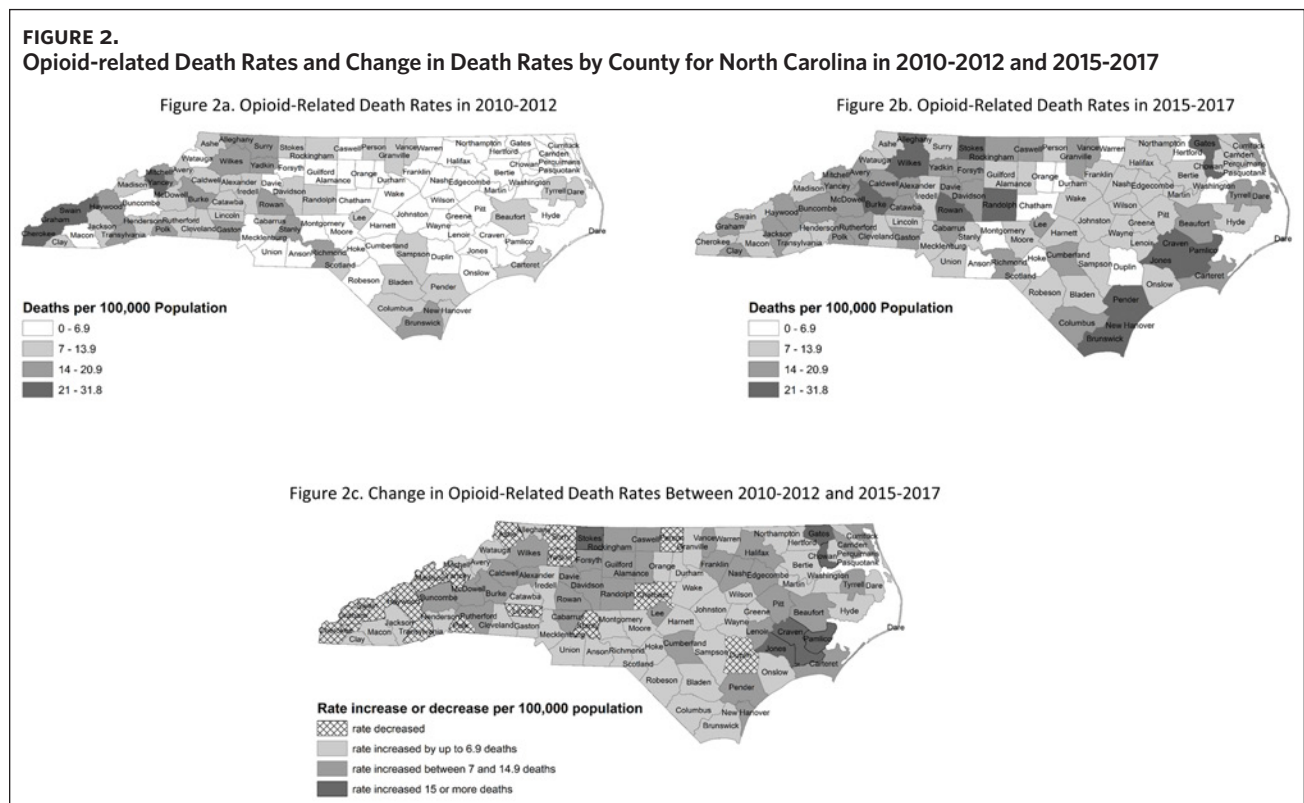
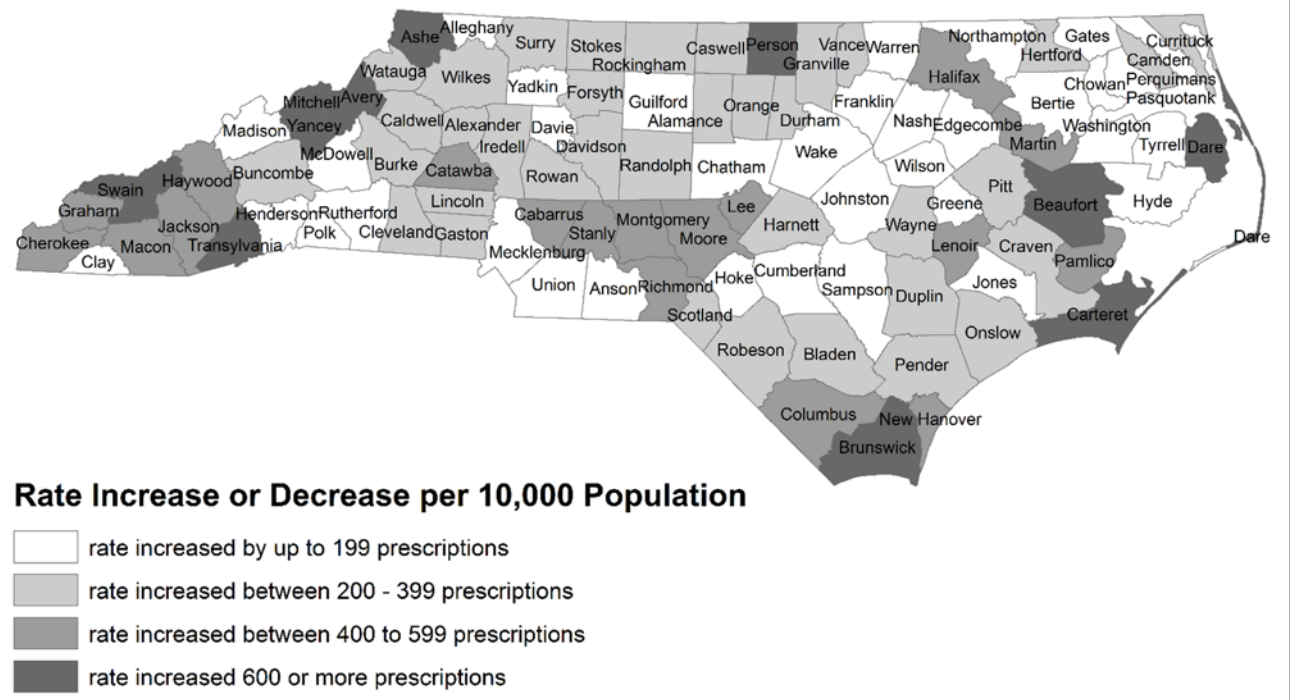


FIGURE 3.
Opioid-related Death Rates, Intervention and Treatment Trends for North Carolina: 2010-2017



later (2015-2017) time period. The relationship between the number of opioid pills prescribed and the opioid-related death rate was positive (more pills with more deaths) but not statistically significant ($r = +0.12, P = 0.24$). The relationship between change in number of EMS naloxone administrations and the death rate was positive and statistically significant ($r = +0.20, P = 0.05$). The relationship between the change in the number of Certified Peer Support Specialists per population and the change in the mortality rate was in the expected direction (higher numbers of specialists were associated with lower deaths) but was not significant ($r = -0.05, P = 0.652$). We found a negative relationship between the change in buprenorphine prescription rates and the change in mortality rates during the two time periods ($r = -0.27, P = 0.01$) (higher prescription rates were associated with lower death rates).

Discussion

Between 2010-2012 and 2015-2017, there was a significant increase in the opioid-related death rate for North Carolina overall, and also for many individual North Carolina counties, but the increases were not uniform across counties. Some counties that had low opioid-related death rates in 2010-2012 experienced very large increases over the five-year period, such as Jones, Chowan, Davie, Caswell, and Cumberland (Figure 2). Others that had low rates early on (or no deaths at all) remained low (Washington, Hertford), and some with high death rates remained high (Mitchell, Wilkes). But there were others with very high rates in the early period that experienced a decrease later on, particu-

larly several counties in the far west of the state, such as Cherokee, Swain, and Graham. This pattern suggests that at least some counties may have found successful strategies for addressing the epidemic, or at least curtailing deaths.

A key part of North Carolina's strategy for addressing the epidemic has been to limit the supply of prescription opioid pills [3, 16]. Opioid-related deaths include deaths due to both prescription and non-prescription opioids. While reducing the supply of prescription pills may prevent people from becoming addicted, those who become addicted may gravitate toward non-legal drugs like heroin and fentanyl, which can be more lethal [18]. A correlation between prescription opioid pills and mortality rates has been noted in numerous other studies, including studies focused on North Carolina [4, 5, 16]. Our results did not show a statistically significant relationship between the per capita pill rates and death rates at the county level. Our trend results showed an increase in the overall eight-year statewide trend for opioid pills per capita, but a decrease in the rate since 2015. There have been policy actions at the state and national level that have likely helped to bring down the number of opioid prescriptions. At the national level, the CDC released guidelines for prescribing opioids for pain in 2016, which likely influenced prescribing patterns [18]. The Comprehensive Addiction and Recovery Act (CARA) and the 21st Century Cures Act, both signed in 2016, authorized and funded a range of actions to address the opioid epidemic, including support for state prescription drug monitoring programs (PMDP) to track prescriptions of controlled substances [19]. The NC CSRS tracks prescriptions of controlled sub-

stances in North Carolina [15], and the 2017 North Carolina Strengthening Opioid Misuse Prevention (STOP) Act requires prescribers to review it before prescribing opioids [20, 21, 22]. The STOP Act also limits initial opioid prescriptions to no more than five days of medication (seven for post-surgical patients). The North Carolina Heroin and Opioid Prevention and Enforcement (HOPE) Act, signed in 2018, also increased tools for law enforcement to better curtail the illegal diversion of prescription opioids [23, 24]. The decrease shown by the data in the number of opioid pills per capita suggest progress; it is modest so far, but bears watching in the future.

Another strategy for reducing opioid-related overdose deaths has been to increase the availability and use of naloxone [3, 25]. Naloxone is a prescription medication that reverses the effects of an opioid overdose and can save lives. Naloxone has been used by EMS providers for many years. The North Carolina Good Samaritan Act, passed in 2013, changed the law to allow non-medical personnel to also administer and dispense the drug to reverse an overdose without fear of criminal prosecution or liability [26, 27, 28, 29]. Subsequent legislation in 2016 allowed naloxone kits to be purchased from a pharmacy without a prescription under a statewide standing order [26, 30]. At the federal level, CARA and the Cures Act provided funding for naloxone education, training, and distribution [19]. In North Carolina, naloxone has been distributed to some law enforcement agencies and to family and friends of opioid users as a preventive and emergency response measure. The North Carolina Opioid Action Plan metrics include two measures related to naloxone—the number of community administrations and the number of EMS administrations. The community data is only available for 2013 and later and is based on self-reports, so for our analysis we only used the rate of EMS naloxone administrations. We found a positive correlation between mortality rates and EMS naloxone rates; where EMS naloxone administrations are high, death rates tend also to be high. EMS naloxone administration rates are likely high for those counties where the opioid problem is greatest, therefore the mortality rates in these counties are also high. We might have found a different relationship if we had community naloxone data. EMS naloxone use may be an indicator of the problem; for an individual with an overdose event, naloxone can be a life saver and, without its availability, death rates might be even higher.

Our results showed a small but significant relationship between the use of buprenorphine and a reduction in the opioid-related death rate in some counties. For individuals with an opioid dependency or substance use disorder, treatment typically involves a combination of medication to suppress withdrawal effects and counselling to help adjust habits and behaviors, hence the term medication assisted treatment [18]. The Substance Abuse and Mental Health Services Administration (SAMHSA) certifies opioid treatment centers (OTCs) and approves them to dispense con-

trolled opioid treatment medications such as methadone and buprenorphine [31, 32, 33]. Under the provisions of the Drug Addiction Treatment Act of 2000 (DATA), buprenorphine can also be prescribed outside of an OTC, in a doctor's office setting, so long as the physician has received a waiver from SAMHSA (buprenorphine can be prescribed for pain without a waiver) [34]. The DATA Act also reduced record keeping requirements for physicians who prescribe buprenorphine, and recent additional legislative changes raise the number of patients a physician can treat at any one time [34]. Provider training for MAT has also become more available, and the number of newly certified practitioners who can prescribe the medication has increased every year since 2002 in North Carolina [35]. The increasing number of buprenorphine prescriptions indicates an increased need for the medicine, but also indicates greater use of MAT for opioid use disorders. Our results suggest that increased availability and use of MAT may have a significant effect on reducing opioid-related deaths in North Carolina. A qualitative evaluation would be useful for identifying other strategies and factors involved where mortality rates are decreasing.

We did not find a relationship between the number of Certified Peer Support Specialists and the opioid-related death rate. Certified Peer Support Specialists are individuals with a personal recovery history who have completed a 40-hour training program [36, 37]. They act as mentors, advocates, patient navigators, and counselors and work at opioid treatment centers, as well as in other settings. Peer Support Specialists can receive their training through a number of different organizations in the state, but are certified through the North Carolina Certified Peer Support Specialist Program at UNC-Chapel Hill. As of December 2018, there were 3,386 peer specialists statewide in North Carolina, although their numbers are growing [37]. A number of counties have none at all, so it may be too early to expect this form of peer support treatment to yield measurable results. Further study of the program and its impact on opioid recovery is warranted.

Our study is an initial attempt to demonstrate how the Opioid Action Plan data can be used to track progress in reducing opioid-related deaths. The major limitations of this analysis relate to the data themselves. Opioid-related mortality data are derived from death certificates, and underlying cause of death may be difficult to ascertain where multiple substances may be involved or the intent of the individual is difficult to determine. The buprenorphine data and the prescription opioid data are from the NC CSRS, and the quality of this data is unknown. Further, some buprenorphine prescriptions may be for pain, not for MAT. Also, medications dispensed in OTCs are not captured in the NC CSRS reporting system. EMS naloxone administration data are entered at the county level, and there may be variations in data quality from county to county. There have also been changes to the EMS data system that could impact data

consistency from year to year. All the data metrics are indirect, and serve as proxy measures for the underlying health changes in the populations studied.

Conclusion

In 2017, North Carolina developed a coordinated set of actions to address the opioid crisis, as well as a surveillance and measurement plan to track the epidemic and document progress. We used this surveillance data to examine yearly trends for opioid mortality and interventions. Our study found an increase in the statewide opioid-related death rate and in the rate of opioid pills prescribed. At the county level, there was an increase in opioid mortality for 84 counties and a decrease for 16 between 2010-2012 and 2015-2017. We did not find a decrease in mortality that could be attributed to the rate of naloxone administrations, but that does not mean that naloxone should not be part of the ongoing strategy. There was a small but significant association between an increase in buprenorphine prescriptions and a decrease in death rates in the aggregate, but significant variation among counties. The Opioid Action Plan data are easily accessible for the public and for researchers, and can be used to understand the characteristics of the crisis, to monitor progress, and to evaluate policies and actions taken by law enforcement, the community, and medical providers to address the crisis. The opioid epidemic in North Carolina and nationwide continues to evolve; new drugs and drug combinations will require health professionals, prevention specialists, policymakers, and researchers to look for new and different patterns and to adapt accordingly. Future study can use data to closely monitor the trends of opioid-related death rates and suggest more in-depth analysis in order to identify what the issues are and which intervention strategies are most successful. **NCMJ**

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