

Ensuring Access to Opioid Treatment Program Services Among Delawareans Vulnerable to Flooding

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Abstract

Objective: To quantify potential flood-related access disruptions to medication-assisted treatment for opioid use disorder (OUD) among Delawareans. **Methods:** Spatial flood risk maps and infrastructure, services, and hazard risk, transportation networks, opioid treatment programs (OTPs) for the State of Delaware were integrated to visually display the relationship between these layers. A complex network theory-based simulation model was used to assess both direct (e.g., inundation with flood water) and indirect (e.g., isolation) impacts of floods. **Results:** Delaware is at increasing risk from flooding associated with storms and sea-level rise, which can lead to sunny day flooding during high tides. Of the 18 OTPs in Delaware, 4 are expected to be flooded in a 100-year flood and 7 are expected to be severely disrupted, increasing to 9 by 2035 and to 10 by 2050, with service reachability less than 15 square miles due to flood-induced isolation. **Conclusions:** Individuals utilizing OTPs for OUDs must be able to access treatment programs regardless of external disruptors like floods. Because these programs require consistent treatment adherence and in-person oversight by clinicians, timely restoration of services and continuity of operations for treatment facilities in post-disaster settings is critical for treatment compliance. **Policy Implications:** The State of Delaware has the third highest rate of drug overdose mortality in the U.S., with three-quarters of all drug-related deaths involving opioids. Impeded access to opioid treatment during a flood disaster can lead to relapse, overdose, and death. Hazard planning must develop policies and practices to address these risks.

Introduction

In disaster and post-disaster contexts, most deaths are attributable to indirect causes, such as lapses in access to care and the deterioration of vital infrastructure.^{1,2} As disasters related to climate-mediated hazards become more common,³ it is important to better characterize and understand the wider societal-level impacts of disasters. One area of impact that needs more substantive exploration is the impact of disasters on the provision of opioid treatment program (OTP) services.

At 47.3 overdose deaths per 100,000 people, Delaware has the third highest drug overdose mortality rate of all U.S. States, with 75% of those overdose deaths involving opioids.⁴ In 2020, there were nearly 450 drug overdose deaths in Delaware.⁵ Ensuring that individuals with opioid

use disorder (OUD) in disaster contexts have access to treatment is an important dimension of both facility- and community-level disaster preparedness and response.

Prior disasters and emergencies have led to documented disruptions to access to OTPs. Following Hurricane Sandy, individuals with substance use disorders ran out of “take home” doses of medications for treating opioid use disorders.⁶ Following Hurricane Katrina, individuals in OTPs were at higher risk of withdrawal and relapse due to disruptions in treatment attributable to not only storm damage and displacement but also cumbersome state and federal regulations without functional emergency provisions.⁷ Another study after Hurricane Katrina noted the downstream effects of treatment disruptions for individuals with comorbid psychiatric conditions⁸; these included but were not limited to homelessness, criminality, and overdose. In a study assessing disruptions to OTPs, Elliott et al., set forth recommendations from state opioid treatment authorities to mitigate the negative impacts of disasters on treatment continuity.⁹ However, most provisions centered on providing at-home doses, improving patient-provider communication, and implementing other stop-gap measures rather than addressing larger policy and planning frameworks to reduce overall risk.

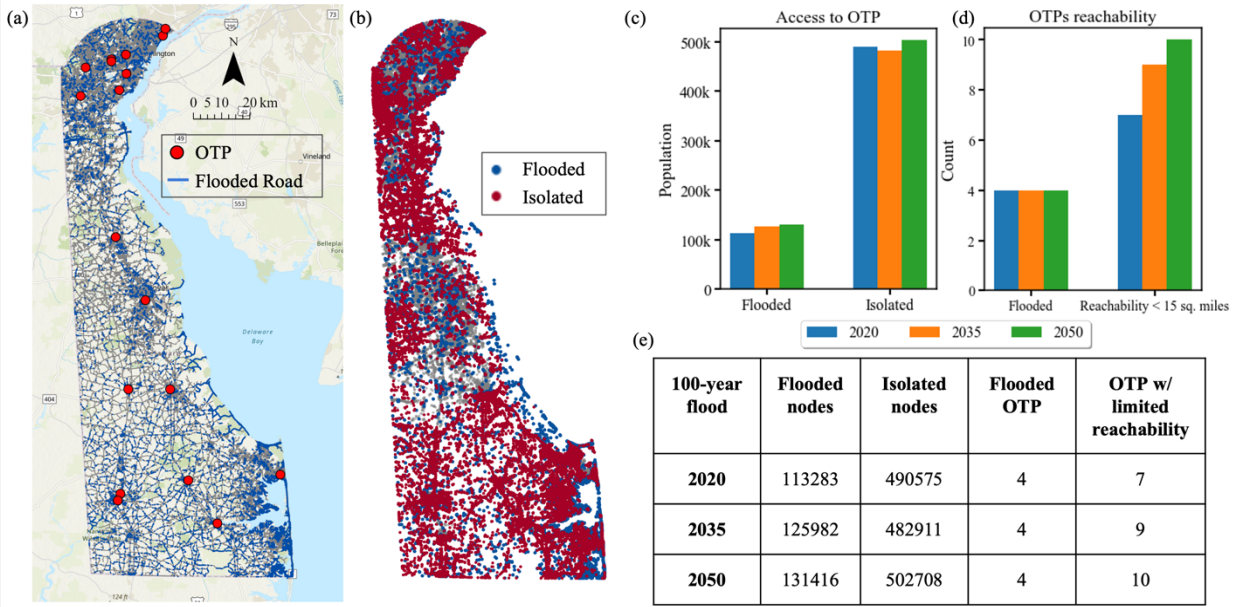
Methods

The location of OTPs in Delaware was downloaded from the U.S. Department of Health & Human Services and the Centers for Medicare & Medicaid Services. The road network was extracted from the open-source platform OpenStreetMap, and flood risk data was obtained from the First Street Foundation. These flood data are produced through a probabilistic flood model that considers flooding risk due to rainfall (pluvial), riverine flooding (fluvial), and coastal surge flooding. A complex network approach was employed to integrate flood risk with the transportation network, which was then abstracted as a graph with nodes representing intersections and links representing roads.¹⁰ During network disruption simulation, once a road is detected in a flood zone, it was removed from the network. A search algorithm was then deployed to identify the flooded and isolated intersections from OTPs. The properties and population associated with those intersections were then estimated.

Results

Delaware has a total of 18 OTPs (Figure 1). Mapping the State’s transportation network onto the OTP facility locations produces a total of 137,586 nodes and 170,114 edges, where nodes are intersections and links are roads (1a). When the 100-year floodplain map is overlaid with the transportation network, flooded roads can be identified. During flooding, 18,160 nodes in Delaware will be directly inundated. An additional 72,196 nodes, while not inundated, will lose access to OTPs (1b).

Figure 1. Flood disrupted road access to OTPs in Delaware



(a) 100-year flood map overlaid with road network of Delaware and spatial distribution of the OTPs. (b) Flooded and isolated (disconnected) nodes for access to OTPs. (c) the population impacted due to flooding and isolation. (d) OTPs that are either flooded or severely disrupted with reachability less than 15 sq. miles. (e) Estimated number of population and OTPs impacted by flooding.

The loss of access to OTPs is expected to grow over time (1c). Accounting for climate change impacts, the population impacted by flooding will increase when using projected flood risk for 2035 and 2050. In particular, isolated access to OTPs increases by more than three times the increase in the number of flooded OTPs (1c). Accordingly, the proportion of the population that may be isolated from needed OTP services during a flood disaster will only increase over time. The operation of OTPs can be severely impacted as well (1d). Four OTPs will be flooded and 7 OTPs have a reachability (i.e., service coverage) less than 15 sq. miles in Year 2020 scenario. The reachability disruption risk continues to grow to 9 facilities in 2035 and 10 facilities in 2050 if no proper flood mitigation is implemented.

The risk of access loss is not equally distributed across Delaware. Communities like Middletown in New Castle County have a large population at risk of losing access to OTPs. However, the median household income of Middletown residents is nearly 30% higher than the state median income.¹¹ Other communities which will be severely affected by flooding - Bridgeville and Millsboro in Sussex County - have median household incomes over 20% lower than the state median income. Higher socioeconomic status and other social determinants of health may allow affected populations to utilize additional resources - financial and otherwise - to mitigate negative impacts of flood disasters. Future research should consider the synergies between factors like income that contribute to social vulnerability and access to OTP and other types of acute care during a flooding disaster.

Discussion

The importance of maintaining operational capacity for OTP in post-disaster contexts is multidimensional. First, individuals in treatment programs need to closely adhere to their

treatment regimens to reduce the risk of relapse. Because medication-assisted treatment programs require access to methadone (or equivalent medications) and, in most scenarios, oversight by clinical staff, the physical security and operability of OTP facilities is vital to the provision of care.¹² As flood risks increase over time, it is critically important to ensure that Delawareans who utilize OTPs are able to quickly access services in flood disaster contexts to maintain treatment progress. Second, individuals who use opioids experience lapses in availability of opioids pre-and post-disaster. This, in conjunction with disturbances to treatment protocols, results in an increase in the number of emergency services consults for drug withdrawals. Quick resumption of OTP services can not only mitigate the negative health impacts on Delawareans but also relieve pressure on Delaware health systems as a whole. Further, because of the specialized nature of and federal regulations for OTP facilities, it is nearly impossible for these facilities to reopen in new locations in a timely manner.⁶ This is particularly problematic because the care provided by these programs is highly time-sensitive. Program, local, and state officials should account for these federal regulations in emergency planning and continuity of operations planning. Moreover, strengthening resilient and equitable post-flooding access to acute care services should not be the health sector's responsibility alone. Transportation infrastructure development and hazard mitigation decision-making should also consider the project's impact on the community's accessibility to OTP, especially those disadvantaged ones who repeatedly suffer from accessibility loss while having limited capacity to cope with and recover from the flooding.

Public Health Implications

Flooding and other types of disasters can disrupt access to many types of infrastructure and services, including access to acute medical care such as OTPs. The negative health impacts of these disruptions can be particularly severe for people with OUDs. In the case of a 100-year flood in Delaware, more than 600,000 Delaware residents would potentially be unable to access an OTP because of a flooded road or the isolation of an OTP facility by floodwater. Missing treatment has been consistently associated with mental distress and psychological consequences, as well as relapse, overdose, and death. Therefore, planning and policy interventions that address increasing flood hazards and associated risks to OTPs in Delaware are needed to prevent disaster-associated program closures.

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