UnityPhilly: Experiences with a Smartphone App that Facilitates Community Response to Opioid Overdoses

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ABSTRACT

This case study presents the use of UnityPhilly, a community-based smartphone intervention that facilitates layperson response to opioid overdoses. Our analysis focuses the information needs of lay responders. In a Philadelphia neighborhood particularly hard hit by the opioid crisis, 112 participants received training on identifying and reversing an overdose with the drug naloxone, and installed the UnityPhilly app on their smartphone. Over the course of one year, participants used the app to report 291 observed overdoses to one another and EMS, and respond to the scene of 74 overdose incidents. Our case study uses thematic analysis of interviews and survey data collected throughout the community trial. Results indicate that basic functionality was easy to use for many, enabling active user engagement and indicating significant potential for this intervention. However, usability issues included communication and information features during incident response, which were not discoverable. Addressing usability issues and information needs could help lay responders as well as overdose victims.

CCS CONCEPTS

• **Human-centered computing** → **Ubiquitous and mobile computing design and evaluation methods**; *Empirical studies in ubiquitous and mobile computing*; Empirical studies in collaborative and social computing; • **Information systems** → *Spatial-temporal systems*; • **Applied computing** → *Sociology*.

KEYWORDS

emergency response, peer support, community-based intervention, bystander intervention, public health, substance use

C&T '21, June 20–25, 2021, Seattle, WA, USA

ACM ISBN 978-1-4503-9056-9/21/06…$15.00
https://doi.org/10.1145/3461564.3461593

ACM Reference Format:
Gabriela Marcu, Amber Hardin, Janna Ataiants, Alexis Roth, Stephen E. Lankenau, and David G. Schwartz. 2021. UnityPhilly: Experiences with a Smartphone App that Facilitates Community Response to Opioid Overdoses. In *C&T '21: Proceedings of the 10th International Conference on Communities & Technologies - Wicked Problems in the Age of Tech (C&T '21), June 20–25, 2021, Seattle, WA, USA.* ACM, New York, NY, USA, 7 pages. https://doi.org/10.1145/3461564.3461593

1 INTRODUCTION

The opioid epidemic has been a significant and rising cause of mortality and morbidity in the United States, and has only worsened during the COVID-19 pandemic [29]. The rate of drug-related overdose deaths in Philadelphia is more than triple the national average [11]. Philadelphia reported that "2020 was the deadliest year ever for overdoses in Philadelphia," in large part because of exponential increases in the presence of fentanyl [17]. Fentanyl is a synthetic substance unpredictably mixed in with other opioids, and it is 50 to 100 times more potent than morphine [7]. City data indicate that 80% of accidental overdose deaths involved fentanyl [17].

A key intervention for curbing the overwhelming number of fatalities is distributing naloxone in affected communities. Naloxone, also known by the brand name Narcan, is administered intranasally to reverse an overdose and prevent death [4]. Laypersons can administer naloxone as a nasal spray with few medical risks, making it a feasible intervention for wide use by the public [4]. A 5-year model comparing public policy interventions indicated that "increasing naloxone availability resulted in the greatest number of addiction deaths averted among the 11 interventions" analyzed [21]. The authors of the study note that a range of interventions together are needed to curb the opioid epidemic, and that provision of naloxone can have the greatest short-term effects [21].

In 2014, Pennsylvania joined other states in passing legislation that enables pharmacists to provide naloxone to anyone without a prescription [8]. In addition, "Good Samaritan" laws protect community members from prosecution if they administer naloxone because they believe someone is overdosing [8]. Community-based organizations have played a key role in the distribution of naloxone through bystander training programs. These organizations focus on harm reduction strategies, typically having started as needle exchange programs to prevent the spread of diseases such as HIV

from sharing needles [10]. For example, a Boston-based study in 2009 found that participants of needle exchange programs witness a large number of overdoses [4]. They identified the potential of this population for bystander intervention and then demonstrated the feasibility of a bystander training program.

Prevention Point Philadelphia is a local leader providing bystander intervention training, working to meet demand with a high volume of requests for training sessions [22]. It is located in the neighborhood of Kensington, the epicenter of the opioid epidemic in Philadelphia. Kensington draws nearby residents as well as people from other parts of the country because of its notoriety for access to heroin and other opioids, for which locals have referred to it as the 'Walmart of heroin' [20]. A 2018 public health report correlates the highest concentration of naloxone administration in the city to Prevention Point's location in Kensington [19]. Compared to the 236 overdose deaths in Kensington that year, more than 1,000 (over 4 times as many) overdoses were non-fatal because they were reversed with naloxone [19]. Prevention Point distributed about 5,500 doses of naloxone that year, while Philadelphia's fire department administered naloxone 4,000 times [8].

Taking a sociotechnical perspective [9, 12] on this problem, we consider the prevalence of smartphones alongside emergency response infrastructure. With the continued proliferation of smartphones in communities, their role will shape, and be shaped by, changing social and policy factors. For example, in 2014, the U.S. Federal Communications Commission announced that it will begin supporting text messaging to 9-1-1 using SMS and IP [3], but this service is not yet available in Philadelphia. Meanwhile, there have been suggestions in both the U.S. and Canada to "lower the barriers to calling 9-1-1 by limiting police involvement during routine calls" related to overdoses where there is no fatality or risk to public safety [5]. In 2016, the U.S. Food and Drug Administration launched a nationwide Naloxone App Competition "to create a mobile phone application that can connect opioid users experiencing an overdose with nearby carriers of the prescription drug naloxone – the antidote for an opioid overdose – thereby increasing the likelihood of timely administration and overdose reversal" [6].

In this case study, we describe one such smartphone application, UnityPhilly, which we developed and deployed in cooperation with Prevention Point Philadelphia. We report on a one-year trial, completed just prior to the COVID-19 pandemic with 112 participants. Analysis of interview data from a subsample of 20 of these participants reveal how basic functionality enabled their response to an overdose, while not all features and functionality met their information needs in the moment. We analyze use and non-use of app features, and overall attitudes toward the role of a smartphone app in facilitating community response to opioid overdoses.

2 COMMUNITY-BASED RESPONSE TO OPIOID OVERDOSES

Opioid overdoses are common within the long-term trajectory of substance use, treatment, and recovery. During an opioid-involved overdose, the victim typically loses consciousness very rapidly, rendering them incapable of sending out a signal for help or administering naloxone to themselves. These responsibilities are therefore shifted onto bystanders [18]. Studies have found that, generally, bystanders of opioid overdoses have reported willingness to help others, though the help they would provide might depend on the individual overdosing (e.g., friend, stranger) [23, 27]. The majority of individuals receiving and administering naloxone are persons who use drugs [24, 30], reflecting a "buddy ethic" among opioid users who "watch out for each other" when using [14]. Among non-medical opioid users (NMOUs) and their family members, the expression of prosocial behavior such as responding to an overdose is likely tied to a shared identity held by those who have experienced the suffering associated with opioid use [1, 28]. One study of naloxone recipients identified that most (74.6%) cases of naloxone administration are performed on companions or acquaintances of recipients [24]. However, bystanders administering naloxone to strangers is also common [15]. The number of laypersons seeking out naloxone and training from organizations such as overdose prevention programs has been increasing considerably, demonstrating a motivation to respond to overdoses [30].

A community-based intervention in this context can tap into these known prosocial behaviors. To enable layperson help during an opioid overdose, UnityPhilly is designed as an Emergency Response Community (ERC). Within the landscape of emergency response technologies, ERCs involve a unique interaction paradigm wherein one layperson alerts another based on proximity, and collaborates with them directly [25]. The ERC approach to lay medical intervention is based on the premise that even though most community members within the vicinity of an incident will not carry the necessary medication, there will be a sufficient number of laypersons in a population carrying the medication at any given time to evoke a positive response within minutes [25].

An ERC Effectiveness Modeler has been developed in order to aid researchers and policymakers in understanding the potential efficacy of ERCs given certain parameters, such as prevalence of the medical condition, estimated per capita density of laypersons carrying the medication, and mobile service availability [13]. Using these parameters, the modeler identifies potential outcomes, such as expected response times by ERC members relative to expected response times of trained emergency responders [13]. Response via an ERC for opioid-involved overdoses in a metropolitan area, such as the Kensington neighborhood in Philadelphia where our research is conducted, was estimated to be faster than emergency medical services in 30.61% of overdose cases [13]. This UnityPhilly case study describes the first field trial of an ERC for opoid overdoses.

We developed UnityPhilly as a smartphone application, and we are aware that this makes it less accessible to some populations than an SMS-based intervention. However, an SMS approach suffers from two main shortcomings. On the technological level, our primary goal at this stage is not inclusivity but rather exploring the benefits and innovative use that smartphone technology can bring to communities battling the opioid epidemic. Pursuing SMS-driven inclusivity would eliminate many of the location tracking that supports signal and response functions needed to support an effective intervention, and which have been shown to be inferior to app-based emergency response [2]. On the prosocial behavioral level, the use of a purposefully designed and branded community app can instill a sense of belonging and mutual responsibility that cannot be replicated in SMS messaging.

3 METHODS

This case study reports on experiences of participants in a 12-month trial of UnityPhilly. In prior work, we described generative research that confirmed acceptability of the UnityPhilly concept in Kensington and identified potential concerns within the community, in preparation for the trial [16]. Descriptive statistics on app use throughout the trial have been reported in a prior publication [26]. This case study focuses on thematic analysis of interviews from the end of the trial, with a subsample of its participants, to understand community perspectives on UnityPhilly. The study was approved by the Drexel University Institutional Review Board and registered with ClinicalTrials.gov (NCT03305497).

3.1 UnityPhilly app

The UnityPhilly app enables a person witnessing an overdose to signal an SOS alert for others nearby. This action automatically initiates a call to 911 and triggers a push notification on the phones of other UnityPhilly app users who are within a 15-minute estimated-time-of-arrival (ETA) from the location. Alerted individuals can then use the app to indicate they are either on their way to assist with the overdose or they are declining to respond to this incident. The app includes other features, such as navigation to the overdose incident, and options for communicating with the signaler, including a "Push-To-Talk" button for a walkie-talkie type of communication. Detailed information about UnityPhilly can be found in a prior publication from the larger study [26].

3.2 Recruitment and procedures

From October 2018 to January 2020, 112 people were recruited from different parts of Kensington, through Prevention Point Philadelphia. Recruitment criteria included: the possession of an Android or iPhone smartphone with a data plan; the agreement to install UnityPhilly and have the app track the participants' locations; the agreement to carry naloxone; as well as living, working, or spending a significant portion of time in Kensington.

The baseline procedures involved: written consent, registration of demographic and contact information, completion of a baseline survey, overdose prevention training, and UnityPhilly app training. The baseline survey collected sociodemographic, drug use, overdose, and naloxone use characteristics. At the end of the baseline procedures, each participant received an overdose prevention kit, including two spray devices, each containing 4 mg of intranasal naloxone. Participants were compensated with $25 in cash for baseline procedures.

Data collection throughout the rest of the trial consisted of app system data and incident survey data. App use was monitored during the 12 months of the UnityPhilly trial, from March 1, 2019 through February 29, 2020. All app activities were timestamped and logged on the system server, including: signaling an overdose by pressing the SOS button; receiving an alert based on location ETA; agreeing to respond to an alert by selecting "En-route"; declining to respond to an alert by selecting "Can't go"; and arriving on scene to the location of an overdose. No activity data were retained on participant smartphones.

Within 72 hours following each suspected overdose incident alert, a Qualtrics-based incident survey was sent to study participants involved in the incident. Survey text included the date and time of the overdose incident to help trigger recollection. Out of 290 incident surveys that were sent, 243 (83.79%) valid responses were received. The survey instrument polled respondents on the observed condition of the victim; naloxone administration; number of naloxone doses administered; arrival of EMS/police/fire responders; time lapsed between layperson arrival and EMS/police/fire arrival; observed victim recovery; and post-recovery actions. The participants were compensated with $5 cash for each follow-up survey completed.

Descriptive statistics across these data are presented in another publication [26]. This case study focuses on qualitative analysis of interviews at the conclusion of the trial, informed by app use and incident survey data.

3.3 Qualitative sampling and interviews

A subsample of 20 people was selected for interviews from the total sample of 112 participants. The selection of participants for interviews was guided by the principle of proportionality so that the subsample would be representative of participants in terms of gender, drug use status (use/non-use of opioids), and app use (participants with higher and lower levels of app use). Interview participants were initially contacted via a phone call, text message or in person where they came to collect monthly incentives for short surveys or to take part in a supplemental study.

Interviews were conducted between the end of January 2020 and mid-March 2020. Eighteen interviews took place in the research office in Kensington and the last two interviews were held by phone, since the end of the qualitative part of the study coincided with the start of the COVID-19 epidemic. Interviews ranged in length from 17 to 55 minutes. The interview guide included the following domains: motivation for participation in the study; feedback on UnityPhilly training and overdose prevention training; experience of using the app as a signaler and responder; reasons for not using the app; overall feedback on the app and its specific features; and recommendations for future use of the app. Participants were compensated $25 in cash for participating in an interview.

3.4 Analysis

In-depth qualitative interviews were recorded on a digital recorder and transcribed by a transcription agency. Transcripts were uploaded into Dedoose version 8.3.35 (2020) and analyzed through a combination of deductive and inductive coding. An initial round of deductive coding by the third author replicated the overarching domains in the qualitative interview (e.g., motivation for participation in the study, feedback on UnityPhilly training). Six of these resulting codes became the focus of further analysis: app use, app non-use, probe of all app features, false alarms, app feedback and improvement, overall experience in the study. Data from these codes were combined and open coded by the first two authors and five research assistants. As inductive coding continued, codes were compared, revised, and combined through discussions among all coders. Key patterns identified across the codes were used to generate themes, which are described in this case study.

4 FINDINGS

Across 12 months and 112 participants, 291 suspected opioid overdoses were signaled. Of these signals, 89 (30.6%) were false alarms. Of the remaining 202 cases, 74 (36.6%) resulted in a UnityPhilly user administering naloxone. Naloxone was administered 1.42 times per week on average, and was done more than 5 min in advance of EMS arrival in 59.46% of cases. (See [26] for more descriptive statistics.)

The 20 qualitative interview participants drew on their experiences in the trial to discuss their perceptions of the UnityPhilly app. They enjoyed how the app united others in their community around a common purpose and shared mission. Many of them felt the basic functions of UnityPhilly were easy to use, while other functions were not discoverable. Finally, they described the stress they experienced in the moment, and how the ways in which the app calculated and displaying distance information played a role in managing that stress.

4.1 Uniting People Around a Common Purpose and Shared Mission

General perceptions of UnityPhilly confirm and extend findings from our generative research in Kensington [16] which indicated a strong motivation to help victims of overdose—especially when grounded in personal experience with opioids, overdoses, or the suffering or loss of a loved one. These shared experiences engendered more trust and reliance on one another, compared to professional responders and outsiders to their community who were perceived as less compassionate. Participants' desire to unite as a community and help their own ultimately inspired the app name of UnityPhilly.

Actual use of UnityPhilly during the trial gave participants a sense that they were uniting with others: *"I liked the fact that it brought together people that all had the same common purpose; they all wanted to do the same thing"* (P18). When UnityPhilly led participants to encounters with other app users in person, they felt that these did not come with the same drawbacks as interactions with Emergency Medical Services (EMS):

> *"It's essentially a community of people who have the app, and we're meeting people, we're meeting strangers who have the same mission to get to that person who's overdosing. So occasionally I would come across other responders on the scene. So that was pretty interesting. And it was interesting to see that it wasn't EMS. Because it's a different vibe when EMS is on the scene. It's just like, it becomes a territorial thing with EMS."* (P10)

Participants saw UnityPhilly as technology that had the potential to help people, and their motivation to be involved sometimes stemmed from a shared identity with overdose victims:

> *"I liked that I was helping and involved with technology that might help people in my area with problems similar to my own. Maybe different levels, but still. And I think that was great from a technology and a humane point of view."* (P9)

Interestingly, a characteristic of caring was even attributed to others on UnityPhilly: *"It's cool to have additional support. You know, it's like at least you know that there's people out there who care and want to help"* (P1). This perception indicated that discernible activity on UnityPhilly could help app users feel supported, but also highlights the importance of fostering and maintaining trust among app users.

Participants especially welcomed the additional support from and through technology because they were in a neighborhood where overdoses are very common. Seemingly expressing the urgency of the opioid crisis in Kensington, they noted that *"it's definitely necessary out here"* (P7). Consequently, participants wanted to see growth in active UnityPhilly users: *"I think it's a great idea, I just wish it would grow faster as far as getting it out there into more and more people's hands"* (P11). One participant described wanting to see the app more active in and around geographic locations of active opioid use:

> *"I would just say getting it more in the hands of folks who are in and around communities, were actively using, but also folks around the hot spots where it's happening, would be important."* (P20)

Some appeared to become spontaneous evangelists for UnityPhilly, sharing with us that they had mentioned and explained it to people who were not participating in our study: *"Like oh, you don't know about the app? So I'll show them... I do tell them about it"* (P10). This behavior suggests that snowball recruitment could be a potential avenue for growth, especially since those active with UnityPhilly could help to vet and invite new community members whom they trust.

4.2 Basic Functions Felt Easy and Familiar but Others Lacked Discoverability

A top priority in the design of UnityPhilly was enabling users to efficiently and easily signal an overdose, then confirm response. Outside of these basic functions, we also brainstormed other kinds of functionality for communication, informational support, and social-emotional support. However, it was important that other functions not clutter the interface, add cognitive load, or otherwise impede facilitation of rapid response. Our analysis of trial data indicated that UnityPhilly's basic functions were easy to use, while others were so out of the way as to be undiscoverable to some.

Participants did not report difficulty with signaling or responding. For example, signaling a witnessed overdose only required launching the app and pressing a large button labeled "SOS," and this was experienced as a simple process: *"Well it's easy, it's big, it's quick, you just – you hit it and it goes from there, it does everything else on its own"* (P11). One participant even described the process of signaling as easier than making a phone call, seemingly because it took fewer presses of a button: *"It's a lot easier than calling – you know, having to go to your phone and pull your keypad"* (P1). Other features that were noted for their usability were the 'can't go' button which allows those users alerted about a nearby overdose to indicate they would not respond, and the route map which provides GPS-based navigation to the overdose location. Participants also explained that after our brief training they felt ready to use the app: *"After your training... they showed me how to use it and that was it. Information retained. It was pretty easy. It was pretty user friendly. Yeah. Intuitive. That's the word I was looking for"* (P9).

One aspect of UnityPhilly's design that made it user friendly was its similarity to other, familiar technologies. For example, UnityPhilly uses the Google Maps Geocoding API, and participants found the map and directions to be familiar, easy to use functionality: *"They [the maps] were right on. It was easy to be able to find out which way to go. And it gives you actual directions if you don't know. Just like the Google Maps do. So it was pretty good, just like that"* (P18). Likewise, those who used the push-to-talk feature found it to be similar to the walkie-talkie feature of previous models of Nextel phones: *"What I liked is that you could – it was almost like being on the old Nextel [phone] and saying 'I'm on my way'"* (P9). However, this was one of the features of which some participants were not aware.

Our interview guide probed UnityPhilly's various features, and this helped us uncover which of them participants had not discovered. Participants also noted on their own that there were instances in which they did not know how to perform a non-basic task:

> *"Occasionally, I'll come across not being able to put some information or find some information. But that might be me. Like I don't, I'm not techy like that. So I don't understand some of the stuff on the app. I just know how to respond."* (P10)

We found that the most commonly undiscovered were communication features (push-to-talk, a chat with others involved in responding to an incident) and informational resources (how to attend to a victim of overdose, how to administer naloxone). For example, when asked about the informational resources, one participant shared: *"I didn't know it was in there, to be honest with you. I thought I explored it pretty well, but I didn't see them online"* (P11).

Participants who had discovered these features described them as useful. Although all participants received opioid reversal training prior to downloading and using UnityPhilly, having accessible informational resources on the proper steps while responding could serve as useful and reassuring reminders:

> *"This one right here – if you don't know what to do, you're nervous, you're scared, and people are standing around and you don't want to mess up, you look at the video and it tells you exactly what to do and how to do it. That's the most useful thing. Yeah, how to administer it."* (P15)

Our trial therefore provides evidence for the utility of non-basic functions, suggesting their role and discoverability should be further explored—while maintaining simplicity and ease of use for the most critical response tasks. Moreover, while scaling use of UnityPhilly, it will be important to incorporate walk-throughs and training videos to replace the in-person training that participants found helpful. These should be required on download, and accessible later on to refresh app users on various functions available.

4.3 Calculating and Displaying Distance Information

When a UnityPhilly app user signaled a suspected overdose to request help, other app users were automatically notified if they were within an estimated 15 minute distance, which was calculated dynamically based on their selected mode of transportation (foot, bike, car, or 4x4 off road vehicle). We found that participants generally drove to respond to an incident. During interviews, participants shared instances when they felt the notification radius used by the app was too large. For signalers, a map view within the app helped them understand when one or more responders were on the way. One participant described looking at the location of confirmed responders on the map, and perceiving the distance to be quite far:

> *"I remember seeing how close and far they were. You know, it's like when you're in the moment you're not really thinking about what you're pressing and doing. Because I know I was thinking, like, I'm not real good with areas. But it looks just like Google Maps or whatever. But I did think the one person was like – you know, they're kind of far. That's what I remember thinking."* (P8)

The mapped location of responders has the potential to provide reassurance to signalers that help is on the way. However, if the distance is perceived as significant, this could add to the stress experienced by signalers amid an overdose incident. Even responders, who do not have a victim right in front of them, described the stress of the perceived distance. P16 explained the pressure of receiving a notification with the mapped location of a suspected overdose victim:

> *"For me anyway I take this very seriously, okay. So if someone's overdosing and it doesn't matter how far away it is, I'm getting this ping. I'm thinking I have to go... So I think the radius was too far though. Because like I'm saying, here to 2nd and Spring Garden, that's kind of far. And I was a little stressed, and especially the one up on 5th Street, like that was really far. That was rush hour traffic and I'm like, oh shit, this person could be dead by the time I get there. It took me like 20 minutes."* (P16)

A more accurate travel estimate, which accounts for factors such as traffic, could help to reduce this pressure. A smaller response radius, such as 10 minutes, could also be tested to assess its impact on the stress levels of signalers and responders during an incident. Moreover, the way distance information is presented to signalers and responders could be designed in ways that not only reduce cognitive load in a crisis, but also help them to manage psychological stress during the incident (and following). A UnityPhilly user's selected mode of transportation was part of general settings, but could instead be displayed and confirmed with each signaled incident to help a potential responder have more control over obtaining an accurate estimate while making the decision about whether to respond. Reminding the user that there are other potential responders in their community is also helpful to them in that moment. P11 described how comforted he felt knowing UnityPhilly would notify others who could respond even if he declined the request:

> *"Well I like that it's there, that it could be moved to somebody else if I can't make it, so I don't feel as bad. It's a good feature to have, so if it goes to me and I can't be there, at least if I hit the 'can't go' button, then somebody else will get the message. They may be a little bit farther away than me, but at least the call goes out*

so somebody can get it, so that's a good feature. And then I don't really have any gripes about it." (P11)

Overall, our findings confirmed that the map view during an incident was easy to use and effective for both signalers and responders. However, perceptions of distance and other people involved were related to feelings of stress, so there are design opportunities to help signalers and responders manage decision-making as well as psychological stress.

5 CONCLUSION

Our field trial participants were members of a community that has experienced the marginalization and trauma of the opioid epidemic, and they appreciated the use of a smartphone app to coordinate layperson response to overdoses. They were motivated by an app uniting them with others around a common purpose and shared mission, to provide lifesaving help for victims of overdose within their own community. Participants wanted to see engagement from a larger number of people on the app, and were even personally willing to share information about the app with others. Despite a fair number of false alarms and usability issues with non-basic app functions, participants were able to use the basic functions of UnityPhilly, resulting in their administering naloxone for 74 overdose incidents. Our trial provides evidence for the utility of additional features that should be explored further—such as those enabling users to communicate with one another or reference informational resources on how to help a victim of overdose. Finally, there remain design opportunities for helping both signalers and responders to manage decision-making as well as associated psychological stress when a victim has overdosed nearby.

ACKNOWLEDGMENTS

We thank the community organizations and individual participants for their contributions to this research. We are grateful to the data analysis efforts of Michelle Chung, Dana Dean, Julia Dean, Ann Dysert, Kayla Guerrero, Jade Shepherd. This work was supported by the National Institute on Drug Abuse of the National Institutes of Health (grant number 5R34DA044758). The content is solely the responsibility of the authors and does not reflect the official views of the National Institutes of Health.

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