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The impact of Covid-19 on harm reduction policies in Iran: an interrupted time series analysis

Siavash Beiranvand¹, Meysam Behzadifar², Aidin Aryankhesal³, Seyed Jafar Ehsanzadeh⁴ and Masoud Behzadifar^{1,2*}

Abstract

Background The global emergence of the Covid-19 pandemic in 2019 posed unprecedented challenges to healthcare systems, disrupting routine services and necessitating swift adaptations. Harm reduction programs, vital for addressing substance use-related health risks, faced unique challenges during the pandemic, impacting vulnerable populations. This study focuses on the repercussions of Covid-19 on harm reduction policies in Iran, specifically examining the distribution of condoms, syringes, and methadone to high-risk individuals attending Triangle Centers.

Aim The study aims to assess the impact of the Covid-19 pandemic on harm reduction services in Iran and provide evidence-based insights for policy adjustments. Using Interrupted Time Series Analysis (ITSA), the research analyzes trends in the distribution of condoms, syringes, and methadone before and after the official declaration of the pandemic in February 2020.

Method ITSA, a valuable tool for evaluating program impacts, was employed to analyze data collected from Triangle Centers in Lorestan Province, Iran. Monthly records of harm reduction services (condoms, syringes, methadone) from January 2017 to February 2023 were extracted. The pre-intervention period spanned January 2017 to January 2020, with the post-intervention period extending from February 2020 to February 2023. Statistical analyses were conducted using the Newey-West technique, Combi-Huizinga autocorrelation test, and Ordinary Least Squares (OLS) regression, with a significance threshold set at P-value < 0.05.

Results Following the onset of Covid-19, the level change in condom distribution to high-risk individuals showed a significant decline, decreasing by 2,168.87 units per month (95% CI: -2,405.57 to -1,932.15). Methadone dispensation, crucial for opioid harm reduction, also witnessed a substantial level change, decreasing by 5,007.60 cc per month (95% CI: -6,251.75 to -3,763.45). Additionally, the provision of syringes decreased significantly, with a level change of -601.01 units per month (95% CI: -706.39 to -495.62).

Conclusion This study reveals significant disruptions in harm reduction services in Iran post-Covid-19, emphasizing the need for targeted interventions. Factors such as fear, stigma, resource reallocation, and logistical challenges contribute to the observed decreases. Policymakers must prioritize sustaining harm reduction services during pandemics, ensuring continuity for vulnerable populations. The findings underscore the importance of proactive

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policy development and preparedness to prevent delays and inequalities in accessing essential services for individuals with high-risk behaviors. Overall, integrating harm reduction into pandemic planning is crucial for a resilient and equitable health system.

Keywords Harm reduction, Covid-19, Interrupted time series analysis, Iran, Health policy

Introduction

The emergence of Covid-19 in late 2019 led to a global pandemic, challenging healthcare systems, disrupting economies, and changing public health interventions worldwide [1]. Nations had to adapt existing health programs as they grappled with the virus's rapid spread. The novel coronavirus posed an unprecedented global health crisis, extending beyond infectious disease [2]. Due to its contagious nature and high morbidity/mortality rates, immediate and coordinated responses from governments and healthcare institutions were necessary [3]. Covid-19 profoundly affected healthcare systems, overwhelming hospitals with patients, exposing weaknesses in infrastructure, and emphasizing the need for surge capacity planning [4]. Resources and attention directed toward managing the virus led to disruptions in routine healthcare services for non-Covid-19 conditions, causing concerns about short- and long-term consequences on population health [5]. Harm reduction policies and programs are crucial in modern healthcare, addressing the diverse challenges of substance use and related health risks [6]. These proactive strategies recognize the complexity of substance use, ranging from experimental to addictive, with consequences affecting public health, social welfare, and economic stability [7]. Harm reduction approaches, by acknowledging the reality of substance use and minimizing its adverse outcomes, showcase the evolution of public health paradigms [8]. These programs encompass various strategies to mitigate negative consequences on individual health and public welfare, playing integral roles in public health initiatives [9]. However, the arrival of Covid-19 added complexity, requiring swift and adaptive measures to protect both vulnerable populations served by harm reduction programs and the healthcare professionals implementing them [10]. The pandemic's effects extended beyond direct health impacts, disrupting supply chains, altering healthcare access, and straining the continuity of existing programs [11].

Harm reduction policies in Iran have played a crucial role in mitigating the adverse consequences of substance use and preventing the spread of infectious diseases among high-risk populations. Established under the Ministry of Health and Medical Education (MoHME), harm reduction services encompass a range of interventions, including needle and syringe programs, methadone maintenance treatment, and condom distribution. These initiatives aim to address public health concerns, reduce

drug-related harms, and promote safer practices among vulnerable groups.

Key organizations, such as the Welfare Organization, and non-governmental entities, collaborate in delivering these services. Triangular clinics, for instance, serve as specialized facilities for individuals engaging in high-risk behaviors, offering services such as HIV and sexually transmitted disease (STD) counseling, addiction treatment, and education. These clinics represent a critical component of Iran's harm reduction strategy, ensuring accessibility to services without requiring personal identification. However, the Covid-19 pandemic posed significant challenges to the continuity and effectiveness of these programs, particularly for marginalized groups dependent on these services.

The emergence of the Covid-19 pandemic in Iran tested the nation's healthcare system's resilience and adaptability [12]. As the virus rapidly spread, Iran faced a dynamic public health crisis, emphasizing the need for swift and comprehensive responses and a robust healthcare infrastructure [13]. The importance of prioritizing and refining harm reduction policies during and beyond pandemics, such as Covid-19, is crucial [14]. While crisis responses often focus on infectious disease containment, addressing the vulnerabilities of marginalized populations and those with high-risk behaviors remains essential. Failure to do so can lead to compounded health disparities, increased rates of blood borne infections, and worsened mental health burdens [15]. Integrating harm reduction strategies into pandemic planning can protect vulnerable individuals and uphold principles of equity, compassion, and evidence-based healthcare, laying the groundwork for a more resilient health system [16]. The study's aim is to assess the Covid-19 epidemic's impact on harm reduction programs in Iran, providing insights for evidence-based policy adjustments to ensure ongoing effectiveness and adaptability amid health crises.

Methods

Data collection

This study employed Interrupted Time Series Analysis (ITSA) to assess the impact of the Covid-19 pandemic on harm reduction services in Iran, specifically focusing on the distribution of condoms, syringes, and methadone at Triangle Centers in Lorestan Province. Monthly records of these services were collected from January 2017 to February 2023, with the pre-intervention period spanning from January 2017 to January 2020, and the

post-intervention period from February 2020 to February 2023.

Selection of the post-intervention period

The post-intervention period was chosen to extend through February 2023 in order to capture the ongoing disruptions and long-term effects of the Covid-19 pandemic on harm reduction services. While the immediate impact of the pandemic was evident in the early months following the outbreak in early 2020, the effects on service delivery persisted for an extended period due to several factors: Continued Public Health Measures: Despite the gradual reduction of restrictions, various pandemic-related health measures, including social distancing, travel restrictions, and resource reallocation, remained in place well into 2021 and 2022, which likely continued to impact service delivery. Resource Allocation and Healthcare System Strain: The strain on healthcare systems, including a reallocation of resources toward managing Covid-19 patients, may have contributed to continued reductions in harm reduction services during the subsequent years, even after the peak of the pandemic. Delayed Recovery of Services: Many health services, particularly those related to marginalized or high-risk populations, experienced delayed recovery. It is reasonable to assume that full recovery in harm reduction services would take time, potentially extending well beyond the immediate pandemic period, and into 2023. Therefore, we chose to extend the post-intervention period to February 2023 to reflect these prolonged effects and to better capture the recovery (or lack thereof) in harm reduction service provision. This extended post-intervention period allows for a more comprehensive analysis of the pandemic's long-term impact.

Calculation of monthly rates

Monthly rates were calculated as the total number of units (condoms, syringes, or methadone) distributed per month. For example, the rate for condom distribution was the total number of condoms distributed divided by the number of months in the given period. This monthly rate represents the frequency of service delivery during the observed timeframe.

Level change estimation

A level change represents an estimate of the change in a dependent variable that can be attributed to an intervention, such as the introduction of the Covid-19 pandemic. This estimate is calculated by accounting for the pre-intervention trend and comparing the level immediately before and after the intervention. In our case, the "level change" indicates the difference in the number of condoms, syringes, and methadone distributed before and after the declaration of the pandemic.

It captures the abrupt shift that occurred following the intervention while adjusting for ongoing trends before the intervention.

Study design

ITSA is deemed crucial for evaluating the impact of programs or policies on health outcomes [17]. This design involves collecting data before and after intervention implementation, enabling researchers to analyze trends and infer causality [18]. In public health, ITSA studies are valuable for assessing the effectiveness of interventions, providing a longitudinal perspective to distinguish effects from underlying trends or external factors [19]. Policymakers depend on ITSA studies to make informed decisions about implementing or modifying public health programs [20]. Understanding the impact of policies helps refine strategies, allocate resources efficiently, and prioritize effective interventions [21]. Additionally, ITSA studies contribute to evidence-based policymaking by revealing insights into the dynamics of public health interventions, addressing questions about effectiveness, unintended consequences, and long-term sustainability, guiding policy development and implementation [22].

Outcome measures

In this study, we assessed the impact of the Covid-19 pandemic on the distribution of harm reduction services—specifically condoms, syringes, and methadone—using ITSA. The primary outcomes were the monthly distribution rates of these services at Triangle Centers in Lorestan Province, Iran. For each outcome, we calculated the monthly rate as the total number of units (condoms, syringes, or methadone) distributed per month during the observed period.

Measurement of outcomes for ITSA models

To assess the impact of the Covid-19 pandemic, we used ITSA to model the trends in the monthly distribution of each harm reduction service (condoms, syringes, and methadone) before and after the intervention (the onset of the pandemic). The outcomes were quantified as:

Condom Distribution: The total number of condoms distributed to high-risk individuals was measured monthly. The ITSA model estimated the level change in distribution following the pandemic's onset, adjusting for the pre-intervention trend. The result of this analysis is presented in Table 1 as the level change in condom distribution (measured in units per month), and the corresponding 95% confidence interval (CI) is reported.

Methadone Dispensation: The total amount of methadone dispensed (measured in cubic centimeters, cc) was recorded monthly. We then modeled the level change in the dispensation of methadone, similarly adjusting for the pre-intervention trend and comparing the immediate

Table 1 Change in receiving condoms in high-risk groups based on seasonally segmented regression models considering the announcement of the start of Covid-19 in February 2020 in Iran

Parameter	Coefficients	95% CI	Standard Errors	P-Value
Intercept	3112.54	2941.80	3283.27	85.60 0.00
Baseline trend	-23.56	-31.40	-15.73	3.92 0.00
Level change after the intervention	-2168.86	-2405.57	-1932.15	118.68 0.00
Trend change after the intervention	101.78	90.71	112.86	5.55 0.00

Table 2 Change in methadone consumption based on seasonally segmented regression models considering the announcement of the start of Covid-19 in February 2020 in Iran

Parameter	Coefficients	95% CI	Standard Errors	P-Value
Intercept	21868.35	20970.95	22765.74	449.95 0.00
Baseline trend	-48.58	-89.75	-7.40	20.65 0.05
Level change after the intervention	-5007.60	-6251.75	-3763.45	623.81 0.00
Trend change after the intervention	283.49	225.26	341.72	29.20 0.00

Table 3 Change in receiving syringes based on seasonally segmented regression models considering the announcement of the start of Covid-19 in February 2020 in Iran

Parameter	Coefficients	95% CI	Standard Errors	P-Value
Intercept	632.55	556.53	708.56	38.11 0.00
Baseline trend	-1.08	-4.56	2.40	1.74 0.53
Level change after the intervention	-601.01	-706.39	-495.62	52.84 0.00
Trend change after the intervention	23.42	18.49	28.35	2.47 0.00

level before and after the pandemic. The methadone data are presented in Table 2 as the level change (measured in cc per month), with the 95% CI reported. Syringe Distribution: Similarly, the total number of syringes distributed per month was measured. The ITSA model estimated the level change in syringe distribution, accounting for pre-intervention trends and comparing the immediate levels before and after the pandemic. The results for syringe distribution are presented in Table 3 as the level change (measured in units per month), along with the 95% CI. For each outcome, the level change was estimated by examining the immediate change in the dependent

variable (the number of condoms, syringes, or amount of methadone distributed) following the intervention, while accounting for the underlying pre-intervention trends. This approach allows us to isolate the effects of the Covid-19 pandemic on harm reduction services, adjusting for any seasonal or other underlying trends that may have affected distribution patterns over time.

Statistical analysis

In February 2020, the MOHME officially declared the onset of the Covid-19 outbreak in Iran. This study treated the commencement of this pandemic as an intervention. The period from January 2017 to January 2020 was designated as the pre-intervention, while the period from February 2020 to February 2023 was considered the post-intervention. An analysis was conducted to evaluate the impact of Covid-19 on the distribution of condoms, syringes, and methadone among high-risk individuals attending Triangle Centers. The model fitting process involved the application of the Newey-West technique and the assumption of independence [23]. Subsequently, the Combi-Huizinga autocorrelation test was employed to assess autocorrelation at various intervals [24]. In instances where autocorrelation was found to be significant at a specific lag, that lag was incorporated into the ITSA model to accommodate the necessary assumptions [25]. Additionally, we utilized visual displays of residuals from Ordinary Least Squares (OLS) regression, in conjunction with the examination of autocorrelation and partial autocorrelation plots [26]. All statistical analyses were carried out using R software version 4.3.1, with a significance threshold set at a P-value < 0.05.

Results

Provision of harm reduction services before and during the covid-19 pandemic

Before the Covid-19 pandemic, harm reduction services in Iran were delivered systematically through triangular clinics under the Ministry of Health and Medical Education. These clinics provided high-risk individuals with essential supplies such as condoms, syringes, and methadone. On average, the monthly distribution rates for these services were 3,112.54 condoms, 632.55 syringes, and 21,868.35 cc of methadone, ensuring that vulnerable populations had access to critical harm reduction measures. Following the onset of the pandemic in February 2020, the delivery of these services experienced significant disruptions. Fear of infection, logistical challenges, and resource reallocation led to notable declines in service provision. Condoms, syringes, and methadone saw reductions in their monthly distribution rates, raising concerns about the continuity of care for high-risk groups and the potential for increased public health risks, such as HIV transmission and opioid-related harm.

Tables 1 to 3 below illustrate the changes in the provision of harm reduction services before and after the pandemic's onset, based on the segmented regression models used in this study.

Impact of the Covid-19 pandemic on condom distribution

Following the onset of Covid-19 in February 2020, there was a significant level change in the distribution of condoms. The number of condoms distributed per month decreased by 2,168.87 units (95% CI: -2,405.57 to -1,932.15). This result represents a change in the level of distribution that can be directly attributed to the pandemic, with a marked reduction from pre-pandemic distribution levels. The **level change** is calculated by comparing the distribution immediately before and after the pandemic, accounting for the pre-existing trend in distribution (Table 1; Fig. 1).

Impact of the Covid-19 pandemic on methadone distribution

Following the onset of the Covid-19 pandemic in February 2020, there was a significant level change in the distribution of methadone, with a decrease of -5,007.60 cc per month (95% CI: -6,251.75 to -3,763.45). This decline represents the combined effect of both fewer doses provided to individuals and, potentially, lower amounts dispensed per dose. While the exact breakdown between these two factors is not available from the data, it is clear that both factors likely contributed to the observed decrease in methadone dispensation. Upon reviewing the statistics, we note that the level change for methadone distribution was negative, aligning with the data shown in Table 2, which presents a reduction in the total amount dispensed. The confusion in the previous version of the manuscript stemmed from a misrepresentation of a positive value for the post-period, which we have now

corrected. The 95% confidence interval for this decrease is correctly reported as -6,251.75 to -3,763.45 (Fig 2).

Impact of the Covid-19 pandemic on syringe distribution

The distribution of syringes also experienced a decrease following the pandemic. The level change for syringes was -601.01 units per month (95% CI: -706.39 to -495.62), reflecting a significant reduction in the provision of syringes to high-risk individuals. This negative level change indicates a decrease in syringe distribution after the pandemic's onset, consistent with the data shown in Table 3. The positive rate of syringe distribution mentioned previously has been corrected, and the corresponding negative confidence interval is now properly reflected (Fig 3).

Discussion

The findings of this study highlight significant disruptions to harm reduction services in Iran following the onset of the Covid-19 pandemic. The analysis focused on the distribution of condoms, methadone, and syringes among high-risk individuals attending Triangle Centers. The results indicate notable decreases in the provision of these essential harm reduction services, pointing towards potential negative consequences for the health and well-being of vulnerable populations.

The study revealed a substantial reduction in the distribution of condoms to high-risk individuals following the declaration of the Covid-19 pandemic. This decline is concerning, as condoms play a crucial role in preventing the transmission of STIs, including HIV [27]. The decrease in condom distribution may lead to increased risks of STIs among high-risk populations, highlighting the need for targeted interventions to ensure ongoing access to and promotion of safe sexual practices during health crises [28]. The monthly rate of methadone

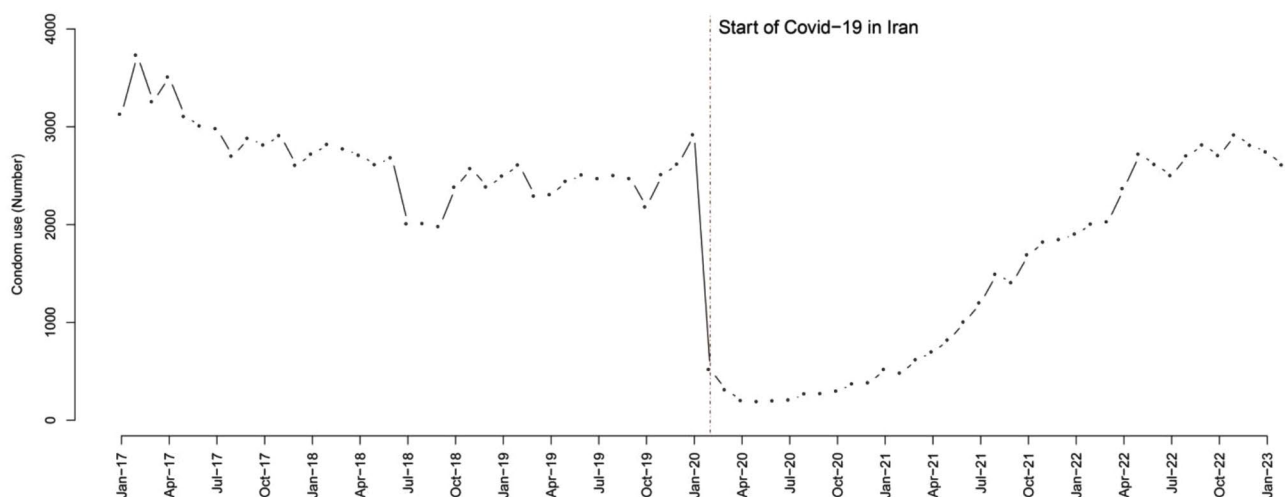


Fig. 1 The temporal trend of condom use rate in high-risk groups before and after the announcement of the start of covid-19 in Iran

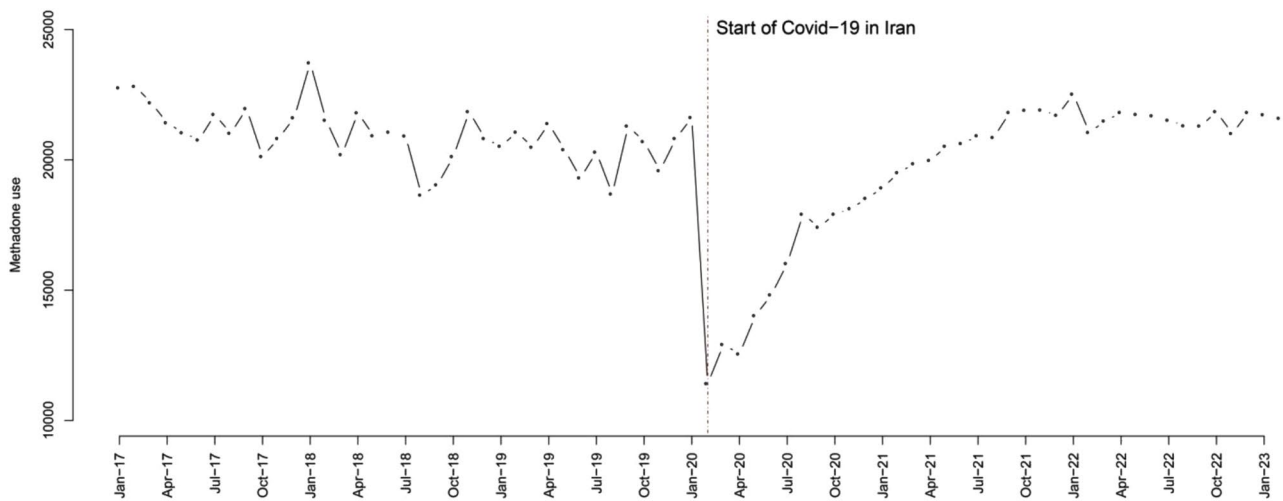


Fig. 2 The temporal trend of methadone consumption before and after the announcement of the start of Covid-19 in Iran

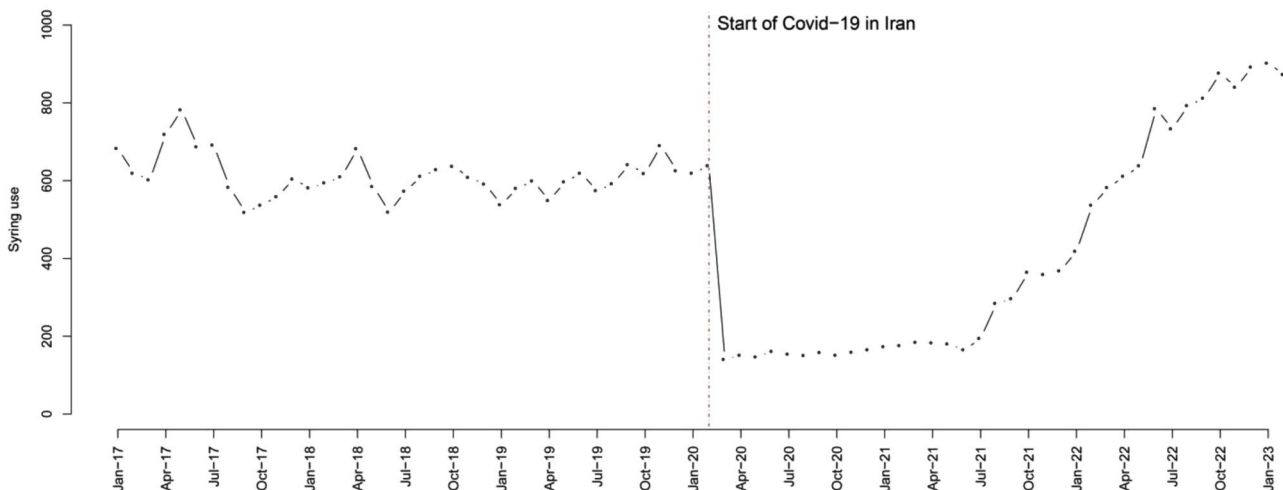


Fig. 3 The temporal trend of receiving syringes before and after the announcement of the start of Covid-19 in Iran

dispensation, a critical component of opioid harm reduction, experienced a significant drop after the initiation of the pandemic [29]. This decline may have severe implications for individuals struggling with opioid addiction, potentially leading to increased withdrawal symptoms, relapse, and associated health risks [30]. The findings underscore the importance of maintaining continuity in methadone services, even during public health emergencies, to support the well-being of individuals with substance use disorders [31]. The study also identified a decrease in the monthly rate of syringe provision following the announcement of Covid-19. This decline raises concerns about the potential increase in unsafe injection practices, contributing to the spread of blood-borne infections, including HIV and hepatitis [32]. Ensuring a steady supply of clean syringes is essential for harm reduction efforts and preventing the transmission of

infectious diseases among individuals who inject drugs [33].

The observed decrease in the harm reduction services to high-risk individuals after the announcement of the beginning of Covid-19 in Iran may be influenced by several factors. The fear of contracting Covid-19 may have influenced the behavior of high-risk individuals, leading to a decrease in their engagement with harm reduction services [14]. Stigma or discrimination associated with seeking healthcare during the pandemic could discourage individuals from accessing services, including those related to harm reduction [33].

One of the most significant effects of Covid-19 on receiving health services was the fear of contracting the disease in health service centers [34]. Various studies have indicated that people visited these centers less due to the overcrowding of health facilities and the fear of contracting Covid-19 [14, 32, 33]. This resulted in

a decline in services to patients, aligning with the findings of our study. The fear of contracting Covid-19 may have influenced the behavior of those at risk, leading to reduced engagement with harm reduction services [29]. Additionally, the stigma or discrimination associated with seeking healthcare during a pandemic can discourage people from accessing services, including those related to harm reduction [1].

The Covid-19 pandemic has led to disruptions in routine healthcare services globally [14]. The strain on healthcare resources, reallocation of personnel, and prioritization of Covid-19-related services may have resulted in reduced capacity to maintain regular harm reduction activities [30].

At the onset of the Covid-19 pandemic in Iran, the disease spread rapidly, leading to the engagement of all hospitals in accommodating these patients [35]. Simultaneously, primary health care centers, directly linked to triangular centers, actively utilized their resources to offer screening and diagnostic services for Covid-19 patients [36]. Many health workers from these centers extended their support to other facilities, aiming to alleviate the workload of their colleagues. Their efforts were crucial as the primary priority of the health system in Iran was to conduct extensive testing [37].

The immediate response to the pandemic might have led to a shift in resource allocation, with a focus on Covid-19 testing, treatment, and prevention measures. This could have affected the availability of resources, both financial and human, for harm reduction programs [38].

The government of Iran implemented social distancing policies and imposed restrictions on the movement of people and vehicles in various cities. These measures significantly impacted the distribution of services and equipment [39]. In the initial stages of the disease, the process of dispensing medicine was hindered due to stringent monitoring to prevent the spread of the virus through both vehicular and human means [40]. The global disruption of supply chains during the pandemic could have affected the availability and distribution of healthcare commodities [10]. Logistic challenges, transportation disruptions, or shortages in the supply chain may have contributed to the observed decrease [9]. In a study involving participants from 77 countries, over 81% of respondents reported that service recipients had encountered restrictions on the utilization of harm reduction services due to quarantine policies [14].

On the other hand, the restrictions imposed on traffic and services had an impact on receiving health services [15]. Pandemics and related quarantine measures may influence the behavior of at-risk individuals. Changes in social interactions, economic conditions or living conditions can affect the need and use of harm reduction services and lead to fluctuations in the rate of receiving

harm reduction services [27]. In one study, 37.5% of respondents reported shortages of drugs such as methadone and complained about their experience of not having access to this drug [14].

Lockdowns, travel restrictions, or fear of infection could have hindered high-risk individuals' access to healthcare facilities, including triangular clinics, where harm reduction services are provided. This reduced access could result in fewer individuals seeking and receiving harm reduction activities [41].

Healthcare providers may have faced increased demands related to Covid-19, leading to shifts in their priorities. The focus on pandemic response might have diverted attention and resources away from routine harm reduction activities [42].

In Iran, as in other countries, individuals with high-risk behaviors were susceptible to neglect and marginalization, potentially leading to heightened complications and increased mortality rates. In the first year following the onset of the Covid-19 pandemic, it appears that individuals receiving harm reduction services encountered a reduction in these services due to personal reasons or complications arising from Covid-19's impact on the Iranian health system. This could be attributed to ineffective policymaking and a lack of preparedness for situations like the Covid-19 pandemic. The development and anticipation of appropriate policies to sustain the provision of harm reduction services during events such as Covid-19, along with consideration of potential responses in similar epidemics, can contribute to preventing delays and inequalities in access to services for individuals with high-risk behaviors.

Limitations

The study relies on data extracted from Triangular clinics in Lorestan Province, which may not represent the entire population of high-risk individuals in Iran. The findings may not be generalizable to other regions or populations with different characteristics. Triangular clinics' services and the population they serve may have unique features that differ from other harm reduction programs in Iran, limiting the broader applicability of the results. The accuracy and completeness of the data collected from Triangular clinics depend on the reliability of the recording and reporting systems. Incomplete or inaccurate data could introduce bias into the analysis. The study relies on recorded service counts, and potential variations in documentation practices or reporting accuracy over time could impact the validity of the results. The analysis may not fully account for potential confounding factors that could influence harm reduction services, such as changes in government policies, socio-economic conditions, or concurrent public health initiatives. External events or interventions that coincided with the Covid-19 pandemic

may have influenced harm reduction services independently, and their effects may not be adequately controlled for in the study design. The ITSA assumes that the Covid-19 pandemic was the only significant event affecting harm reduction services during the study period. Other unobserved events or policy changes may have influenced the outcomes, challenging the causal attribution solely to the pandemic. The findings may not be directly applicable to different cultural, socioeconomic, or healthcare system contexts. Policies and responses to the pandemic can vary widely between countries and regions. The manuscript primarily relies on quantitative data, and qualitative insights or perspectives from high-risk individuals, healthcare providers, or policymakers could provide a more comprehensive understanding of the observed changes.

Implications for policy and practice

- 1. Emergency preparedness and response:** The observed disruptions in harm reduction services during the Covid-19 pandemic underscore the need for robust emergency preparedness and response plans. Policymakers in Iran should develop and implement strategies that ensure the continuity of essential harm reduction services during health crises. This includes clear protocols for resource allocation, service delivery, and workforce management to maintain the provision of condoms, syringes, and methadone to high-risk individuals.
- 2. Integration of harm reduction into pandemic planning:** The findings emphasize the importance of integrating harm reduction strategies into broader pandemic planning efforts. As the Covid-19 pandemic has shown, the focus on infectious disease containment can inadvertently lead to neglecting the needs of vulnerable populations engaged in high-risk behaviors. Policies should explicitly address the continuation of harm reduction services during pandemics, ensuring that the health system remains responsive to the diverse needs of the population.
- 3. Community engagement and education:** Addressing the potential fear, stigma, or discrimination associated with seeking healthcare during a pandemic is crucial. Policymakers should prioritize community engagement and education campaigns to raise awareness about the continued availability and safety of harm reduction services. Efforts should be made to destigmatize seeking help for substance use disorders and promote the understanding that harm reduction remains a critical component of public health, even during health emergencies.
- 4. Resource allocation and logistic support:** The study suggests that disruptions in the supply chain and logistical challenges contributed to the decrease in harm reduction services. Policymakers should allocate resources for ensuring a steady supply of condoms, syringes, and methadone during pandemics. Logistic support, including streamlined distribution processes and addressing transportation challenges, is crucial for maintaining the availability of harm reduction commodities.
- 5. Telehealth and alternative service delivery:** Considering the limitations imposed by lockdowns and travel restrictions, exploring telehealth options and alternative service delivery models becomes imperative. Policymakers should investigate the feasibility of virtual counseling sessions, remote monitoring, and home delivery of harm reduction supplies. This can ensure continued access to services while minimizing the risk of infection for both service providers and recipients.
- 6. Capacity building for healthcare providers:** The study hints at shifts in healthcare priorities and resource allocation during pandemics. Capacity building for healthcare providers in harm reduction principles and practices should be emphasized to ensure that, even during health crises, there is a dedicated focus on the needs of high-risk populations. This includes training healthcare professionals to adapt their services to the evolving demands of public health emergencies.
- 7. Policy advocacy and collaboration:** Advocacy for evidence-based harm reduction policies should be an ongoing effort, especially during public health crises. Collaborative initiatives between government agencies, non-governmental organizations, and community-based organizations are crucial for effective policy implementation. Policymakers should actively seek input from experts and stakeholders in harm reduction to create policies that are responsive to the dynamic challenges posed by pandemics.
- 8. Long-term sustainability planning:** The study's focus on the post-intervention period highlights the importance of long-term sustainability planning. Policymakers should develop strategies to ensure the resilience of harm reduction programs beyond the immediate crisis. This includes securing funding, building infrastructure, and establishing frameworks that enable adaptability to unforeseen challenges in the future.

Conclusion

This study reveals substantial disruptions in harm reduction services in Iran following the onset of the Covid-19 pandemic. The provision of condoms, syringes, and

methadone to high-risk individuals attending triangular clinics significantly declined, posing serious public health challenges. These disruptions were influenced by factors such as fear of infection, logistical challenges, resource reallocation, and limited accessibility due to pandemic-related restrictions. The findings underscore the critical need to prioritize harm reduction services during health crises. This study contributes to the field by demonstrating how pandemics can exacerbate vulnerabilities among marginalized populations, particularly individuals with high-risk behaviors, and highlights the broader public health implications of neglecting these services. One key contribution of this study is its focus on harm reduction within the unique context of Iran, where triangular clinics represent a pivotal strategy in mitigating substance use-related harms. The analysis provides evidence of the pandemic's specific impact on these services, offering insights for policymakers and stakeholders in Iran and similar settings. By identifying gaps in service continuity, this research emphasizes the importance of integrating harm reduction programs into broader emergency preparedness plans. Furthermore, the use of ITSA provides robust evidence of the pandemic's effect on harm reduction, offering a methodological framework for future studies. This study underscores the importance of evidence-based policymaking to protect vulnerable populations, especially during global health emergencies. Policymakers must ensure the continuity of harm reduction services by developing adaptable strategies that account for potential disruptions during pandemics. This includes maintaining supply chains, addressing logistical barriers, and reducing stigma around accessing these services. Investing in harm reduction programs not only supports vulnerable populations but also strengthens public health systems' resilience and equity. By shedding light on the pandemic's consequences for harm reduction, this study aims to inform strategies that safeguard these critical services, ensuring they remain accessible and effective during health crises and beyond. The insights derived from this study contribute to the broader understanding of harm reduction's role in promoting health equity and public health resilience in times of crisis.

Abbreviations

ITSA	Interrupted time series analysis
MOHME	Ministry of Health and Medical Education
HIV	Human immunodeficiency viruses
STDs	Sexually transmitted diseases
OLS	Ordinary least squares
CI	Confidence interval

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Not applicable.

Author contributions

SB, MaB, AA, and MeB were the principal investigators who contributed to the conception and design of the study, collected, entered, analyzed, interpreted the data, prepared the manuscript. MaB acted as a corresponding author. MaB, AA, SB, and SJE contributed to data analysis, interpretation and drafted the manuscript. All authors read and approved the final manuscript.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of the Lorestan University of Medical Sciences (IR.LUMS.REC.1402.296).

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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