C.O.R.R.A.: Feasibility of Community Overdose Response Respiratory Alert

Minzhu Zhao
University of Minnesota
Minneapolis, Minnesota, USA
zhao2056@umn.edu

Ahmed Y. Hassanein
University of Minnesota
Minneapolis, Minnesota, USA
hassa940@umn.edu

Svetlana Yarosh
University of Minnesota
Minneapolis, Minnesota, USA
lana@umn.edu

Abstract

Drug overdoses have become an epidemic worldwide over the past decade, with 68,000 fatal overdoses in 2023 in the U.S. alone. While such deaths could be reversed with timely reversal medication administration, ensuring that early detection leads to prompt response remains challenging, making effective intervention difficult. In this study, we propose a design concept that combines early detection and community-based response to opioid overdoses. Specifically, we examine the social acceptability and feasibility of using thermal cameras in public spaces to detect respiratory emergencies and mobilize bystander response. We propose a proof-of-concept system, which combines thermal sensing for respiratory failure detection with naloxone administration guidance for bystanders. Then we evaluate the social acceptability and feasibility of this proposed intervention through a street survey and interviews with nine frontline health emergency workers.

CCS Concepts

• **Human-centered computing**; • **Empirical studies**;

Keywords

substance use disorder, overdose, public health, thermal sensing

ACM Reference Format:
Minzhu Zhao, Ahmed Y. Hassanein, and Svetlana Yarosh. 2025. C.O.R.R.A.: Feasibility of Community Overdose Response Respiratory Alert. In *Proceedings of (CHI '25 Workshop on Envisioning the Future of Interactive Health).* ACM, New York, NY, USA, 4 pages.

1 Introduction

The opioid crisis has become one of the most critical public health issues to combat in the U.S. and worldwide [29]. In 2023, more than 68,000 lives were lost in the U.S. due to drug overdose, mostly opioids [9].

Compared with many other life-threatening medical emergencies, opioid overdoses have a more straightforward intervention approach: using reversal medication (naloxone). This can effectively prevent overdose death, even when administered by untrained bystanders with simple guidance within the critical 3-5 minute window before brain damage begins. Meanwhile, data from the Centers for Disease Control and Prevention (CDC) also reveal a crucial opportunity: 42.6% of overdose victims in the U.S. in 2023 had at least one bystander nearby who could potentially intervene [9]. This represents a vital opportunity: to engage the bystander in prompt intervention in public spaces as a community-based strategy for overdose. However, it is rare that bystanders notice when someone is overdosing, and even if they do, distinguishing between someone who is sleeping and someone experiencing a potentially fatal overdose is challenging for untrained bystanders, leading to their hesitation when immediate intervention is needed.

Although such a community-based overdose detection and response could work as a new strategy, the deployment of such technologies in public spaces could raise practical concerns such as social acceptability. Therefore, before implementing these interventions, it is also crucial to first understand their social acceptability and feasibility in terms of how communities perceive and might interact with these systems and whether they could be effectively integrated into existing emergency response frameworks. Following this, we raise two research questions:

- **RQ1**: How do bystanders and frontline service providers perceive the feasibility of implementing the community overdose response device?
- **RQ2**: What concerns do people have about participating in an overdose intervention in public spaces?

Our ongoing study investigates the acceptability and feasibility of using thermal sensing in public spaces (libraries, trains, buses) to detect when somebody stops breathing (i.e., due to opioid overdose) and to mobilize bystanders to deploy overdose reversal medication. Until now, we conducted a large street survey to establish the public's opinion of such a potential system and their willingness to deploy an overdose reversal medication if prompted. We also interviewed nine service providers who have experienced people having real overdoses in their line of work to understand the acceptability and feasibility of our proposal. Meanwhile, we demonstrated the technical feasibility by implementing a proof-of-concept system called Community Overdose Response Respiratory Alert (C.O.R.R.A.), which incorporates thermal sensing to respiratory failure detection and automatically dispense medication.

2 Related Work

Our study focuses on understanding the acceptability and feasibility of using thermal sensing in public spaces for intervention to prevent overdose. Therefore, the following literature review section is separated into two parts. It begins by presenting the detection technologies for breathing patterns. Then, we review existing work on SUD interventions in HCI field.

CHI '25 Workshop on Envisioning the Future of Interactive Health, Yokohama, Japan

2.1 Respiratory Patterns Detection and Cameras in Pubic Spaces

To detect or monitor respiratory patterns, trending sensing technologies could be categorized into two threads: 1) contact-based and 2) contactless. Contact-based technology, such as wearable devices, is suitable for an individual to use to track various vital signs through physical contact with a body. Contactless technologies are suitable for deployment in certain rooms or public spaces. Various **contact-based technologies,** have been proposed, such as smart watches [22]. **Contactless technologies,** radar [17], sonar [21], thermal cameras [34], have been proposed. Inspired by previous work using contactless techniques to monitor health emergency [21], our study proposes a proof-of-concept system with thermal detection to detect overdoses in public spaces. Surveillance cameras and other sensing technologies have become common in public spaces in recent decades, widely used for protection of human assets [20], and healthcare [7].

However, some challenges related to camera-based detection in public spaces raise concerns, particularly uncontrolled conditions, and privacy considerations. In particular, tensions arise in camera-based detection when surveillance is employed for social good, such as in health emergencies. Meanwhile, since our system relies on community response, understanding people's willingness to engage with and support the community-based response to overdose could inform future design.

2.2 HCI and SUD Interventions

In 2019, the Computing Community Consortium (CCC) held a workshop to discuss the opportunities and challenges of developing computational support systems for substance use disorders (SUDs) from four perspectives: prevention, detection, treatment, and recovery [36].

Based on human-centered computing principles and patient-centric ecological approaches to SUDs, most HCI work in this space has explored growing technological capabilities for recovery stage [3, 8, 32]– part of the treatment experience of substance use disorders, such as detecting and mitigating the risk of SUDs relapse [14, 18, 27, 35, 39, 40], establishing digital social support networks [6, 31], motivating consistent daily structure and recovery routine [10, 32, 37, 41], empowering people's re-entry [12, 25, 26, 28, 30]. Research has also examined how substance use behaviors are disclosed and discussed in online spaces [11, 13, 19, 33], and the spread of unverified health information [5, 23, 24].

Although SUD recovery and online discourse have received considerable research attention, the most relevant work focuses on individual substance monitoring after acute treatment [4, 15, 16, 35, 38–40]. Limited studies on detection remain underexplored in this space, particularly in public spaces. Our study specifically focuses on the immediate detection and intervention of opioid-related overdoses, exploring how technology could help the entire care ecology respond quickly to overdoses.

3 Tech Proof-of-concept and Implementation

While our primary contribution is to examine the social acceptance and feasibility of technical support for overdose detection and interventions in public spaces, we develop a proof-of-concept system as a technology probe- - Community Overdose Response Respiratory Alert (C.O.R.R.A.) system. This system employs thermal sensing in public spaces to detect respiratory failure and alert bystanders to administer reversal medication. The technical implementation below demonstrates the general design of this approach as a demo, enabling us to conduct a specific case study of potential overdose interventions. This system is designed to address two critical stages of overdose: 1) overdose detection and 2) alert and reversal support. The detection part is implemented by 1) a thermal camera to capture the heat signatures of individuals for detection and 2) Raspberry Pi 5 to process real-time data. Once an overdose is detected, the system provides immediate reversal support to facilitate rapid response. This includes 1) a tablet interface to display medication usage instructions and 2) an automatic reversal medication (Naloxone Spray) dispenser, to ensure medication accessibility.

The **detection mechanism** of our proof-of-concept system is based on previous work on thermal sensing of breathing patterns [1, 2]. Rather than tracking specific overdose symptoms, we simplify the mechanism by focusing on respiratory failure. To detect an overdose, the device tracks and measures the average temperature around a person's nose once per second and stores this data in memory. If the temperature difference remains below 0.125°C for seven seconds, an overdose is detected, and the alarm is triggered. The **reversal support part** of our design is important for a life-saving intervention. Although overdose detection is crucial, it is ineffective without immediate access to reversal medication and appropriate help. To ensure that help is readily available before EMS arrives, our system is designed to empower bystanders to take action, bridge the gap between detection and emergency response by dispensing medication immediately, and displaying an informational video to guide bystanders in administering naloxone correctly on the screen.

In summary, we develop a proof-of-concept system (shown in Figure 1) that supports a community-based response strategy, using thermal imaging. Our system addresses this critical gap for overdose intervention in public spaces by integrating detection with reversal support, encouraging bystander intervention.

4 Understanding Social Acceptability and Feasibility

To demonstrate the acceptability and feasibility of using thermal sensing in public spaces for overdose detection and to mobilize bystanders to deploy reversal medication, we have street surveys to establish public opinion of such a potential system and their willingness to respond. In addition, we also have a small set of semi-structured interviews with direct service providers, including community workers, librarians, and police, discussing acceptability and feasibility.

4.1 Street Survey

4.1.1 Method. We created a street survey with a one-page comic illustrating our proof-of-concept to evaluate its social acceptability. A total of 201 street surveys were conducted with passersby, who were randomly selected by three researchers in public spaces where the system could potentially be deployed, including light rail train stations and public libraries.

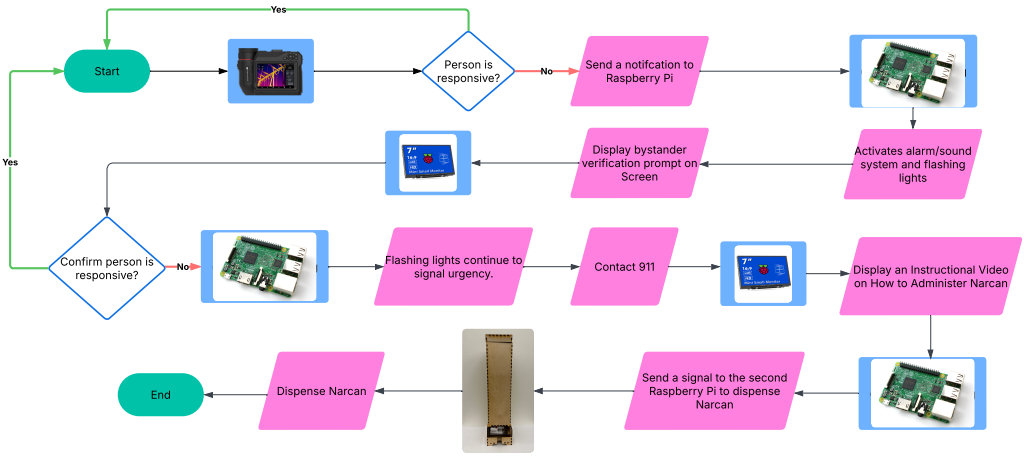

Figure 1: Hardware and software of our proof-of-concept system which combines thermal sensing for respiratory failure detection with naloxone administration guidance for bystanders.

4.1.2 Preliminary Results. Our survey asked participants whether they thought it would be okay to deploy a camera for these purposes and what they would be willing to do in that situation. More than 83% respondents believe that the system could be beneficial, while around 77% believe that the benefits of such intervention outweigh concerns. 168 of 201 people (83%) thought that they would be willing (strongly agree or agree) to administer Naloxone Spray. Even more people (85%) agreed or strongly agreed that they would be willing to check the person and put it in the system if the person did not respond. Based on our street survey, it is probable that at least one of these individuals will be inclined to assist.

4.2 Interviews with Community Professionals

4.2.1 Method. We recruited interviewees who have experience with encountering real or suspected overdoses in various job roles. Our study used a combination of direct outreach (the researchers disseminated advertisements and flyers to security specialists in libraries, metro police, social workers on harm reduction, and security professionals in the street) and snowball methods for recruitment. Based on the survey responses, we invited 9 respondents with various job roles to participate in our interviews. To kick off the interview, we asked interviewees about their experience dealing with overdose. To probe their perceptions, we demonstrate comics to show how our designed system works. Following demonstrating our design concept, we asked interviewees further questions about insights on the current design. Each interview lasted 30 minutes and each interviewee received $15 USD for their participation.

4.2.2 Preliminary Results.

Integrating Technology for SUD Emergency Community Response. Most interviewees mentioned that the deployment of such a system in public spaces would benefit their work by responding more quickly to potential emergencies. For instance, P3 appreciated it working as a great early notification tool — *...if this would detect something like this, it would maybe communicate a message ...we could maybe get to respond faster.*

Importance of Public Education on Harm Reduction. The other major suggestion of incorporating this technology into public spaces that emerged from our interviews relates to improving public education about the opioid crisis and harm reduction in general. For instance, *"...like this is, you know, if you hear this device like this is what it means and just a lot of public education about it. "*(P4)

Privacy Consideration. Privacy issues and potential surveillance of this technology were also discussed a lot, such as *"...data privacy is very important..."*(P5). Most professionals support the establishment based on existing infrastructure. P7 mentioned *"...people are already being monitored and it just adds something that could be helpful...."*

5 Discussion and Future Works

Although our study demonstrates some preliminary results on the feasibility of the thermal-camera-based community overdose response device, we hope to obtain more feedback on the current design concept for the future work by presenting it in the workshop. Also, we are aiming to have an open discussion on other alternative overdose detection technologies that could address the limitations of our current proposal in the HCI and Health community.

References

[1] Abbas K Abbas, Konrad Heimann, Katrin Jergus, Thorsten Orlikowsky, and Steffen Leonhardt. 2011. Neonatal non-contact respiratory monitoring based on real-time infrared thermography. *Biomedical engineering online* 10 (2011), 1–17.

[2] Abdulkadir H Alkali, Reza Saatchi, Heather Elphick, and Derek Burke. 2017. Thermal image processing for real-time non-contact respiration rate monitoring. *IET Circuits, Devices & Systems* 11, 2 (2017), 142–148.

[3] Robert D Ashford, Brandon G Bergman, John F Kelly, and Brenda Curtis. 2020. Systematic review: Digital recovery support services used to support substance use disorder recovery. *Human Behavior and Emerging Technologies* 2, 1 (2020), 18–32.

[4] Sangwon Bae, Denzil Ferreira, Brian Suffoletto, Juan C Puyana, Ryan Kurtz, Tammy Chung, and Anind K Dey. 2017. Detecting drinking episodes in young

adults using smartphone-based sensors. *Proceedings of the ACM on interactive, mobile, wearable and ubiquitous technologies* 1, 2 (2017), 1–36.

[5] Stevie Chancellor, George Nitzburg, Andrea Hu, Francisco Zampieri, and Munmun De Choudhury. 2019. Discovering alternative treatments for opioid use recovery using social media. In *Proceedings of the 2019 CHI conference on human factors in computing systems*. 1–15.

[6] Jason B Colditz, Lily H Hsiao, Brandon G Bergman, David W Best, Eric G Hulsey, Jaime E Sidani, Bruce L Rollman, and Kevin L Kraemer. 2024. Characteristics and engagement among English-language online forums for addiction recovery available in the US. *Internet Interventions* 35 (2024), 100708.

[7] Linas Darginavicius, Jone Vencloviene, Paulius Dobozinskas, Egle Vaitkaitiene, Dinas Vaitkaitis, Andrius Pranskunas, and Asta Krikscionaitiene. 2023. AI-enabled public surveillance cameras for rapid emergency medical service activation in out-of-hospital cardiac arrests. *Current problems in cardiology* (2023), 101915.

[8] Larry Davidson, Michael Rowe, Paul DiLeo, Chyrell Bellamy, and Miriam Delphin-Rittmon. 2021. Recovery-oriented systems of care: a perspective on the past, present, and future. *Alcohol Research: Current Reviews* 41, 1 (2021).

[9] Centers for Disease Control and Prevention. 2025. State Unintentional Drug Overdose Reporting System (SUDORS). Final Data. https://www.cdc.gov/overdose-prevention/data-research/facts-stats/sudors-dashboard-fatal-overdose-data.html Accessed: January 27, 2025.

[10] Eric L Garland, Bhanu T Gullapalli, Kort C Prince, Adam W Hanley, Mathias Sanyer, Mark Tuomenoksa, and Tauhidur Rahman. 2023. Zoom-based Mindfulness-Oriented Recovery Enhancement plus just-in-time mindfulness practice triggered by wearable sensors for opioid craving and chronic pain. *Mindfulness* 14, 6 (2023), 1329–1345.

[11] Robert P Gauthier, Mary Jean Costello, and James R Wallace. 2022. "I Will Not Drink With You Today": A Topic-Guided Thematic Analysis of Addiction Recovery on Reddit. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems*. 1–17.

[12] Jeremy Heyer, Zachary Schmitt, Lynn Dombrowski, and Svetlana Yarosh. 2020. Opportunities for enhancing access and efficacy of peer sponsorship in substance use disorder recovery. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. 1–14.

[13] Tom Huang, Anas Elghafari, Kunal Relia, and Rumi Chunara. 2017. High-resolution temporal representations of alcohol and tobacco behaviors from social media data. *Proceedings of the ACM on human-computer interaction* 1, CSCW (2017), 1–26.

[14] Jasmine Jones, Ye Yuan, and Svetlana Yarosh. 2021. Be consistent, work the program, be present every day: exploring Technologies for Self-Tracking in early recovery. *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies* 5, 4 (2021), 1–26.

[15] Hsin-Liu (Cindy) Kao, Bo-Jhang Ho, Allan C. Lin, and Hao-Hua Chu. 2012. Phone-based gait analysis to detect alcohol usage. In *Proceedings of the 2012 ACM Conference on Ubiquitous Computing* (Pittsburgh, Pennsylvania) *(UbiComp '12)*. Association for Computing Machinery, New York, NY, USA, 661–662. doi:10.1145/2370216.2370354

[16] Sahiti Kunchay and Saeed Abdullah. 2020. WatchOver: using Apple watches to assess and predict substance co-use in young adults. In *Adjunct Proceedings of the 2020 ACM International Joint Conference on Pervasive and Ubiquitous Computing and Proceedings of the 2020 ACM International Symposium on Wearable Computers* (Virtual Event, Mexico) *(UbiComp/ISWC '20 Adjunct)*. Association for Computing Machinery, New York, NY, USA, 488–493. doi:10.1145/3410530.3414373

[17] Magdalena Liebetruth, Kai Kehe, Dirk Steinritz, and Stefan Sammito. 2024. Systematic Literature Review Regarding Heart Rate and Respiratory Rate Measurement by Means of Radar Technology. *Sensors* 24, 3 (2024), 1003.

[18] Diana MacLean, Sonal Gupta, Anna Lembke, Christopher Manning, and Jeffrey Heer. 2015. Forum77: An analysis of an online health forum dedicated to addiction recovery. In *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing*. 1511–1526.

[19] Katherine G McKim, Cat Mai, Danielle Hess, and Shuo Niu. 2021. Investigating drug addiction discourse on youtube. In *Companion Publication of the 2021 Conference on Computer Supported Cooperative Work and Social Computing*. 130–134.

[20] Khan Muhammad, Jamil Ahmad, Zhihan Lv, Paolo Bellavista, Po Yang, and Sung Wook Baik. 2018. Efficient deep CNN-based fire detection and localization in video surveillance applications. *IEEE Transactions on Systems, Man, and Cybernetics: Systems* 49, 7 (2018), 1419–1434.

[21] Rajalakshmi Nandakumar, Shyamnath Gollakota, and Jacob E Sunshine. 2019. Opioid overdose detection using smartphones. *Science translational medicine* 11, 474 (2019), eaau8914.

[22] Aravind Natarajan, Hao-Wei Su, Conor Heneghan, Leanna Blunt, Corey O'Connor, and Logan Niehaus. 2021. Measurement of respiratory rate using wearable devices and applications to COVID-19 detection. *NPJ digital medicine* 4, 1 (2021), 136.

[23] Shuo Niu, Katherine G McKim, and Kathleen Palm Reed. 2022. Education, Personal Experiences, and Advocacy: Examining Drug-Addiction Videos on YouTube. *Proceedings of the ACM on human-computer interaction* 6, CSCW2 (2022), 1–28.

[24] Shuo Niu and Kathleen Palm Reed. 2023. Towards Understanding Substance Abuse Misinformation in YouTube Videos. In *Companion Publication of the 2023 Conference on Computer Supported Cooperative Work and Social Computing*. 64–68.

[25] Alexandra Papoutsaki, Samuel So, Georgia Kenderova, Bryan Shapiro, and Daniel A Epstein. 2021. Understanding delivery of collectively built protocols in an online health community for discontinuation of psychiatric drugs. *Proceedings of the ACM on Human-Computer Interaction* 5, CSCW2 (2021), 1–29.

[26] Jessica A Pater, Chanda Phelan, Victor P Cornet, Ryan Ahmed, Sarah Colletta, Erik Hess, Connie Kerrigan, and Tammy Toscos. 2021. User-centered design of a mobile app to support peer recovery in a clinical setting. *Proceedings of the ACM on Human-Computer Interaction* 5, CSCW1 (2021), 1–31.

[27] Thanh-Trung Phan, Florian Labhart, Skanda Muralidhar, and Daniel Gatica-Perez. 2020. Understanding heavy drinking at night through smartphone sensing and active human engagement. In *Proceedings of the 14th EAI International Conference on Pervasive Computing Technologies for Healthcare*. 211–222.

[28] Chanda Phelan, Jeremy Heyer, Rachel Pfafman, Connie Kerrigan, Golfo K Tzilos Wernette, Lynn Dombrowski, Andrew D Miller, and Jessica Pater. 2022. The Work of Digital Social Re-entry in Substance Use Disorder Recovery. *Proceedings of the ACM on Human-Computer Interaction* 6, CSCW2 (2022), 1–33.

[29] CDC Overdose Prevention. 2024. Understanding the opioid overdose epidemic.

[30] Sabirat Rubya, Xizi Wang, and Svetlana Yarosh. 2019. HAIR: Towards developing a global self-updating peer support group meeting list using human-aided information retrieval. In *Proceedings of the 2019 Conference on Human Information Interaction and Retrieval*. 83–92.

[31] Sabirat Rubya and Svetlana Yarosh. 2017. Video-mediated peer support in an online community for recovery from substance use disorders. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing*. 1454–1469.

[32] Zachary Schmitt and Svetlana Yarosh. 2018. Participatory design of technologies to support recovery from substance use disorders. *Proceedings of the ACM on Human-Computer Interaction* 2, CSCW (2018), 1–27.

[33] Ryan Sequeira, Avijit Gayen, Niloy Ganguly, Sourav Kumar Dandapat, and Joydeep Chandra. 2019. A large-scale study of the Twitter follower network to characterize the spread of prescription drug abuse tweets. *IEEE Transactions on Computational Social Systems* 6, 6 (2019), 1232–1244.

[34] Yudai Takahashi, Yi Gu, Takaaki Nakada, Ryuzo Abe, and Toshiya Nakaguchi. 2021. Estimation of respiratory rate from thermography using respiratory likelihood index. *Sensors* 21, 13 (2021), 4406.

[35] Acar Tamersoy, Duen Horng Chau, and Munmun De Choudhury. 2017. Analysis of smoking and drinking relapse in an online community. In *Proceedings of the 2017 international conference on digital health*. 33–42.

[36] Lana Yarosh, Suzanne Bakken, Alan Borning, Munmun De Choudhury, Cliff Lampe, Elizabeth Mynatt, Stephen Schueller, and Tiffany Veinot. 2020. Computational Support for Substance Use Disorder Prevention, Detection, Treatment, and Recovery. *arXiv preprint arXiv:2006.13259* (2020).

[37] Svetlana Yarosh. 2013. Shifting dynamics or breaking sacred traditions? The role of technology in twelve-step fellowships. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 3413–3422.

[38] Chuang-Wen You, Ya-Fang Lin, Cheng-Yuan Li, Yu-Lun Tsai, Ming-Chyi Huang, Chao-Hui Lee, Hao-Chuan Wang, and Hao-Hua Chu. 2016. KeDiary: Using Mobile Phones to Assist Patients in Recovering from Drug Addiction. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* (San Jose, California, USA) *(CHI '16)*. Association for Computing Machinery, New York, NY, USA, 5704–5709. doi:10.1145/2858036.2858185

[39] Chuang-wen You, Kuo-Cheng Wang, Ming-Chyi Huang, Yen-Chang Chen, Cheng-Lin Lin, Po-Shiun Ho, Hao-Chuan Wang, Polly Huang, and Hao-Hua Chu. 2015. Soberdiary: A phone-based support system for assisting recovery from alcohol dependence. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. 3839–3848.

[40] Yihong Zhang, Panote Siriaraya, Yukiko Kawai, and Adam Jatowt. 2019. Rehabpath: recommending alcohol and drug-free routes. In *Proceedings of the 28th ACM International Conference on Information and Knowledge Management*. 2929–2932.

[41] Shuo Zhou, Timothy Bickmore, Amy Rubin, Catherine Yeksigian, Molly Sawdy, and Steven R Simon. 2018. User gaze behavior while discussing substance use with a virtual agent. In *Proceedings of the 18th International Conference on Intelligent Virtual Agents*. 353–354.