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Simulating the effects of medicaid expansion on the opioid epidemic in North Carolina☆

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HIGHLIGHTS

- A simulation estimated the effects of Medicaid expansion and MOUD-based treatment.
- Focusing on MOUD for those newly eligible could avert 1704 overdoses yearly.
- Prioritizing MOUD averted 2x the number of opioid-related mortalities.

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ABSTRACT

Expanding Medicaid plays a large role in ensuring that people across the United States have access to health care services. Although North Carolina recently moved toward Medicaid expansion, the impact of expansion on overdoses and overdose mortality may vary based on the type of treatment (offering medications for opioid use disorder [MOUD] vs. offering inpatient medically managed withdrawal without linkage to further MOUD treatment or non–MOUD-based treatment) accessed by individuals newly eligible for treatment through expansion. Based on official North Carolina statistics and published peer-reviewed literature, we developed a simulation model that forecasts opioid overdose and mortality under different scenarios for type of treatment accessed (MOUD-based vs. non–MOUD-based) and Medicaid coverage levels. An optimistic scenario assuming 70 % of individuals newly eligible for treatment would enter treatment during the first year of expansion estimated that 332 (Simulation Interval: 246–412) overdose deaths would be averted. A scenario more in line with recent historical trends assuming 38 % of individuals newly eligible for treatment would enter treatment resulted in 213 (Simulation Interval: 157–263) averted overdose deaths. In all scenarios, MOUD-based treatment approaches increased the number of lives saved compared with approaches expanding opioid treatment through non–MOUD-based treatment. Our study emphasized the need to ensure access to MOUD-based treatment for individuals newly covered by the Medicaid expansion.

1. Introduction

Opioid use disorder (OUD) represents a public health crisis, and there is a growing need for comprehensive and effective treatment strategies. Currently, three medications are approved to treat opioid use disorder (MOUD): buprenorphine-naloxone (buprenorphine), methadone, and naltrexone (National Institute on Drug Abuse, 2016). The use of buprenorphine and methadone has been shown to halve the risk of opioid overdose (National Institute on Drug Abuse, 2016; Sordo et al., 2017). Although successful for many individuals, research has shown that treatment relying solely on behavioral or psychosocial therapy without the use of MOUD (i.e., nonpharmacologic treatment) is associated with a higher risk of opioid overdose compared with MOUD-based treatment (Bailey et al., 2013; Mattick et al., 2014; Wakeman et al., 2020). Although MOUD is offered during inpatient medically managed withdrawal programs (also known as detoxification), most patients are not linked to further MOUD treatment following the inpatient stay (Morgan et al., 2018; Savinkina et al., 2022). In one study of over 40,000 individuals with OUD, patients who initiated treatment with inpatient detoxification or residential services without the use of MOUD were more likely to return to detoxification within 3 months, experience a serious opioid-related acute care episode, and experience an opioid

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overdose compared with patients receiving MOUD-based treatment (Wakeman et al., 2020). Therefore, clinical recommendations emphasize access to MOUD as an essential component of treating OUD (National Institute on Drug Abuse, 2016; Substance Abuse and Mental Health Services Administration, 2023). However, only between 15 % and 22 % of individuals with an OUD in the United States are estimated to receive an MOUD (Jones et al., 2023; Krawczyk et al., 2022). Among public health policymakers, there is an increased recognition that decreasing barriers to access and then maintaining MOUD-based treatment is key to ending the opioid overdose crisis.

In 2010, the Affordable Care Act gave states the option of expanding Medicaid eligibility to a greater proportion of their population. Since then, 41 states have expanded Medicaid (including Washington, DC; KFF Media, 2023). On December 1, 2023, North Carolina elected to expand Medicaid (N.C. Department of Health and Human Services, 2024). Medicaid expansion can increase the number of individuals receiving treatment for OUD as individuals become newly eligible for insurance, and also present an opportunity to guide individuals living with OUD to specific treatment modalities. As of 2020, Medicaid includes MOUD coverage under the Substance Use Disorder Prevention that Promotes Opioid Recovery and Treatment for Patients and Communities Act (SUPPORT Act), but this coverage has been substantially underused. Variability in access to MOUD-based treatment among Medicaid-covered patients may lead to differences in the impact of Medicaid expansion on North Carolina's opioid overdose epidemic.

Although over 600,000 residents of North Carolina will be newly eligible under Medicaid expansion (U.S. Department of Health and Human Services, 2023), questions remain regarding how Medicaid expansion will affect access to MOUD-based treatment and, in turn, how this treatment expansion might impact opioid overdose morbidity and mortality.

Although the number of North Carolina residents receiving MOUD-based treatment for OUD has increased over the past several years, many individuals with OUD are not currently in treatment (Krawczyk et al., 2022). Our study aimed to estimate the effects of differing levels of MOUD-focused versus non–MOUD-focused treatment uptake related to Medicaid expansion on opioid overdose and mortality outcomes. We chose North Carolina to illustrate scenarios that could be applicable to other states planning Medicaid expansion and to inform policies seeking to improve access to treatment for OUD. We also selected North Carolina because it recently passed Medicaid Expansion legislation and has been greatly impacted by the opioid crisis. This helps provide an opportunity to demonstrate the effectiveness of Medicaid expansion on overdose in its current evolution.

2. Methods

2.1. Conceptual Model

Our simulation uses nested conditional probabilities to test the impact of differing levels of treatment access related to Medicaid expansion in North Carolina. The simulation starts with the North Carolina's adult population of 8 million people. We then segmented this population based on opioid misuse status (people who reportedly misused opioids and those who do not). We then further stratified that population of people who misuse into disorder and non-disorder compartments followed by compartments based on treatment participation. We further differentiate people who misuse heroin and illegal fentanyl ("Heroin Use" for short) from those who mostly misuse prescription opioids ("No Heroin Use" for short). The overdose rate from heroin/fentanyl use is higher than from prescription opioid use, although recently more counterfeit prescription painkillers contain fentanyl (Drug Enforcement Administration, 2022). Once the misuse population was stratified, we assigned the type of treatment received by individuals within treatment (non–MOUD-based treatment such as detoxification without linkage to MOUD following an inpatient stay or residential programs vs. MOUD-based treatment with buprenorphine or methadone). For ease of conveying results, we grouped detoxification without linkage to MOUD following an inpatient stay and non–MOUD-based treatments within a "non–MOUD-based treatment" category while acknowledging that detoxification includes use of MOUD during an inpatient stay. Fig. 1 shows a breakdown of our simulation categories and the terminal nodes, or outcomes, that we are measuring.

2.2. Data and parameter estimation

We used data from the North Carolina Opioid and Substance Use Action Plan Data Dashboard, the National Survey on Drug Use and Health, and peer-reviewed publications that provided data on Medicaid expansion in other states and on the effectiveness of MOUD-based versus non–MOUD-based treatments to parameterize our model (Appendix Table 1). We considered that an estimated 270,000 of North Carolina residents have an OUD (Substance Abuse and Mental Health Services Administration, 2020). The number of individuals who are newly eligible under Medicaid expansion is around 600,000. Based on the estimates from West Virginia (Saloner et al., 2019) and 2021–2022 NSDUH estimates from North Carolina, we assumed 6 % OUD prevalence among those not covered through insurance and estimated that about 36,000 individuals with OUD now have access to treatment with Medicaid expansion in North Carolina. These numbers are likely underestimated due to reporting bias associated with stigma and other factors, but they provide a conservative estimate of the people who would benefit from Medicaid expansion.

2.3. Baseline scenario – no medicaid expansion

The baseline scenario reflects the state of opioid use in North Carolina in 2022. We assumed that 38 % of people with an OUD are receiving treatment within the baseline scenario (McKethan et al., 2019; Substance Abuse and Mental Health Services Administration, 2021). Of those entering treatment, we assumed that half would enter an MOUD-based treatment program and half would enter a non–MOUD-based treatment (behavioral intervention, detoxification, or residential program). Wakeman et al. (2020) estimated that only 14 % of people with OUD seeking treatment receive MOUD-based treatment using national data from 2015 to 2017. Acknowledging that state and federal agencies have made significant efforts to increase the number of individuals receiving MOUD-based treatment (Krawczyk et al., 2022), we assumed that this percentage has increased. Lacking more recent data to inform this parameter, we optimistically assumed that half of people entering OUD treatment would have access to MOUD.

2.4. Treatment expansion scenarios

We considered three scenarios with either a focus on MOUD-based treatment or non–MOUD-based treatment (e.g., detoxification without linkage to MOUD or residential treatment modalities). The three scenarios are stratified based on the percentage of eligible participants entering treatment. We used 38 %, 70 %, and 100 % of eligible participants entering treatment as our expansion scenarios. The 38 % scenario is an "expected" treatment utilization based on treatment utilization among the Medicaid-covered population (McKethan et al., 2019). The 70 % scenario offers a more optimistic perspective based on past progress, which is supported by studies showing substantial increases in buprenorphine and naltrexone prescribing after states expanded eligibility compared with states that did not expand (Sharp et al., 2018). Specifically, the number of people in treatment increased 140 % (14,591−37,356) between 2010 and 2019 and further increased by 80 % over the next 5 years, which might fall within a realistic range given increased efforts from the North Carolina Department of Health and Human Services and communities to emphasize the need for OUD treatment. Finally, the 100 % "best case" scenario was used to gauge the

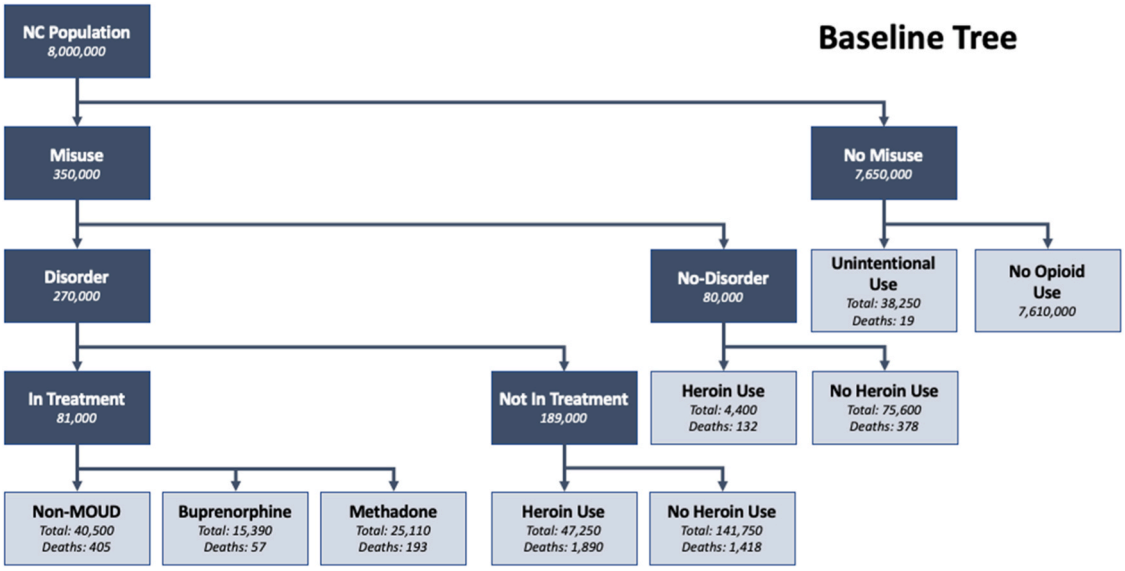

Fig. 1. Tree diagram for our baseline (reference) scenario showing our simulation categories and outcomes over 1 year.

upper limit of the expansion effects. For each of the three expansion scenarios, we ran two versions: (1) an MOUD-based treatment scenario where use of methadone or buprenorphine was prioritized and (2) a non–MOUD-based treatment scenario where detoxification without linkage to MOUD post-discharge or residential programs were prioritized. Although naltrexone is classified as MOUD, it is not associated with the same magnitude of decrease in opioid-related mortality as buprenorphine and methadone. According to 2019 N-SSATS data, naltrexone makes up around 1 % of the MOUD treatment in North Carolina. Therefore, we did not simulate the provision of naltrexone and these individuals are assumed to not have any reduction in opioid-related mortality compared to individuals without treatment. Table 1 summarizes simulated scenarios.

Each expansion scenario reflects the increase in treatment participation for the newly eligible population of 36,000 individuals with OUD. For each scenario, we compared mortality and overdose outcomes with our baseline scenario. This comparison is used to assess the impact of treatment types and treatment participation compared with the baseline scenario without Medicaid expansion.

To inform the annual probability of overdose-related mortality for individuals receiving non–MOUD-based treatment, we used data reported by Wakeman et al. (2020) from 2015 through 2017. They concluded that detoxification without linkage to MOUD, intensive behavioral health, and naltrexone treatment were not associated with reduced overdose or fewer serious opioid-related events at 3 or 12 months. Therefore, we assumed the annual probability of overdose for those receiving non–MOUD-based treatment would be lower than those with no treatment but elevated compared to those within MOUD-based treatment (Appendix Table 1). Because the mortality rate in 2022 was higher than in 2017, we would expect that mortality among individuals receiving non–MOUD-based treatment would also be higher than reported in Wakeman et al. (2020). Our simulations thus produced conservative estimates. With more people receiving MOUD-based treatment we would expect a decrease in mortality. It is difficult to gauge how these rates have changed over time, particularly with the increasing presence of fentanyl and counterfeit prescription opioid pills on the illicit market. To address this uncertainty, we increased and decreased our mortality, disorder, and baseline treatment participation parameters by a factor of 25 % to construct simulation uncertainty intervals (SI) around our reported outcomes. Appendix Table 1 lists the parameters used in our analysis.

Table 1
Overview of scenarios and their respective breakdown of treatment types among participants.

Treatment Type	Baseline – Without Medicaid Expansion	Non–MOUD-Focused Expansion Strategy	MOUD-Focused Expansion Strategy
People in non–MOUD-based treatment or detoxification without MOUD linkage	50 %	75 %	25 %
People in buprenorphine-focused treatment	19 %	12.5 %	27 %
People in methadone-focused treatment	31 %	12.5 %	48 %

3. Results

3.1. Treatment populations

Our baseline scenario with no Medicaid Expansion shows 81,000 people in treatment. Under our realistic scenario, we see a total of 94,680 (+13,680) people enter treatment if 38 % of individuals newly eligible for treatment begin treatment. In our more optimistic scenario, where 70 % of individuals participate in treatment, we see 106,200 (+25,200) people enter treatment. Under the best-case scenario (100 % participation), 117,000 (+36,000) eligible individuals with OUD participate in treatment. Fig. 2 shows the expected number of individuals entering treatment under differing participation levels across our scenarios.

3.2. Scenario outcomes

Our baseline scenario was built to reflect realistic estimates for 2022 (i.e., without Medicaid expansion). This scenario shows 35,936 overdoses (SI: 22,736–52,920) with 4492 opioid-involved overdose deaths (SI: 2842–6615) over a 12-month period representing calendar year 2022. This is compared with the 3761 opioid-related overdose deaths currently reported for 2022 in North Carolina.

The first counterfactual scenario assumes that 38 % of the individuals newly eligible under Medicaid expansion initiate OUD treatment. This is our lowest estimate of treatment initiation, and 11,400

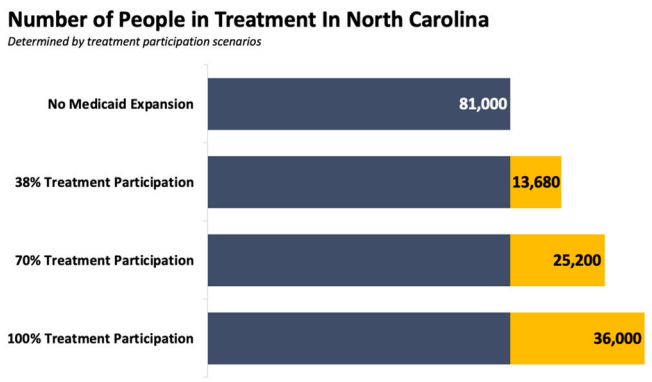

Fig. 2. Treatment participation in North Carolina across scenarios as determined by our simulation.

people are estimated to enter treatment even with the lowest estimate. This results in 400 averted overdoses (SI: 320–552) with a non–MOUD-focused strategy and 1704 (SI: 1256–2104) averted overdoses with an MOUD-focused strategy. The mortality decrease shows a similar pattern with 50 (SI: 40–69) averted opioid-related deaths with a non–MOUD-focused strategy and 213 (SI: 157–263) averted opioid-induced deaths with an MOUD-focused strategy. This represents a 4-fold increase in the number of lives saved with an MOUD-focused strategy compared with a non–MOUD-focused strategy.

Our second counterfactual scenario increased treatment participation to 70 %, resulting in 1200 (SI: 920–1544) averted overdoses with a non–MOUD-focused strategy and 2656 (SI: 1968–3296) averted overdoses with an MOUD-focused strategy. The decrease in mortality shows a similar pattern with 150 (SI: 115–193) averted opioid-induced deaths with a non–MOUD-focused strategy and 332 (SI: 246–412) averted opioid-induced deaths with an MOUD-focused strategy. This represents an increase of over 2 times the number of averted mortalities for an MOUD-focused strategy compared with a non–MOUD-focused strategy.

Our third scenario increases treatment participation to 100 %. Although this is not necessarily realistic, the resulting estimates can function as the upper bound of our simulation. This full participation scenario results in 1920 (SI: 1464–2464) averted opioid-induced overdoses with a non–MOUD-focused strategy and 3552 (SI: 2632–4400) averted opioid-involved overdoses with an MOUD-focused strategy. Mortality levels follow a similar pattern of reduction with 240 (SI: 183–308) averted opioid-involved overdose deaths with a non–MOUD-focused strategy and 444 (SI: 329–550) averted opioid-involved overdose deaths with an MOUD-focused strategy. This represents an increase of nearly 2 times the number of averted mortalities for an MOUD-focused strategy compared with a non–MOUD-focused strategy.

Fig. 3 shows the overall differences in opioid-related overdoses. This figure highlights the dramatic differences between the two treatment types while comparing the overdose rates with the baseline scenario of 35,936 overdoses.

Fig. 4 shows the overall differences in opioid-related mortality.

Figs. 3 and 4 show the overdose and mortality results from each of our scenarios compared with the baseline scenario. These figures show MOUD-focused treatment is more effective than non–MOUD-focused treatment at preventing overdoses and mortalities from opioid use. The figures also highlight the importance of treatment participation in helping to reduce these numbers.

Our simulation shows a decrease in mortality and overdose across each scenario, with the greatest decrease coming from MOUD-focused treatment. Appendix Table 2 shows the results of our analysis for each scenario across each expansion strategy. This table highlights the range of potential outcomes for each of these scenario and strategy combinations and the simulation intervals produced from our analysis. Fig. 5 shows the number of opioid-involved overdose deaths that could be averted in those scenarios.

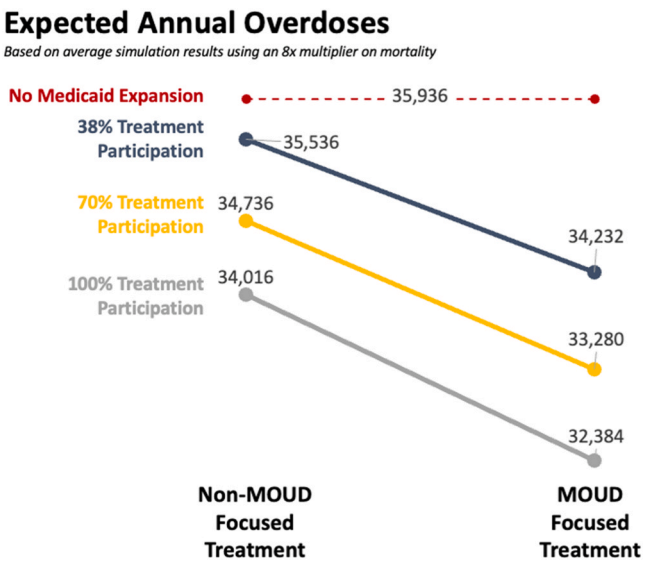

Fig. 3. Opioid-induced overdoses in North Carolina across scenarios compared with our baseline.

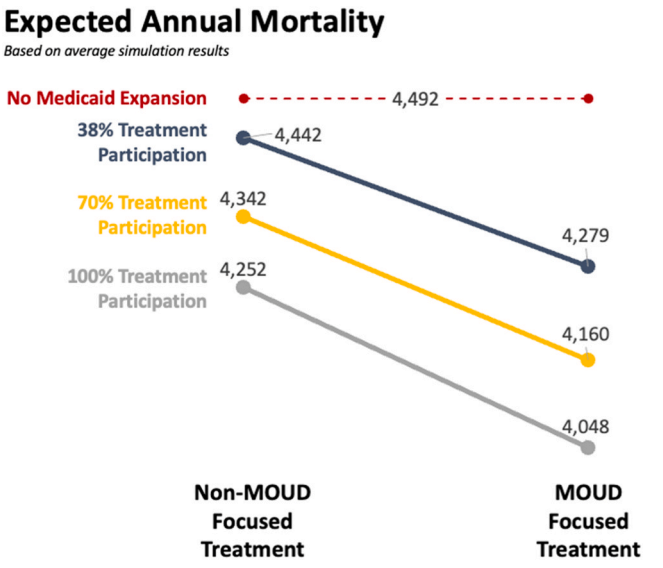

Fig. 4. The estimated number of opioid overdose–related deaths in North Carolina per year for each participation scenario and treatment strategy.

4. Discussion

Currently, most people with OUD who receive treatment are receiving non–pharmacologically based treatment. Less than half of privately funded substance use treatment programs offer MOUD, and only one-third of patients within those programs are given MOUD-based treatment (Knudsen et al., 2011). A significant gap between treatment needs and capacity exists at both the state and national level with a lack of providers willing and eligible to provide MOUD, even with the recent repeal of the requirement for additional training for prescribers of buprenorphine (referred to as the "X-waiver") and increased flexibility for prescribing, including telehealth and take-home methadone provisions (Jones et al., 2015). Despite a well-established evidence base, many drug treatment providers and individuals who use opioids hold negative beliefs or stigma against the use of MOUD (Dickson-Gomez

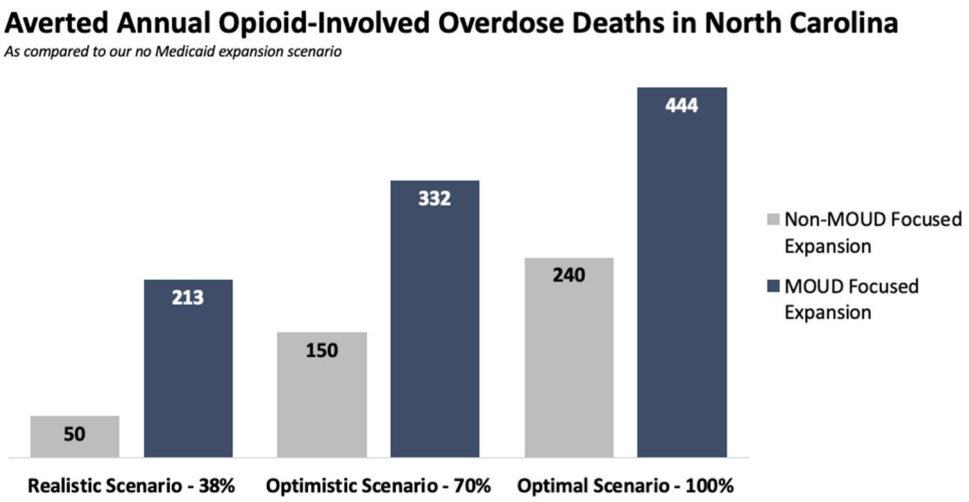

Fig. 5. Estimated number of opioid-involved overdose deaths in North Carolina averted per year for each scenario and expansion strategy.

et al., 2022). This simulation study presents treatment participation rates (e.g., 75 %) that may currently not be realistic due to these stigmatizing beliefs. Therefore, policymakers should consider how to address the stigma against MOUD-based treatment while simultaneously increasing access to treatment. Communication campaigns (Lefebvre et al., 2020), provider trainings, and engaging people with lived experience using MOUD can share information on MOUD and decrease stigma (Lefebvre et al., 2020). This is vital to increasing the likelihood that someone with OUD will attempt to get treatment for their disorder while simultaneously improving the quality of treatment they will receive.

North Carolina has made progress in increasing the number of individuals receiving MOUD-based treatment over the past decade. From 2010–2019, the percentage of individuals with OUD who received an MOUD-focused treatment regimen increased 140 % from 14,591 to 37,356 based on National Survey on Drug Use and Health data (Krawczyk et al., 2022). However, nearly 200,000 individuals are estimated to be living with OUD who could benefit from MOUD-based treatment (Krawczyk et al., 2022). Finding ways to decrease stigma around MOUD-based treatment while increasing access to treatment is vital to reducing the number of people with OUD.

Recent research has reported that Medicaid enrollees have increased use of MOUD compared to patients who are commercially insured (Medicaid Outcomes Distributed Research Network (MODRN) et al., 2021; Stewart et al., 2024). In a serial cross-section of 11 states, including North Carolina, Donohue et al. reported a pooled prevalence of Medicaid enrollees receiving MOUD increasing from 47.8 % in 2014 to 57.1 % in 2018 (Medicaid Outcomes Distributed Research Network (MODRN) et al., 2021). However, they note that there is substantial variability across states. Similarly, Stewart et al. reported a prevalence of MOUD use increasing in Washington state for Medicaid enrollees from 39.7 % in 2016 to 50.5 % in 2019 (Stewart et al., 2024). Therefore, the non-MOUD-focused expansion strategy assuming that only 25 % of Medicaid enrollees would be given MOUD-based treatment should be regarded as a strictly hypothetical scenario that serves to illustrate the potential differences in opioid overdose deaths associated with the differing prevalence of MOUD-based treatment for this important population.

With the changing landscape around healthcare engagement across the country, especially after the COVID-19 pandemic, many novel ways to engage patients and grant treatment access can be used and implemented going forward. One way is to leverage more flexible modalities, such as prescribing MOUD via telehealth and initiating buprenorphine via telephone, which can increase access to MOUD, particularly in more rural areas (Harris et al., 2020). Another is through hub-and-spoke models of care or collaborative care models, which can assist patients in navigating barriers to accessing and staying in treatment (Brooklyn and Sigmon, 2017). Implementing these new ways of engaging patients is necessary to ensure broader access to treatment.

These findings highlight that the greatest decreases in opioid-involved morbidity and mortality would be achieved by focusing on programs that can facilitate linkage to MOUD-based treatment. This result highlights the need to lower barriers to entry and retention within MOUD-based treatment. Increasing access to treatment is necessary, but it is also necessary to ensure that the type of treatment is optimal for overcoming OUD. Destigmatizing and offering MOUD-based treatment will save more lives than any other current treatment available.

Although Medicaid is expanding in North Carolina, other states are also considering full or partial expansion. Our study may help inform states considering expansion and trying to curb the opioid epidemic. For example, Kansas has proposed Medicaid expansion by 2025 (State of Kansas Budget Report 2024), and Georgia began implementing the Section 1115 Pathways to Coverage waiver, which is a step toward full Medicaid expansion (KFF, 2024). Our approach can provide stakeholders with evidence-based what-if scenarios to address opioid epidemic with the help of the expansion. It is important to note that these metrics are based on estimated rates. It is also important to note that these metrics are estimates with various levels of uncertainty. We varied our metrics to better represent the range of possibilities, but it is impossible to accurately predict how these metrics will change over time with an ever-changing world.

5. Limitations

Our simulation offers insight into the effect and potential outcomes of expanding Medicaid and the initiation of MOUD-based or non–MOUD-based treatment by individuals newly eligible in North Carolina. Although we can estimate overdose and mortality outcomes, limitations to our simulation should be considered, including the high-level nature of our model. We use metrics such as the proportion of the population with opioid use, overdose rate, mortality rate, and other population-level parameters to simulate our scenarios. When parameterizing the model, we made several assumptions regarding the generalizability of rates to the newly eligible for Medicaid population of North Carolina due to a lack of data specific to our simulated population. For example, the opioid mortality rate for individuals receiving buprenorphine treatment is based on a national study of patients with commercial insurance. The opioid mortality rate may differ for patients newly eligible for Medicaid or for patients in North Carolina. These scenarios are only as good as the metrics used as inputs and thus have limitations

when extending our findings to specific subpopulations. Many metrics, including race/ethnicity, education, poverty, or other factors impacting opioid use and treatment engagement, would further refine our estimates but will also bring additional uncertainty due to the lack of data or the complexity of measurement.

This simulation is focused specifically on the role of MOUD within initiated treatment and its impact on mortality and overdose outcomes as opposed to the financial and economic impacts. The opioid epidemic is a complex issue with many moving parts, and our focus on patient outcomes is only representative of a portion of the overall problem. For example, some uninsured people in the expansion population may already be using MOUD, potentially paid for through the SAPT block grant. We expect them to continue using MOUD under the expansion, however the rate is considered unclear, and we can further use it as an experimental parameter. It is important for policy makers to consider every component when making decisions and therefore we considered simulation "what if" scenarios to help account for this uncertainty.

Another limitation of this simulation is the changing nature of the epidemic. Model parameters are based on historical rates of methadone and buprenorphine use which may not accurately reflect the distribution for people newly starting MOUD. Additionally, we have seen dramatic shifts in overdose rates, mortality rates, and overall use since the COVID-19 pandemic (Tanz et al., 2022). Although we have adjusted our rates to account for uncertainty, within this focused inquiry, it is difficult to assess how the changing landscape including the levels of fentanyl contamination and polysubstance use will affect opioid-related outcomes in the foreseeable future.

6. Conclusion

Medicaid expansion is anticipated to provide access to OUD treatment for approximately 36,000 people in North Carolina. However, not all treatment options are effective in the same way. We show that an MOUD-focused treatment strategy reduces mortality and overdose rates over a detoxification strategy, averting nearly 4 times more opioid-related deaths per year based on our 38 % participation scenario. These results suggest that emphasizing the use of MOUD (vs. other treatment modalities that do not offer long-term MOUD treatment) will augment public health benefits associated with Medicaid expansion in North Carolina. Therefore, ensuring access to MOUD-based treatment should be prioritized as an important component of expansion to ensure as many lives are saved as possible.

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CRediT authorship contribution statement

Anthony Berghammer: Writing – review & editing, Writing – original draft, Visualization, Software, Project administration, Formal analysis, Data curation. **Georgiy Bobashev:** Writing – review & editing, Writing – original draft, Validation, Supervision, Project administration, Methodology, Funding acquisition, Conceptualization. **Joella W. Adams:** Writing – review & editing, Writing – original draft, Validation, Supervision, Methodology, Investigation, Conceptualization. **Sazid Khan:** Writing – review & editing, Writing – original draft, Methodology, Conceptualization.

Declaration of Competing Interest

No conflict declared

Appendix

Appendix Table 1
. Estimates for key model parameters.

Parameter	Value	Source
Population		
North Carolina population aged 18+ years of age	8000,000	U.S. Census, 2020
North Carolina residents with past-year opioid misuse	350,000	National Survey on Drug Use and Health 2018–2019
North Carolina residents with opioid use disorder (OUD), diagnosed or undiagnosed	270,000	Krawczyk et al. (2022), National Survey on Drug Use and Health, 2019
Number of North Carolina residents with OUD newly eligible for Medicaid with expansion	36,000	Calculated
Opioid use states		
Proportion of residents without OUD and without intentional misuse of opioids who accidentally ingest heroin/fentanyl	0.5 %	Assumed
Proportion of residents with opioid misuse but without OUD who use heroin/fentanyl	5.5 %	Assumed
Proportion of residents with opioid misuse and OUD who use heroin/fentanyl	25 %	National Survey on Drug Use and Health, 2020
Treatment (baseline scenario)		
Proportion of residents with OUD (diagnosed or undiagnosed) with past-year treatment for OUD	30 %	Krawczyk et al. (2022)
Proportion of residents receiving OUD treatment within non–MOUD-based treatment (e.g., intensive behavioral counseling, detoxification)	50 %	Assumed, informed by Wakeman et al. (2020)
Proportion of residents within OUD treatment receiving buprenorphine-naloxone	19 %	National Survey of Substance Abuse Treatment Services (N-SSATS) 2019
Proportion of residents within OUD treatment receiving methadone	31 %	National Survey of Substance Abuse Treatment Services (N-SSATS) 2019
Opioid overdose		
Number of opioid overdoses leading to an overdose-related fatality	1/8	Assumed
Annual opioid-related mortality		
Accidental death for individuals with no intentional use of opioids	0.05 %	Assumed, informed by surveillance data
Individuals without OUD using opioids other than heroin/fentanyl	0.5 %	Assumed, informed by surveillance data
Individuals without OUD using heroin/fentanyl	3 %	Assumed, informed by surveillance data
Individuals with OUD using opioids other than heroin/fentanyl	1 %	Assumed, informed by surveillance data
Individuals with OUD using heroin/fentanyl	4 %	Assumed, informed by surveillance data

(*continued on next page*)

Appendix Table 1 (*continued*)

Parameter	Value	Source
Individuals with OUD in non–MOUD-based treatment (e.g., intensive behavioral counseling, detoxification)	1 %	Assumed, informed by Wakeman et al. (2020)
Individuals with OUD receiving buprenorphine-naloxone based treatment for OUD	0.37 %	Morgan et al. (2019)
Individuals with OUD receiving methadone based treatment for OUD	0.77 %	Sordo et al. (2017)

Appendix Table 2
Estimated number of opioid-involved overdose deaths per year for each scenario and expansion strategy.

Treatment Participation Scenario	No Medicaid Expansion*	Non–MOUD-Focused Expansion	MOUD-Focused Expansion
38 %	4492	4442	4279
	(2842, 6615)	*(2802, 6546)*	*(2685, 6352)*
70 %	4492	4342	4160
	(2842, 6615)	*(2727, 6422)*	*(2596, 6203)*
100 %	4492	4252	4048
	(2842, 6615)	*(2659, 6307)*	*(2513, 6065)*

Range represents lower and upper bound when varying the overdose mortality parameters by ±25 %.
*Unaffected by scenario adjustments.

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