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Balancing need and risk, supply and demand: Developing a tool to prioritize naloxone distribution

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ORIGINAL RESEARCH



Balancing need and risk, supply and demand: Developing a tool to prioritize naloxone distribution

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ABSTRACT

Background: Opioid overdose deaths continue to rise nationally. The demand for naloxone, the opioid overdose antidote, is outpacing the supply. With increasing naloxone requests, tools to prioritize distribution are critical to ensure available supplies will reach those at highest risk of overdose. **Methods:** We developed a standardized “Naloxone Request Form” (NRF) and corresponding weighted prioritization algorithm to serve as decisional aid to better enable grant staff to prioritize naloxone distribution in a data-driven manner. The algorithm computed raw priority scores for each agency, which were then separated into the predetermined quintiles. Historical naloxone distribution decisions were compared with agencies’ prioritization quintile. **Results:** Results demonstrated that the NRF and corresponding algorithm was successful at prioritizing agencies based on potential impact. Although, overall, naloxone was distributed more heavily to the agencies deemed highest priority, our algorithm identified significant shortcomings of the “first come, first served” method of distribution we had initially deployed. **Conclusions:** This work has laid the foundation to use this tool prospectively to allow for data-driven decision-making for naloxone distribution. Our tool is flexible and can be customized to best fit the needs of a variety of programs and locations to ensure the distribution of limited supplies of naloxone have the greatest impact.

KEYWORDS

Opioid overdose;
naloxone distribution;
decision-making

Introduction

Opioid overdose deaths, recently driven by the increased prevalence of illicitly-manufactured fentanyl,¹ necessitates urgent action to increase the distribution of naloxone, the opioid overdose reversal medication. However, limited financial resources require careful and strategic stewardship of funds to ensure effective distribution of naloxone among the growing number of entities requesting it. Without naloxone distribution prioritization, there will be an increased need to “ration” naloxone supplies that some cities, such as Baltimore, have already faced.²



Emerging research in the area of naloxone distribution prioritization is systematically approaching this challenge. For example, Dodson and colleagues³ used geospatial analysis methods to identify geographic hotspots of opioid overdoses to target naloxone distribution, and Yates, Frey, and Montgomery⁴ developed a telephone-based individual-level risk stratification tool to identify persons at the highest risk of overdose. Although both of these approaches are important steps in using data to drive naloxone distribution, they are limited in their ability to be scaled-up and broadly implemented by community-based programs lacking in

sophisticated analytic capacity or resources for research and evaluation.

As federal funding to address the opioid overdose crisis has increased dramatically in recent years,⁵ so too has naloxone funding and distribution. To ensure this life-saving medication is reaching the populations who need it most, funding recipients need practical tools to prioritize how to distribute naloxone with the greatest impact.

Despite increased funding for naloxone, requests are far outpacing the available supply. As with many organizations commissioned to administer opioid funding, Missouri began operating overdose education and naloxone distribution initiatives with broad frameworks targeting specific audiences at risk of experiencing and/or witnessing an overdose. However, outside these broad guidelines, naloxone distribution operated primarily on a “first come, first serve” basis. The primary goal was to get education and naloxone out to those in need as quickly as possible. Early on, it became clear that need far exceeded resources and supply, and that a data-driven decision-making tool was warranted.

Studies have demonstrated that naloxone distribution is most effective when it targets individuals at high risk of experiencing or witnessing an overdose,⁶ including

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Table 1. Rank order naloxone distribution prioritization by region.

Region	Prescribing rate per 100,000 (2016)	Opioid overdose death rate per 100,000 (2015–2016)	Region rank	Freq. (%)
A: West Central	83.25	7.9	7	13 (7%)
B: Northeast	58.12	5.5	4	2 (1%)
C: Eastern	75.18	22.7	9	91 (52%)
D: Southwest	70.88	7.9	6	22 (13%)
E: Southeast	113.09	5.0	3	8 (5%)
F: Upper Central	51.01	6.3	5	27 (16%)
G: South Central	64.47	2.5	1	3 (2%)
H: Northwest	64.01	5.3	2	2 (1%)
I: Lower Central	84.30	12.1	8	6 (3%)
Missouri	80.4	15.1	–	174 (100%)

individuals experiencing homelessness,⁷ those with a lowered opioid tolerance,⁸ those with a history of incarceration,⁹ and those who have experienced a previous overdose.¹⁰ Estimates vary, but research has suggested that individuals who use drugs and/or other bystanders are responsible for more than 80% of overdose reversals with naloxone.^{11,12} Family members also carry out numerous reversals.¹³ Training and equipping the general public and first responders with naloxone reduces opioid overdose deaths.¹⁴ Although the greatest impact involves equipping both audiences, in terms of prioritization, equipping *only* the general public has been estimated to have a greater impact and be more cost effective than equipping *only* first responders.¹⁵

Based on previous research and state-specific indicators, the first aim of this study was to develop a tool to prioritize naloxone distribution in the state of Missouri. The second aim was to assess the efficacy of the scoring algorithm (i.e., variability in resulting priority scores). The third aim was to identify discrepancies with previous naloxone distribution decisions based on the outputs of the scoring algorithm.

Methods

To determine if naloxone was reaching the highest-need locations and populations, we developed a standardized “Naloxone Request Form” (NRF) and corresponding scoring guide. The NRF collects information from agencies that requested naloxone to serve as decisional aid to better enable administrative grant staff to prioritize naloxone distribution in a data-driven manner. Based on empirical and conceptual justification, supply characteristics, and Missouri’s opioid overdose data, we used the following categories to develop our prioritization system: geographic region served; type of agency; service capacity (i.e., potential number of individuals reached); naloxone use/purpose (i.e., whether naloxone would be used for emergent administration and/or distributed to participants); acceptable types of naloxone; and access to additional funding sources.

From November 2017 to September 2018, NRFs were completed through an electronic survey via Qualtrics, which was accessible through a number of mechanisms (e.g., direct email communication, posted on project websites, etc.) as a way to request naloxone. Additionally, if needed, agencies were able to call project staff directly and provide the answers to the questions verbally that project staff entered in to the electronic survey. Project staff followed-up with

organizations that submitted the NRF to discuss their organization, naloxone needs, and confirm some of their responses, as needed. While there is the possibility that data was input incorrectly that would bias an organization’s priority score, when the input responses seemed wildly inaccurate or improbable, project staff followed up with that organization to confirm the correct responses. For the current study, we compiled the completed NRFs, which included agencies that both received naloxone following the request and those that did not, and retrospectively completed forms for any agency that received naloxone, but had not filled out the NRF. The NRF was implemented in November 2017, so we retrospectively completed this form for agencies that were supplied with naloxone between December 2016 and August 2017, making the study inclusion period December 2016 through September 2018. We then applied the algorithm to the data.

Geographic region served

Geographic region was included as an indicator as opioid overdose deaths disproportionately affect specific regions in Missouri.¹⁶ In 2016, overdose deaths were most heavily concentrated in the seven-county, Eastern, greater St. Louis region, which accounted for approximately 68% of deaths statewide. Demographic data further underscored that not all groups fared the same. In 2016, the rate of overdose deaths among Black males was more than double that of White males, and this disparity, driven by the Eastern region, has continued to increase in Missouri over time.¹⁶

Requesting agencies selected their geographic service area(s) on the NRF. Response options allowed for reporting a county-level service area, a regional service area (a collection of counties designated in to nine regions by the Missouri Department of Health and Senior Services, DHSS), or a statewide service area. Each of the nine DHSS delineated regions was ranked for priority naloxone distribution using averaged 2015–2016 opioid overdose death rates with the 2016 opioid prescribing rate used as a tiebreaker (see Table 1). There were nine possible rankings for this item. Agencies indicating they served a statewide catchment area were prioritized using the middle of the range of prioritization scores (i.e., a score of 5 on the scale).

Table 2. Rank order naloxone distribution prioritization by agency capacity.

Overdose response capacity (first responders)			Uninsured individuals served (direct service providers)			Total combined		
Item	Freq.	Percent (%)	Item	Freq.	Percent (%)	Freq.	Percent (%)	Capacity rank
We do not respond to overdoses	5	6.9	We do not serve uninsured individuals	2	2.0	7	4.0	0 ^a
Less than one per month	29	40.3	1–25	58	56.9	87	50.0	1
One per week	30	41.7	26–50	20	19.6	50	28.7	2
3–4 per week	6	8.3	51–100	15	14.7	21	12.1	3
One per day	1	1.4	101–200	6	5.9	7	4.0	4
Multiple per day	1	1.4	>200	1	1.0	2	1.2	5
Total	72	41.4		102	58.6	174	100	

^aNote: The 0 rank option is selected, the priority categorization will automatically be listed as the lowest priority regardless of the agency's raw score. Higher scores for "Capacity Rank" indicate higher priority agencies. The row "Total" represents the number and percent of all agencies that were asked each question (i.e., 74 agencies, 41.4% of the total number of agencies were first responders and received the question about overdose response capacity; 102 agencies, 58.6% of the total number of agencies were not first responder agencies and were instead asked about their service capacity), whereas the column percent value represents the proportion of agencies within each column total. The response options we used were defined based on our previous knowledge of the agencies that would be requesting naloxone. These response options can and should be customized for locations with varying levels of service capacity.

Type of agency

Agencies were asked to respond to the question: "With what type of agency are you affiliated?" There were three possible rankings for this item. Agencies indicating they were harm reduction, drug user health, crisis care, homeless, recovery, treatment, justice-involved, friend, family, or addiction-specific groups/agencies were ranked as highest priority. Emergency responders, including law enforcement and fire, were ranked second due to their frequent responses to emergent overdose events. Agencies not focusing on addiction, including health departments, pharmacies, libraries, construction companies, and schools, were given the lowest priority ranking. These agencies were denoted as the lowest priority because libraries and schools are able to access naloxone through Adapt Pharma's community naloxone programming, Missouri pharmacies are unable to accept free naloxone, health departments have traditionally been less likely to serve as a naloxone distribution source for people in active addiction, and construction companies typically provide health insurance through which naloxone can be billed.

Service capacity

Slightly different service capacity questions were asked of emergency responders than of non-emergency responder agencies. Emergency responders were asked "On average, how many opioid overdoses does your agency respond to within a one month period of time?" Response options included: we do not respond to overdoses; less than one per month; one per week; 3–4 per week; one per day; multiple per day. All other agencies were asked about the "Number of new, uninsured individuals at risk of experiencing or witnessing an opioid overdose served monthly." Response options included: 1–25; 26–50; 51–100; 101–200; >200; unsure/unknown; and we do not serve uninsured individuals. Because of Missouri's naloxone standing order¹⁷ that enables naloxone access through pharmacies without an outside prescription and because most insurance companies cover at least a portion of the cost of naloxone, we asked non-emergency responder agencies about their capacity to serve *uninsured* individuals who may not have the means to

purchase or access naloxone through other sources. There were five possible rankings for these items.

Responses were prioritized based on the number of people served, with a higher number of overdose responses or clients served indicating higher priority for naloxone distribution (see Table 2). This decision was primarily logistical given that prioritizing and supplying a few agencies that could make a large impact is a more efficient method of distribution than prioritizing and supplying smaller agencies that serve less individuals. Specifically, emergency responder agencies that reported witnessing and responding to overdoses most frequently and non-emergency responder agencies who reported serving greater numbers of uninsured individuals at-risk of witnessing or experiencing an overdose were given greater priority.

Naloxone use/purpose

Requestors were asked: "How do you intend to use naloxone?" Response options were (1) store naloxone for use on-site or to administer directly during an overdose event and (2) distribute naloxone to clients/participants. Agencies were allowed to select both options. There were two possible rankings for this item with higher prioritization given to agencies that planned to distribute naloxone over those that only wanted naloxone on-site for emergent administration.

Acceptable types of naloxone

Because we had access to multiple forms of naloxone (i.e., Narcan[®] nasal spray purchased using grant funds and intramuscular naloxone provided through the Direct Relief medication donation program), requestors were asked whether they would accept (1) Narcan[®] nasal spray only, (2) Intramuscular naloxone only, or (3) both. No agencies reported that they would accept only intramuscular naloxone, so there were two possible rankings for this item. Due to substantial cost differences and differences in our available supply for each, agencies that accepted either form (as opposed to only Narcan[®] nasal spray) were given priority and ranked higher than agencies that reported they would only accept intranasal naloxone.

Table 3. Agency categorization and naloxone distribution by priority quintile.

Priority score	Number of agency requests		Number of naloxone doses distributed	
	Frequency	Percent (%)	Frequency	Percent (%)
5 (Highest priority)	14	8.05	10,140	37.69
4	79	45.40	9,028	33.56
3	48	27.59	5,378	19.99
2	23	13.22	1,082	4.02
1 (Lowest priority)	10	5.75	1,274	4.74
Total	174	100.00	26,902	100.00

Access to additional funding sources

Requestors were asked whether or not they had access to additional funding sources for naloxone. There were two rankings for this item. Due to the limited supplies, agencies that did not have an additional funding source for naloxone were prioritized over agencies that were able to purchase naloxone through other sources, although both responses could still result in agencies being supplied.

Results

Data were collected from 174 agencies with 132 agencies receiving 26,902 doses of naloxone between December 2016 and September 2018 through three federally-funded opioid-focused grants. A majority were fully supplied through one of the grants, with only seven agencies having been supplied with naloxone by a combination of two grants. Forty-two agencies (24.13%) requested but did not receive naloxone from any of the grants during this time period. A majority of the requests ($n = 91$; 52%) were from agencies serving the Eastern region (Table 1). Requests from agencies were closely split between agencies that serve the individuals at the highest risk of witness or experiencing an opioid overdose ($n = 83$; 48%) and emergency responders ($n = 72$; 41%). Other agencies not focused on addiction (i.e., health departments, pharmacies, libraries, construction companies, and schools) represented 11% of requests ($n = 19$). Of the 174 agencies, 102 were non-emergency responder agencies that worked directly with individuals at risk of experiencing and/or witnessing an opioid overdose (e.g., treatment providers, churches, social service agencies, and recovery community centers) and 72 were emergency responder agencies. Only two agencies (one emergency responder and one non-emergency responder agency) were in the highest capacity category (i.e., responded to multiple overdoses per day and served >200 uninsured individuals at risk of experiencing or witnessing an opioid overdose, respectively). A majority of responses, about 82% of first responders, and about 17% of non-emergency responder service providers were in the lower capacity prioritization categories indicating either less than one overdose response per month or one per week, and between 1 and 50 uninsured individuals with at risk of experiencing or witnessing an opioid overdose served, respectively (Table 2). Naloxone use/purpose was split with 100 agencies (57%) indicating their goal was solely to store naloxone for use on-site or to administer naloxone directly during an overdose event and 74 agencies (43%) indicating their goal for naloxone included distribution to their clients

or participants in addition to emergency response or to keep on-site. A majority of agencies ($n = 116$; 67%) indicated that they would only accept Narcan[®] nasal spray. Most agencies indicated they have no alternative source of funding for naloxone ($n = 157$; 90%).

Prioritization of agencies requesting naloxone

To obtain a single priority score for each entity that had requested naloxone, we assigned percentage weights to each rank-ordered criterion (e.g., the rank-order of an agency's Geographic Region Served was weighted 25%). Weightings were based on state-specific data, conceptual justification, supply-related factors, and empirical support for the potential impact of each component on overdose reversals and responses. In Missouri, overdose deaths are consistently concentrated in the Eastern region, a region that is also responsible for driving the statewide racial inequity. Given that our goal was to maximize the impact of the distributed naloxone, we used greater weights for the region and capacity components due to the potential ability to make a larger impact. Additionally, given that naloxone distribution is more effective when distributed to the general public versus first responders and targeted toward individuals at high risk or experiencing or witnessing an overdose (e.g., individuals actively using, experiencing homelessness, and with a history of incarceration),^{11,14,15} greater weights were assigned to the agency type and purpose components of the algorithm. The naloxone type and funding source components were assigned relatively smaller weights given that these two domains were related to supply availability rather than the potential impact on overdose reversals. Although the relative strength of the weights was informed by the empirical literature, ultimately, the specific weights assigned to each component were determined by consensus of the research team.

The final scoring algorithm was as follows:

$$\text{Priority Score} = 0.25 * (\text{Region}) + 0.25 * (\text{Agency Type}) + 0.25 * (\text{Capacity}) + 0.15 * (\text{Purpose}) + 0.05 * (\text{Naloxone Type}) + 0.05 * (\text{Funding Source}) * 10$$

Quintile categories were created based on the range of all possible scores and an agency's resulting priority score was classified into one of the predefined quintiles. However, emergency responder agencies that reported that they do not respond to opioid overdoses and non-emergency responder service providers that do not serve uninsured clients at risk of experiencing or witness an opioid overdose

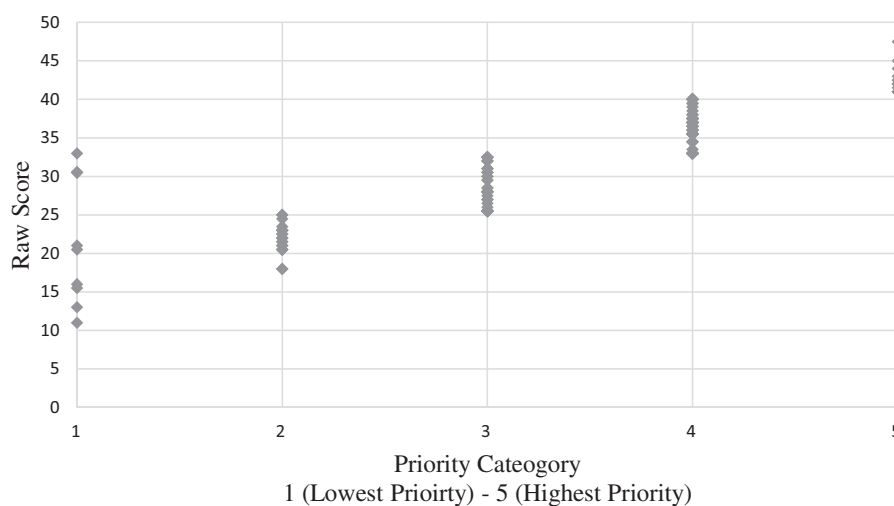


Figure 1. Raw priority scores by agency within each priority quintile.

were automatically placed in the lowest priority category regardless of their priority score. Possible scores on the algorithm ranged from 10 (the agency reported the lowest ranked response in each category) to 47.5 (the agency reported the highest ranked response in each category). We chose to use quintiles (versus fewer groups) to increase variance for subsequent decision-making. Of the 174 agencies we assessed, 14 (8.05%) were identified as highest priority (See Table 3 and Figure 1). Of agencies in the highest priority quintile, only one agency had the highest rank in every component (i.e., Eastern region service area, harm reduction/drug user health organization, served more than 200 individuals at risk of experiencing or witnessing an opioid overdose, planning to distribute naloxone to community members, would accept either form—intramuscular or intranasal, and did not have additional funding sources for naloxone).

Geographic region served

All agencies in the highest priority quintile ($n = 14$) selected the Eastern region as their geographic service area (region rank = 9). Of agencies in the lowest priority quintile ($n = 10$), four agencies were located in the highest need region. However, these agencies all indicated they did not respond to overdoses and/or did not serve the uninsured.

Type of agency

A majority of agencies that were identified in the highest priority quintile were agencies that served those at high risk of experiencing and/or witnessing an overdose ($n = 13$; 93%). Agencies in the lowest priority quintile ($n = 10$) included one agency with the highest agency rank (agency rank = 3) that indicated not serving uninsured individuals at risk of experiencing and/or witnessing an overdose, eight emergency responder agencies (agency rank = 2), and one agency not specifically focused on addiction (agency rank = 1).

Service capacity

Of the agencies in the highest priority quintile, a majority of agencies had a capacity rank of 3 ($n = 10$; 71%), two agencies had a capacity rank of 4 (14%), and two agencies had the highest capacity rank (14%; see Table 3). Most of the agencies in the lowest priority quintile ($n = 10$) received a capacity rank of zero due to the fact that their agency was not responding to overdoses or was not serving uninsured individuals at risk of experiencing or witnessing an opioid overdose ($n = 7$; 70%).

Naloxone use or purpose

A majority of the agencies in the highest priority quintile indicated their goal for naloxone distribution included distribution to their clients or participants in addition to keeping on-site for emergency response ($n = 9$; 64%). All agencies in the lowest priority quintile ($n = 10$) planned to use naloxone for emergent administration only.

Acceptable types of naloxone

Agencies in the highest priority quintile were split on the types of naloxone they would accept with eight agencies (57%) willing to accept both Narcan[®] nasal spray and intramuscular naloxone and six agencies (43%) only willing to accept Narcan[®] nasal spray. A majority of those in the lowest priority quintile were only willing to accept Narcan[®] nasal spray ($n = 7$; 70%).

Access to additional funding sources

A majority of agencies in the highest priority quintile ($n = 12$; 86%) and the lowest priority quintile ($n = 10$; 100%) indicated they had no additional funding source for naloxone.

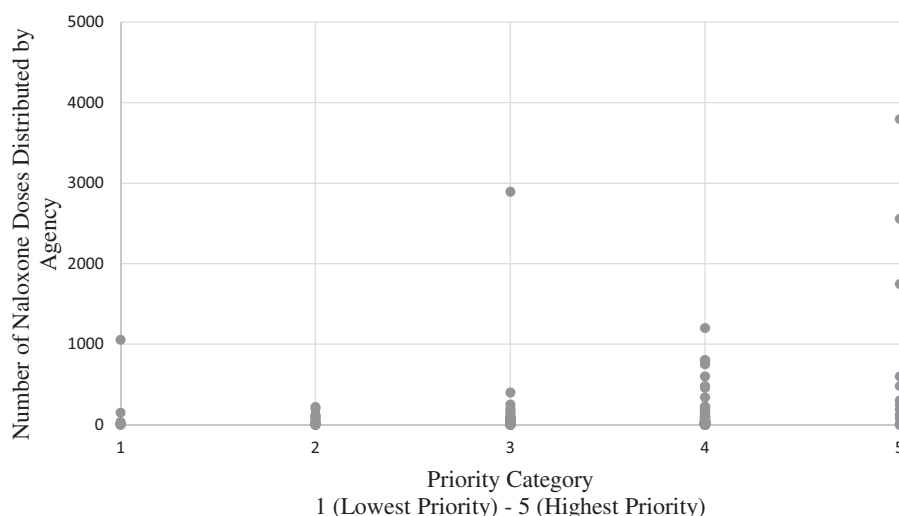


Figure 2. Distribution of naloxone doses by agency within each priority category.

Naloxone distribution to agencies within each priority quintile

We examined naloxone distribution to agencies in each of the priority quintiles to assess the extent to which naloxone funds were allocated to agencies identified as highest need by the algorithm. Although only approximately 8% of agencies were identified in the highest priority quintile, approximately 38% of the 26,902 naloxone doses were distributed to these agencies (Table 3).

Overall, naloxone was distributed more heavily to the agencies deemed highest priority. However, our algorithm identified significant shortcomings of the “first come, first served” method of distribution initially deployed (Figure 2). Specifically, although a majority of the naloxone doses (37.69%) were distributed to agencies identified as the highest priority for distribution, more than 80% of those were distributed to only three agencies. Additionally, three agencies identified as the highest priority for naloxone distribution did not receive any naloxone. Among agencies categorized in the second highest priority category (category 4), 15 of the 78 agencies were not supplied with naloxone. There were also outliers among agencies in the lower priority categories. For example, almost 4% (1,054 doses) of the total naloxone doses distributed were given to a single law enforcement agency in the lowest priority quintile that reported they do not respond to overdoses.

Discussion

We created a decisional-aid tool to help prioritize grant-based naloxone distribution efforts, and retrospectively assessed our prior distribution efforts using this tool. Results suggest distributing naloxone to requesting agencies through a “first come, first served” method, as was originally done, resulted in a misallocation of the limited supply of medication. Underscoring the critical need for this tool, multiple agencies scoring as the “highest priority” for distribution did not receive naloxone, while lower priority agencies received it, potentially resulting in missed opportunities to decrease

opioid overdose fatalities. Indeed, ongoing use of a weighted algorithm, which accounts for empirically-based indicators of naloxone impact, may improve the likelihood of reaching individuals with the highest need. Although we applied this algorithm to retrospective data to test its potential utility, ideally, this tool should be implemented prospectively to assist with current and future naloxone allocations.

Limitations and future directions

Although our preliminary analysis provides a framework for prioritizing an in-demand and limited live-saving medication, there were several limitations. First, prioritization of region was insufficient as a method of addressing racial inequities. Although it is possible that agencies may find it difficult to identify the demographic makeup of their constituents, an additional item would have enabled us to better prioritize naloxone distribution to agencies that predominantly served disparate populations in our region.

Second, agencies indicating they had a statewide service area were challenging to prioritize within the “geographic region served” category. Scoring these agencies as the highest need in terms of geographic region would have artificially inflated their priority scores and would have been particularly troublesome given that some of these agencies, though providing services statewide, were primarily concentrated in lower-need regions of the state. For agencies that indicated they were statewide, we used the midpoint of the geographic region subscale as their score for this category, but this could not accurately capture the overdose fatality rate of their true catchment area.

Third, we combined data across grants to increase the representation of agencies we were assessing. However, because of varying populations of focus and geographic focus areas resulting from different funding restrictions, agencies served by each grant tended to cluster together in resulting priority scores. Future efforts to implement a data-driven approach to naloxone distribution would benefit from examining the priority scores and making naloxone distribution decisions within rather than across grant initiatives.

Fourth, we did not assess the practical feasibility of agency representatives being required to complete this tool when making a request. Rather, our project staff individually followed up with agencies to ensure data were collected if the requestor neglected to do so, stated it was too burdensome, provided incomplete or inaccurate information, or—as was the case early in implementation—the tool was not yet developed. In Missouri, there is no system by which to secure objective information on the agencies requesting naloxone, although if this is available in other areas, using this type of system would undoubtedly result in the most accurate information. Because the data collection process can be implemented so flexibly and that once implemented, the completion of this form was required prior to receiving naloxone, we don't anticipate this as a barrier to response rate. It is possible though that the individual responsible for completing the form for their agency may not immediately know the answers to all the questions (e.g., they may not know how many uninsured individuals they serve monthly), so in some instances, the form may not be able to be completed in one sitting. This along with the requirement for completing the form, could cause delays in distributing naloxone particularly for agencies implementing this prospectively. Determining the likelihood of all requestors completing the tool as a requirement for receiving naloxone and providing accurate responses will be critical to ascertaining its real utility going forward.

Finally, although this tool allows for more intentional decision-making based on an agency's priority score, when applying prospectively and without foreknowledge of how many agencies and naloxone requests there will be, decisions related to exactly how much to distribute to mid-range priority agencies may be challenging as higher-need requests could be forthcoming.

In order to increase the ability to fulfill as many requests for naloxone as possible, future work in this area should explore approaches to increase the receptivity of intramuscular naloxone and prioritize the development of cheaper, non-injectable naloxone formulations. In our own data, unsurprisingly, few emergency responders reported being willing to accept either form of naloxone, regardless of whether they were planning to carry for emergent use or distribute to individuals at risk of experiencing or witnessing an opioid overdose (although very few—only four agencies—were planning to distribute). The physical nature of first responders' professions, the risk—however unlikely—of an accidental needle-stick injury during naloxone administration, and their fears about needle-stick injuries and infectious disease exposure likely increase their unwillingness to carry a syringe and naloxone vial for overdose response.¹⁸ However, of non-emergency responders, approximately 50% of agencies were unwilling to accept intramuscular formulations. Although a recent study found that most patients using opioids for pain preferred non-injectable formulations of naloxone, this may not be the case for individuals with a history of opioid use disorder or injection opioid use.¹⁹ Therefore, further education and training efforts that could impact receptivity and acceptance of intramuscular naloxone, should be explored

particularly for agencies serving individuals at high risk of experiencing or witnessing an opioid overdose.

Implementing a customized data-driven naloxone distribution tool

When adapting this tool for application in the future or elsewhere, items should be tailored as needed to better align with the community context and needs. For example, the scale metrics for "Agency Capacity" is an opportunity for customization based on the local context. As seen in [Table 2](#), the cutoffs for "Uninsured Individuals Served by Direct Service Providers" (i.e., 1–25, 26–50, etc.) were based on the project team's previous knowledge of many of the agencies that would be requesting naloxone and the various capacities of these organizations. For example, we anticipated requests from large law enforcement agencies representing both city- and county-wide catchment areas and smaller agencies with only a few officers serving the entire jurisdiction. Treatment and social service agencies in Missouri similarly varied in their capacity to serve uninsured individuals at risk of experiencing or witnessing an opioid overdose event. Some agencies are multi-site and predominantly serve the target population, whereas others are single-site and the target population is only a small subset of their total client base. Alteration to the weighting of the algorithm is another area for customization. Since specific weightings were, by and large, determined by the consensus of the project team, other teams can use this as an opportunity to test alternative algorithm weightings in ways that help customize the algorithm to their community.

Project teams should also partner with key stakeholders, namely those already delivering community-based harm reduction services, to answer several questions when customizing this algorithm. Specifically, (1) Do you have specific populations (e.g., LGBTQ+) in your community that should be prioritized? (2) Is there existing dedicated funding for certain organizations (e.g., law enforcement) already in place, making them a lower priority for grant-based distribution? (3) Is your program able to distribute multiple types of naloxone?

Ideally, this tool will be implemented prospectively. This means that complete data will need to be collected from agencies to apply the algorithm, so follow-up may be required if an agency skips questions. To utilize this scoring tool appropriately, we recommend developing a plan for how agencies' priority scores will tangibly impact naloxone distribution. For example, will agencies with the highest priority scores always be provided with their requested amount and agencies with the lowest priority scores not supplied until the end of the grant year *if* there is naloxone still available? Will some only receive medication if there is a surplus?

Our recommendation for utilizing this tool prospectively to make naloxone distribution decisions is to analyze requests and provide naloxone more frequently and in smaller quantities to allow for priority-based adjustments on an ongoing basis. To this end, we suggest using a monthly

naloxone budget that rolls any surplus into the following month rather than an annual budget. For example, if a grantee has \$375,000 for a year's worth of naloxone (5,000 kits of Nasal Narcan at \$75 per kit that includes two doses), breaking this down monthly means each month approximately 416 kits can be distributed each month (5,000 kits divided by 12 months). Agencies that request naloxone, should indicate approximately how much they would be able to use and/or distribute during the month, and be supplied with only a month's worth at a time, with the understanding that they should continue to request naloxone on an ongoing basis once they need to be resupplied, which may be more or less frequently than monthly. This avoids any agency sitting on naloxone for several months that could otherwise be supplied to another agency in any given month, and would allow for a lower need agency to be supplied one month, with that supply potentially lasting multiple months, while also supplying high-need agencies more frequently.

Finally, it is important to plan to reevaluate scoring as drug trends change, new evidence of risk factors emerges, and more naloxone or funding becomes available.

Conclusion

In conclusion, this work demonstrated that data-driven approaches can be successfully used to prioritize naloxone distribution decisions while supplies are limited. Our tool is flexible and can be customized to best fit the needs of a variety of programs and locations to ensure the distribution of naloxone will have the greatest impact. Additional work should be done to increase funding for naloxone to ideally avoid having to turn away agencies that are interested in distributing naloxone as even low priority agencies may have the opportunity to save a life with naloxone.

Authors' contributions

Claire Wood conceptualized the research project, designed the analytic approach and analyzed the data, and wrote and revised the majority of the manuscript. Lauren Green was responsible for data management and collection, assisting with data interpretation, conceptualizing the project, and writing and revising the manuscript. Anna La Manna and Sarah Phillips assisted with manuscript revisions and formatting, and Sarah Phillips also assisted with data collection. Rachel Winograd and Kim Werner assisted with manuscript revisions and overall project conceptualization. Angie Stuckenschneider assisted with conceptualization and oversight for project implementation and naloxone distribution about which the manuscript was written.

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