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Response to a peer telehealth intervention for emergency department patients presenting with opioid use disorder or unintentional overdose: a stratified interrupted time series analysis

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Abstract

Background People in the United States who use opioids frequently use emergency department (ED) services. Some hospitals have begun placing peer recovery support specialists (PRSS) in EDs to support and advocate for patients and provide linkages to services, in an effort to reduce future presentations for opioid-related and other health problems related to substance use. However, evidence supporting the impact of PRSS services on reducing future ED presentations is limited, and even less is known about ED-based PRSS services delivered via telehealth.

Methods Using records from a large Indiana-based hospital system, we conducted an interrupted time series (ITS) analysis of ED patients presenting for unintentional opioid overdose or other opioid-related issues. Over a five-year period, 2,542 unique ED visits were included across 12 hospitals. The primary outcome assessed was the impact of PRSS telehealth service implementation (comparing pre- and post-periods) on 30-day all-cause ED revisits. Analyses were also stratified by appropriate demographics.

Results There was no significant change in 30-day ED revisits between pre- and post-implementation of the PRSS telehealth program. Results of sex-stratified ITS indicated a significant change for females only, with decreasing log-odds of ED revisits post-program implementation (post-implementation slope $OR = 0.911$, $p = 0.031$; slope change $OR = 0.874$, $p = 0.017$).

Conclusions Although there was no detectable difference in overall ED revisits following program implementation, outcomes of stratified analyses suggested that the program may have been more impactful for females vs. males. Future research should examine the underlying mechanism of the observed sex differences to target behavioral change more effectively for all participants of telehealth PRSS services in ED settings.

Keywords Peer recovery support, Opioid use disorder, Emergency department, Telehealth, Interrupted time series

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Background

Opioid use disorder (OUD) and opioid overdose are critical public health concerns in the United States. Healthcare costs in 2017 due to OUD were estimated at $31.3 billion, not including costs of OUD treatment services [1]. Opioid overdoses caused 645,000 fatalities from 1999–2021 [2], a significant loss of life and productivity that has substantially impacted individuals, families, and communities. In the absence of treatment, one study estimated OUD to be associated with 11.58 discounted lifetime quality-adjusted life-years (QALYs) [3]. Emergency departments (EDs) are heavily utilized for opioid overdose response, with a median of 5,502 individuals presenting to U.S. EDs every week for opioid overdose during 2020 [4]. Additionally, patients with OUD are more likely than the general population to visit the ED for non-OUD related care [5].

ED visits may provide a 'reachable moment' to intervene for patients presenting clinically with overdose or other OUD-related issues. As such, there has been an expansion of interest in understanding the impact of ED-based interventions using harm reduction (e.g., naloxone education and distribution), OUD treatment linkage, and recovery supports, particularly for individuals who have survived opioid overdose [6–9]. One strategy for ED-based interventions is to leverage peer recovery support specialists (PRSS), people with lived substance use disorder (SUD) recovery experience who are trained and certified to provide recovery supports and linkages to care. While ED-based PRSS interventions have expanded considerably in recent years [10], evidence supporting them has been mixed.

Some states, such as Rhode Island, introduced ED-based PRSS services for SUD a decade ago [11], yet research examining this approach is still relatively limited. Some studies of PRSS interventions have noted improvements in the likelihood of leaving the ED with a referral to treatment, as well as time to treatment engagement [12–14]. In contrast, others have demonstrated no difference from usual care [6, 15]. However, even where PRSS services do not perform better, qualitative studies suggest that they are valuable and appreciated by patients and may reduce stigma and discomfort [9, 16–18]. PRSS services may also address other needs (e.g., housing, resource insecurities) underlying an ED presentation, help to reduce other issues that may lead to ED revisits (e.g., access to regular healthcare and harm reduction resources), and may alleviate workloads for already strained hospital-based staff [19]. However, the scalability of PRSS services across all ED settings and broader impact on ED utilization remain unknown.

The fast service pace in EDs, staff knowledge and comfort, and stigma are known challenges to implementing and delivering PRSS and other OUD interventions in EDs [20, 21]. Embedding PRSSs in all EDs, particularly those in smaller or more rural hospitals, may also not be feasible given insufficient volume of substance use-related episodes (including opioid overdose) needed to warrant a stand-alone program and resources. Peer services delivered remotely, using telehealth, are one approach to overcome these barriers [10]. However, research examining telehealth approaches for PRSS services has been limited, even though broad expansion in telehealth SUD services occurred during the COVID-19 pandemic [22]. The present study examines the impact of an ED-based telehealth PRSS intervention on all-cause ED revisits. Our primary hypothesis was that PRSS telehealth program implementation would be associated with a reduction in 30-day, all-cause ED revisits.

Methods

This was a retrospective study using an interrupted time series (ITS) approach with subsequent stratification to understand the PRSS telehealth intervention's impact by comparing odds of ED re-visits before and after the start of the program's implementation. The study was determined not to meet requirements for human subjects research review because a limited, deidentified dataset was used (Indiana University IRB #2006108993).

Study setting and intervention

Data came from 12 Indiana-based EDs within a single healthcare organization network that implemented a novel ED telehealth PRSS program for patients presenting with OUD and/or unintentional opioid overdose. The program was initiated with partial support from federal opioid response funds distributed to the State of Indiana. Program implementation started in September 2018, with all hospitals up and running by June 2019 (see Table 1 for hospital start dates and counts of OUD-related ED encounters, including unintentional opioid overdose, pre- and post-implementation).

The telehealth program operates from a central hub with PRSS available around the clock to serve participating EDs (see Fig. 1). ED staff initiate telehealth services by contacting the hub on behalf of patients with identified needs, based on either the presenting problem (such as opioid poisoning, intoxication, or withdrawal) or information gathered during care. ED staff bring a cart with a video screen to the bedside to connect the patient with the PRSS virtually. ED staff provide minimal information to patients regarding PRSS services before initiating contact. Rather, the PRSS explains the services during the initial encounter and assesses the patient's interest. If the patient is interested, the PRSS conducts a conversation to gather information on their current substance use, withdrawal symptoms, previous treatment and recovery attempts, and current needs for resources. The PRSS also

Table 1 PRSS telehealth program implementation dates by site

	Rurality	Total annual ED visits, 2019*	PRSS program go live date	Date ranges included for analysis**	Total ED encounters with OUD and/or unintentional opioid overdose	Pre-implem. encounters	Post-implem. encounters
Site 1	Rural	8,842	9/24/2018	3/24/2016-3/24/2021	114	39	75
Site 2	Rural	10,274	10/29/2018	4/29/2016-4/29/2021	61	35	26
Site 3	Rural	15,800	12/17/2018	6/17/2016-6/17/2021	193	86	107
Site 4[§]	Suburban	*N/A*	12/24/2018	6/24/2016-6/24/2021	68	38	30
Site 5	Rural	*N/A*	2/25/2019	8/25/2016-8/25/2021	261	115	146
Site 6[§]	Suburban	42,150	3/11/2019	9/11/2016-9/11/2021	524	291	233
Site 7	Urban	44,441	3/18/2019	9/18/2016-9/18/2021	453	267	186
Site 8	Rural	8,258	4/1/2019	10/1/2016-10/1/2021	70	40	30
Site 9	Rural	6,201	4/29/2019	10/29/2016-10/29/2021	29	16	13
Site 10	Urban	52,378	5/13/2019	11/13/2016-11/13/2021	773	413	360
Site 11	Rural	12,866	5/27/2019	11/27/2016-11/27/2021	90	63	27
Site 12[§]	Suburban	20,304	6/10/2019	12/10/2016-12/10/2021	73	47	26

Note: One rural site listed includes two separate hospitals' EDs that were combined for analysis due to small size, proximity in neighboring counties, and program implementation on the same date

*N/A indicates not available. ED visit information obtained from 2019 Hospital Service Reports, Indiana Department of Health

**Date ranges represent 10 quarters (30 months) before and after go live (program implementation) date

[§]Indicates teaching hospital

ensures all contact information for the patient after discharge is included in the electronic health record. After discharge, the PRSS refers the patient to their preferred treatment or recovery pathways (such as outpatient, inpatient, medication-based treatment, 12-step fellowship meetings, detox, etc.). The PRSS attempts follow-up calls for up to one-year post-discharge. If unable to reach the patient, the PRSS leaves a message if possible. After three consecutive unsuccessful attempts, the PRSS stops attempting to contact the patient, but they will resume services if the patient contacts the telehealth hub. The telehealth program was the sole program available in all participating EDs above and beyond standard of care for patients presenting with OUD and/or unintentional opioid overdose.

Data source and case selection

Data were obtained from electronic health records stored within the Indiana Network for Patient Care (INPC), a statewide health information exchange system that captures health record data for all 12 hospitals [23]. Each site had its own unique pre- and post-program implementation periods based on the date their location's telehealth services started (see Table 1). Data were pulled for all individuals who visited the participating EDs due to an unintentional opioid overdose by heroin or other opioids (ICD-10-CM codes T40.1X1A or T40.2X1A) or another opioid-related issue (ICD-10-CM code F11) between 09/24/2016 and 12/10/2021, excluding cases with extreme age values ($n = 18$). Although the ICD-10-CM includes additional codes related to opioid overdose, the transition from ICD-9-CM to ICD-10-CM occurred shortly before the earliest date range included for analysis (beginning 3/24/2016) and we selected these codes to more closely mirror common overdose code options from ICD-9-CM, thus allowing measures to be held constant across time. For each patient who visited the ED whose encounter was coded with one of the qualifying codes, their first visit was considered the "index" ED encounter. A subsequent ED visit for OUD and/or unintentional overdose by the same patient occurring more than 30 days after the first index ED encountered was considered a separate, unique visit.

This process identified a total of $N = 2{,}542$ unique ED visits across the 12 hospitals: 1,392 of these cases were pre-implementation and 1,150 were post implementation (see Table 1). All visits included occurred within 10 quarters (30 months) before and after each site's PRSS program implementation.

Measurements and outcomes

The primary outcome of interest was ED revisits for any cause within 30 days of the initial (index) ED encounter, as identified using INPC data. Analyses used all-cause ED revisits because opioid overdoses are a relatively rare event [24] and because a goal of the hospital's implementation of the telehealth PRSS program was to help reduce overall emergency services in addition to opioid overdose events. Demographic variables included were age, sex, race, ethnicity (Hispanic/non-Hispanic), and insurance.

Analysis

We performed analyses using unique ED visits as the unit of analysis. We applied intention to treat principles to

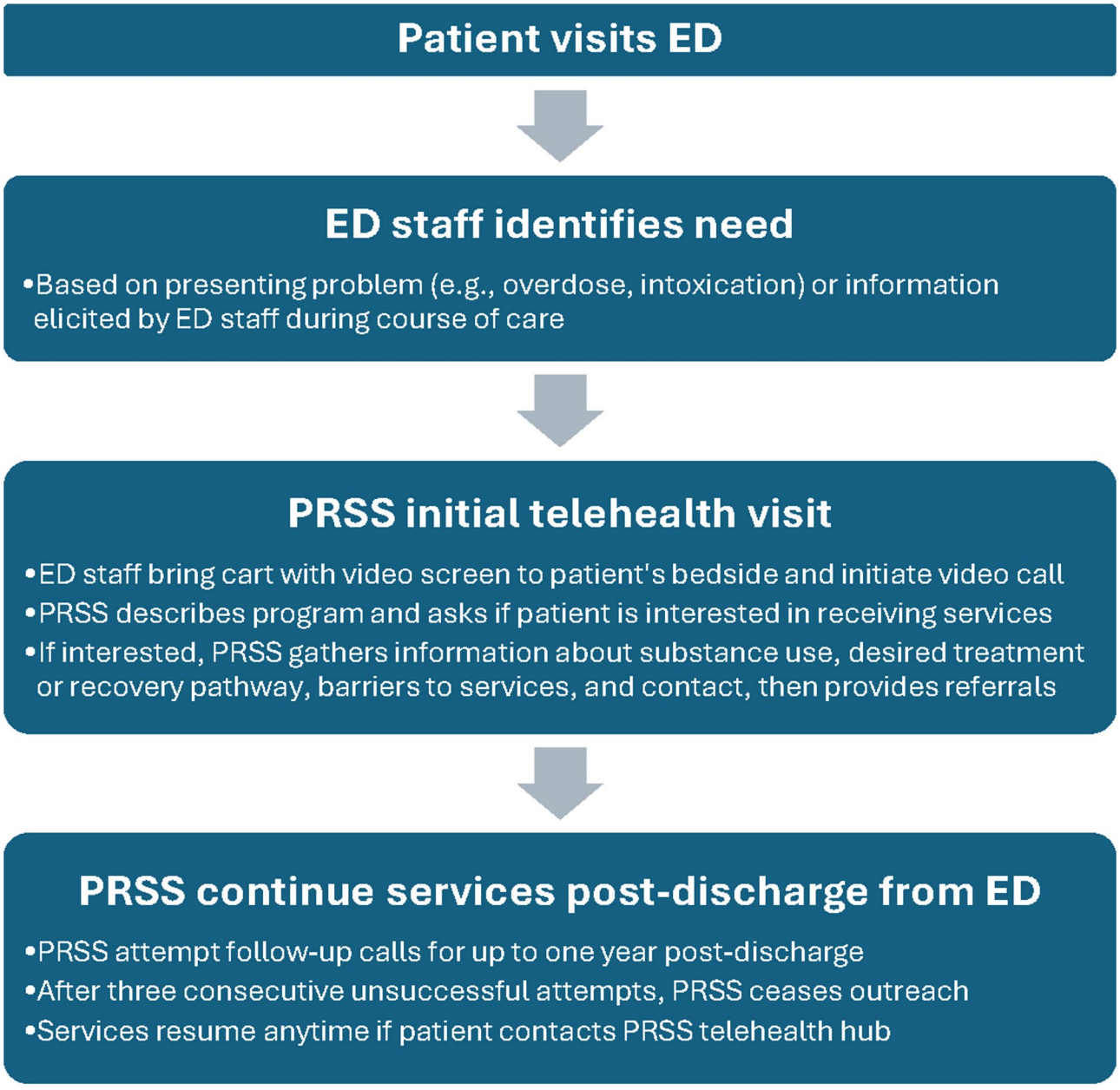

Fig. 1 Workflow of ED-based telehealth PRSS program

provide the most unbiased estimates [25]; therefore, we included all ED visits meeting case selection criteria for analysis whether or not contact with a PRSS was documented (post-implementation) to capture average effects of program implementation. Analyses compared patient characteristics for ED encounters that occurred before and after the PRSS program implementation using Wilcoxon rank sum test for continuous variables and Pearson's chi-square test for categorical variables. To evaluate the difference in the temporal trend in the pre-implementation and post-implementation periods for each site's PRSS program, we performed the segmented regression analysis of interrupted time series on encounter-level data, where a generalized mixed model was fit using logistic regression, with a binary outcome indicating whether an index ED encounter had a 30-day ED revisit. The time series was built using a quarter interval, with the implementation start date for each site entered as the interruption point. We accounted for clustering of multiple index ED encounters within the same hospital with a hospital-specific random intercept. Patient characteristics including age, sex, race, and insurance were included in the model to adjust for differences in the pre-implementation and post-implementation periods. Ethnicity

was not included due to vast majority of patients being non-Hispanic.

Evidence from prior research suggests that ED utilization patterns among people with SUD vary substantially by race, sex, and other demographic factors [26, 27]. Thus, for patient characteristics that had different distributions in the pre- and post-implementation periods, we conducted stratified analyses to control for potential confounding. Specifically, we performed the stratified analyses by fitting the generalized mixed model with interactions between temporal trend and the specific patient characteristic, while adjusting for other patient characteristics. All analyses were conducted using SAS version 9.4 (SAS Institute, Cary, North Carolina, USA).

Results

As shown in Table 2, patients presenting to an ED in the hospital system before PRSS telehealth implementation were significantly younger than those who presented post-PRSS implementation (37.1 vs. 38.6, $p = 0.001$) and were more likely to be female (43.8% vs. 39.2%, $p = 0.021$), compared to those patients who presented for an index ED visit during the post-implementation period. Patients also varied significantly based on insurance type ($p = 0.003$), with pre-implementation patients less likely to be covered by Medicaid (46.9% vs. 54.7%). There were no significant differences by race or ethnicity: both groups were majority White (96.0%, 94.3%) and non-Hispanic (98.3%, 98.4%).

ED revisits within the 30-day timeframe occurred for 21.4% of the pre-implementation ED encounters and 19.9% of the post-implementation ED encounters. Results from the generalized mixed logistic regression model, evaluating temporal trends in pre- and post-implementation periods, are shown in Table 3. In both the unadjusted and adjusted models (the latter including patient characteristics, i.e., age, sex, race, and insurance) for all ED encounters combined, there were no significant temporal trends during the pre-implementation or post-implementation periods. In addition, there was no significant level change or slope change.

Due to the differences in patient characteristics in sex and Medicaid status, we performed stratified analysis by these two variables. We did not perform stratified analysis for race since more than 95% of the patients were White. Results obtained in the stratified analysis by Medicaid status were similar to the main results. There were no temporal trends in the pre-implementation and post-implementation periods for patients on Medicaid and those not on Medicaid, nor were there any significant changes in level or slope. In the stratified analysis by sex, we observed similar results among males, with no significant temporal trends or level/slope changes. However, we found a significantly decreasing trend for females during the post-implementation period (OR = 0.911, 95% CI: 0.836–0.991, $p = 0.031$). Furthermore, the post-implementation slope differed significantly from the pre-implementation slope (OR = 0.874, 95% CI: 0.783–0.976, $p = 0.017$). Given that the slope change represents the ratio of the post-implementation slope OR and pre-implementation slope OR, a value of less than one indicates that the post-implementation slope was significantly smaller than the pre-implementation slope, for females only (see Fig. 2).

Table 2 Demographic characteristics of patients at index ED

	Pre-Implementation (*N* = 1392)	Post-Implementation (*N* = 1150)	*P* Value
Age (range 15–97), mean (SD)	37.1 (13.8)	38.6 (14.2)	0.001
Sex			0.021
Female	609 (43.8%)	451 (39.2%)	
Male	783 (56.3%)	699 (60.8%)	
Race			0.11
White	1337 (96.0%)	1084 (94.3%)	
Black or African American	45 (3.2%)	55 (4.8%)	
Other	10 (0.7%)	11 (1.0%)	
Ethnicity			0.88
Hispanic	23 (1.7%)	18 (1.6%)	
Non-Hispanic	1,369 (98.3%)	1,132 (98.4%)	
Primary insurance			0.003
Commercial	151 (10.8%)	107 (9.3%)	
Medicaid	653 (46.9%)	629 (54.7%)	
Medicare	177 (12.7%)	137 (11.9%)	
Other Government	30 (2.2%)	28 (2.4%)	
Self-pay (i.e., uninsured)	268 (19.3%)	178 (15.5%)	
Other	113 (8.1%)	71 (6.2%)	

Table 3 Odds ratios for the effect of PRSS program implementation on 30-day all-cause ED readmission following index ED encounter (*N* = 2,542)

	OR (95% CI)	*P*-value
All patients, unadjusted		
Level change	0.802 (0.528–1.220)	0.30
Pre-implementation slope	1.021 (0.976–1.068)	0.37
Post-implementation slope	1.002 (0.951–1.055)	0.95
Slope change	0.981 (0.916–1.051)	0.59
All patients, adjusted		
Level change	0.758 (0.496–1.159)	0.20
Pre-implementation slope	1.033 (0.986–1.081)	0.17
Post-implementation slope	0.987 (0.937–1.040)	0.63
Slope change	0.956 (0.892–1.025)	0.21
Stratified by Medicaid status		
Medicaid		
Level change	0.697 (0.407–1.194)	0.19
Pre-implementation slope	1.054 (0.993–1.118)	0.082
Post-implementation slope	0.985 (0.925–1.049)	0.64
Slope change	0.935 (0.858–1.019)	0.12
Non-Medicaid		
Level change	0.887 (0.445–1.768)	0.73
Pre-implementation slope	0.989 (0.920–1.062)	0.75
Post-implementation slope	0.998 (0.907–1.099)	0.97
Slope change	1.010 (0.896–1.138)	0.87
Stratified by Sex		
Females		
Level change	1.020 (0.541–1.925)	0.95
Pre-implementation slope	1.041 (0.971–1.117)	0.25
Post-implementation slope*	0.911 (0.836–0.991)	0.031
Slope change*	0.874 (0.783–0.976)	0.017
Males		
Level change	0.619 (0.350–1.093)	0.098
Pre-implementation slope	1.026 (0.965–1.090)	0.41
Post-implementation slope	1.037 (0.970–1.109)	0.29
Slope change	1.011 (0.923–1.107)	0.82

*$p \leq 0.05$

Discussion

Recent research has examined whether there is value added in leveraging the lived experience of PRSS for intervention delivery in ED settings, typically to support linkage to services or reductions in substance use [10, 28]. This study, which focused on overall 30-day all-cause ED revisits, observed no significant difference between pre- and post-implementation periods for a PRSS telehealth ED intervention. However, the stratified analysis suggests females had lower odds of ED revisits following intervention implementation, compared to odds during the pre-implementation period. This study contributes to a growing literature examining ED-based interventions for OUD, including post-opioid overdose interventions [7, 12]. By examining all-cause rather than only overdose revisits, this study also provides a more complete understanding of emergency service utilization, particularly given that individuals with OUD are likely to present to EDs for many reasons other than opioid overdose [5, 24].

The lack of significant findings for the primary analyses (no change in likelihood of 30-day ED revisits) could be attributed to several possible explanations. First, while opioid overdoses have long been viewed as a 'reachable moment' [17], the unpleasant physical and psychological effects of naloxone administration may make individuals less receptive to behavioral interventions [29]. Although this study included patients presenting due to any opioid-related concern, not only overdose, other studies have failed to document a significant difference in outcomes of ED-based post-opioid overdose interventions delivered by PRSS compared to other staff. Two separate randomized trials conducted by Beaudoin et al. [6] and Watson et al. [19] found no difference in treatment outcomes compared to control conditions for ED patients who received PRSS services, with the latter study also showing

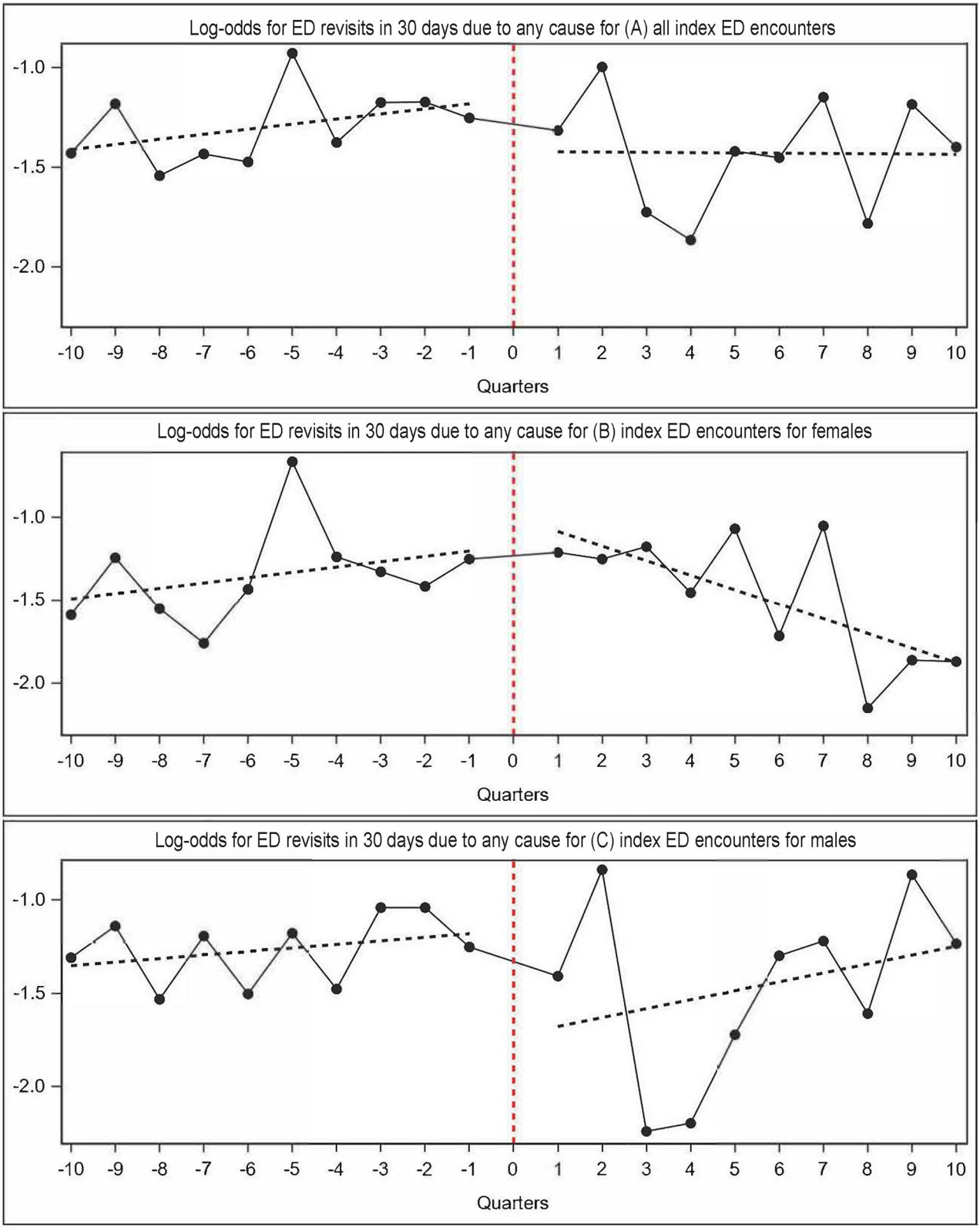

Fig. 2 Log-odds for ED revisits in 30 days due to any cause for (**A**) all index ED encounters, (**B**) index ED encounters for females, and (**C**) index ED encounters for males

no difference in overdose or all-cause ED revisits. These studies did not investigate subgroup differences such as those observed in the sex-stratified analyses in the present study.

Second, although telehealth services for substance use are broadly viewed as satisfactory (and occasionally preferable) by most patients [30], telehealth intervention delivery in the fast-paced environment of the ED may be less effective than in outpatient community settings. This may be particularly true for patients who also perceive stigma in medical settings, as is common among individuals with OUD [18]. Additionally, the use of virtual PRSS services created challenges for peers who did not always have full support or "buy-in" from ED staff, yet without direct access to patients, still had to rely on ED staff to make referrals [31]. Furthermore, many service areas surrounding the hospitals included in the current study lacked sufficient resources available for referrals, making linkage to services a challenging task for PRSS [20].

Third, it is important to note that the onset of the COVID-19 pandemic complicated our post-implementation period, making it difficult to know how much of our observed effect in the sex-stratified analysis was due to the intervention vs. the broader issues impacting healthcare at this time. ED visits nationally decreased by 32% in the second quarter of 2020, despite substantial weekly fluctuations [32]. However, both fatal and nonfatal opioid overdoses increased during the pandemic [33], including counts of overdose-related ED visits [34]. These types of variations in emergency medicine demands may have confounded individuals' likelihood of ED revisits during the post-implementation period.

The significant differences observed for female patients only in the sex-stratified ITS analysis indicate that the PRSS telehealth intervention may differentially impact males and females who present to EDs due to opioid-related concerns, including overdose. Although the implementation of the program did not produce an immediate difference in the odds of ED revisits (i.e., no level change), the significant slope change suggests that PRSS services may have been impactful for females over time. Specifically, the log-odds for female patients' ED revisits were increasing in the quarters leading up to program implementation, yet they began decreasing in the post-implementation period.

In the broader U.S. population, research has consistently shown that women are more likely than men to report using technology for health information seeking and health care [35, 36]. Particularly in rural areas, telehealth allows individuals the chance to connect with providers outside of their small, close-knit communities about sensitive topics (e.g., drug use), creating an added protection for privacy and confidentiality. During the pandemic and the resulting rapid proliferation of telehealth services, including for OUD [22], nationally representative data indicate that women used telehealth services at significantly higher rates than men [37], although research examining sex or gender differences in telehealth service engagement or utilization among populations of individuals with OUD or other substance use disorders is lacking [30, 38].

Studies examining telephonic or community-based PRSS services have shown no sex or gender differences in ongoing PRSS engagement [39–41]. However, research– particularly qualitative– has indicated that women experience unique and pervasive drug use stigma related to subversion of gendered social norms [42]. In some respects, the same role expectations that exacerbate women's stigma may also serve as powerful motivation to engage with treatment services or pursue recovery, particularly related to parenting responsibilities [43]. Thus, for women compared to men, engagement with PRSS services may be more likely to lead to behavioral change that could result in decreased need for emergency medical services.

Limitations

This study is subject to limitations beyond those related to the pandemic discussed above. The use of retrospective health services data is one such limitation. However, ITS is a strong quasi-experimental design for demonstrating causality [44] and has been increasingly employed in health services research where cost, feasibility, or ethics may preclude random assignment [45]. Additionally, the impact of the PRSS program may have been further moderated by other individual-level factors not captured in the administrative INPC data (e.g., severity of OUD). It is also a limitation that case selection for this study did not include all potential ICD-10-CM codes related to opioid overdose (e.g., codes related to overdose by opium, methadone, or fentanyl) and results should be interpreted with this specification in mind. Furthermore, although the selected outcome of the 30-day ED revisits is important to minimize continued negative health outcomes and costs to health service systems, the PRSS telehealth intervention may have been effective in other areas not captured in the current data, including linkages to care and more subjective measures of patient change such as stigma reduction or abstinence self-efficacy. Relatedly, although the reduction in ED visits observed for female patients was characterized as a positive outcome, it is possible that females were still experiencing adverse health but not seeking care (through EDs or other venues). Further research examining ED-based PRSS programs for patients with OUD should examine a range of health service utilization metrics following ED discharge and gather information about patient-important outcomes. Additionally, more research is needed to

understand the relative efficacy of telehealth vs. in-person PRSS programs, including randomized controlled trials.

Conclusions

This study contributes to the understanding of the impact of telehealth PRSS services on ED health service utilization among individuals with OUD. By examining all-cause ED revisits, this study adds to the knowledge base of health service utilization patterns among individuals with OUD, who may present to EDs often and with a variety of urgent health issues [24, 46, 47]. This study is also unique in using data from an ED telehealth program implemented before the COVID-19 pandemic and the associated expansion of telehealth SUD services [22]. Although the results did not demonstrate a detectable difference in overall ED revisits, secondary analyses suggested that female patients may have benefited more from telehealth PRSS services than males. Future work should investigate possible sex, gender, and other demographic differences in responsiveness to both PRSS and telehealth interventions within the ED. Additional qualitative research would also be valuable to elucidate the unique experiences of women who receive PRSS services in ED settings. Understanding the mechanisms driving these differences could inform intervention design and quality improvement to improve overall effects for patients with OUD.

Abbreviations

ED	Emergency department
INPC	Indiana network for patient care
ITS	Interrupted time series
OUD	Opioid use disorder
PRSS	Peer recovery support specialist
SUD	Substance use disorder

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Author contributions

MT conceptualized the paper and was the primary author of the original draft of the manuscript. HX performed all data analyses and contributed to the writing of the analytic plan and results. AM and DW acquired funding for the project. SM was involved in delivery of the project's intervention. HX, AM, SM, FLB, and DW all provided critical feedback on the manuscript and made substantive suggestions for edits. All authors read and approved the final manuscript.

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Data availability

The data that support the findings of this study are available from Regenstrief Institute but restrictions apply to the availability of these data, which were used under license for the current study and are not publicly available. However, data are available from the authors upon reasonable request and with permission of Regenstrief Institute.

Declarations

Ethics approval and consent to participate

Due to the limited nature of the dataset used, the study was determined not to meet requirements for human subject research review (Indiana University IRB #2006108993).

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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