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Drug and Alcohol Dependence 232 (2022) 109263

Contents lists available at ScienceDirect

Drug and Alcohol Dependence

journal homepage: www.elsevier.com/locate/drugalcdep

Examining the impact of the first wave of COVID-19 and associated control measures on interventions to prevent blood-borne viruses among people who inject drugs in Scotland: an interrupted time series study

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ARTICLE INFO

Keywords:
People who inject drugs
Blood-borne virus
Prevention
Service provision
Public health
COVID-19

ABSTRACT

Background: COVID-19 has likely affected the delivery of interventions to prevent blood-borne viruses (BBVs) among people who inject drugs (PWID). We examined the impact of the first wave of COVID-19 in Scotland on: 1) needle and syringe provision (NSP), 2) opioid agonist therapy (OAT) and 3) BBV testing.

Methods: An interrupted time series study design; 23rd March 2020 (date of the first 'lockdown') was chosen as the key date.

Results: The number of HIV tests and HCV tests in drug services/prisons, and the number of needles/syringes (N/S) distributed decreased by 94% (RR=0.062, 95% CI 0.041–0.094, $p < 0.001$), 95% (RR=0.049, 95% CI 0.034–0.069, $p < 0.001$) and 18% (RR = 0.816, 95% CI 0.750–0.887, $p < 0.001$), respectively, immediately after lockdown. Post-lockdown, an increasing trend was observed relating to the number of N/S distributed (0.6%; RR = 1.006, 95% CI 1.001–1.012, $p = 0.015$), HIV tests (12.1%; RR = 1.121, 95% CI 1.092–1.152, $p < 0.001$) and HCV tests (13.2%; RR = 1.132, 95 CI 1.106–1.158, $p < 0.001$). Trends relating to the total amount of methadone prescribed remained stable, but a decreasing trend in the number of prescriptions (2.4%; RR = 0.976, 95% CI 0.959–0.993, $p = 0.006$) and an increasing trend in the quantity prescribed per prescription (2.8%; RR = 1.028, 95% CI 1.013–1.042, $p < 0.001$) was observed post-lockdown.

Conclusions: COVID-19 impacted the delivery of BBV prevention services for PWID in Scotland. While there is evidence of service recovery; further effort is likely required to return some intervention coverage to pre-pandemic levels in the context of subsequent waves of COVID-19.

1. Introduction

Marginalised populations, such as people who inject drugs (PWID), are particularly vulnerable in times of crisis and the COVID-19 pandemic is no exception (Douglas et al., 2020; Friedman et al., 2009; Zolopa et al., 2021). PWID are vulnerable to the direct and indirect effects of the pandemic through likely increased risk of COVID-19 morbidity (due to underlying health conditions); increased stress and isolation that may increase drug use or risk of relapse; loss of income and employment opportunities; and disruptions to the illicit drug supply (Dunlop et al., 2020; Grebely et al., 2020; Jacka et al., 2020; Marsden et al., 2020; Wang et al., 2021). These effects may be further compounded by

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https://doi.org/10.1016/j.drugalcdep.2021.109263
Received 21 September 2021; Received in revised form 22 November 2021; Accepted 9 December 2021
Available online 31 January 2022

disruptions to harm reduction services, including those vital for the prevention of blood-borne viruses (BBVs) (Vasylyeva et al., 2020; Zolopa et al., 2021).

The effective prevention of BBVs requires a comprehensive package of interventions, which includes opioid agonist therapy (OAT), needle and syringe provision (NSP) and BBV testing followed by access to treatment and care (World Health Organisation, 2015). National and international recommendations state that services for PWID are 'essential' and should be maintained despite COVID-19 restrictions (European Monitoring Centre for Drugs and Drug Addiction, 2020; Scottish Drugs Forum, 2020; Scottish Government, 2020; United Nations Human Rights, 2020). However, the delivery of these services in the context of COVID-19, both in Scotland and internationally, have faced considerable challenges (Chang et al., 2020; Dunlop et al., 2020; Grebely et al., 2020; Marsden et al., 2020). Research from elsewhere in the UK and other countries suggests that the delivery and coverage of NSP has reduced, and there are increased barriers to accessing OAT and BBV testing (Bartholomew et al., 2020; Croxford et al., 2021; Dunlop et al., 2020; Munro et al., 2021; Whitfield et al., 2020).

The effectiveness of interventions in preventing BBVs among PWID is dependent on coverage (Larney et al., 2017). Pre-pandemic, the coverage of BBV prevention services in Scotland was good (with 'moderate' OAT and 'high' NSP coverage), compared to other regions globally where less than 1% of PWID live in countries with a high coverage of both NSP and OAT (Larney et al., 2017; Wiessing et al., 2017). However, despite relatively good access to services, Glasgow, Scotland's largest city, is currently experiencing an ongoing outbreak of HIV that represents the largest community-based outbreak in the UK since the 1980s (McAuley et al., 2019; Trayner et al., 2021, 2020). The prevalence of hepatitis C virus (HCV) among PWID has also historically been high; however, significant progress in reducing the prevalence of chronic HCV infection (from 39% in 2015/16–19% in 2019/20) has been made as a result of the scale up of direct-acting antivirals (Health Protection Scotland, 2019a; Palmateer et al., 2021; Public Health England, 2020a). Therefore, ascertaining the impact of COVID-19 on key services is fundamental, as any disruptions in the delivery of BBV prevention services could have severe consequences relating to the transmission of BBVs among PWID in Scotland.

Studies to date assessing the impact of COVID-19 on services for PWID have largely relied on self-reported data or focussed on regional areas (Bartholomew et al., 2020; Brothers et al., 2021; Croxford et al., 2021; Genberg et al., 2021; Glick et al., 2020; Mistler et al., 2021; Whitfield et al., 2020). Although these studies have yielded important insights, a recent systematic review reported that current evidence was limited and further research is required to understand the impact of COVID-19 on interventions for PWID (Munro et al., 2021). To the best of our knowledge, this is the first study to address this evidence gap through use of empirical data from service administration systems covering a large geographical area (encompassing 63% of people with problematic drug use in Scotland) and multiple BBV prevention services (Information Services Division, 2019). This research aims to assess the effects of COVID-19 and associated control measures on interventions that are fundamental for the prevention of BBVs: NSP; OAT; and BBV testing (HCV and HIV).

2. Methods

2.1. Study design

We assessed the effects of the first wave of COVID-19 and associated control measures on interventions to prevent BBVs among PWID in Scotland using an interrupted time series study design. The key date selected was the 23rd of March 2020 (first national 'lockdown') and the study time period was set from September 2018 to August 2020, allowing for six months of data after the first COVID-19 case in Scotland (Fig. 1). Data were available for the following administrative health areas (National Health Service (NHS) Board areas: Greater Glasgow and Clyde (GGC), Lothian (LO), Grampian (GR) and Tayside (TY). These regions represent 57% of the total Scottish population and 63% of people with problematic drug use in Scotland (Information Services Division, 2019; National Records of Scotland, 2020). Qualitative information was also collated on how the provision of interventions were impacted during the first wave of COVID-19 and any mitigation measures that were introduced/enhanced through consultation with public

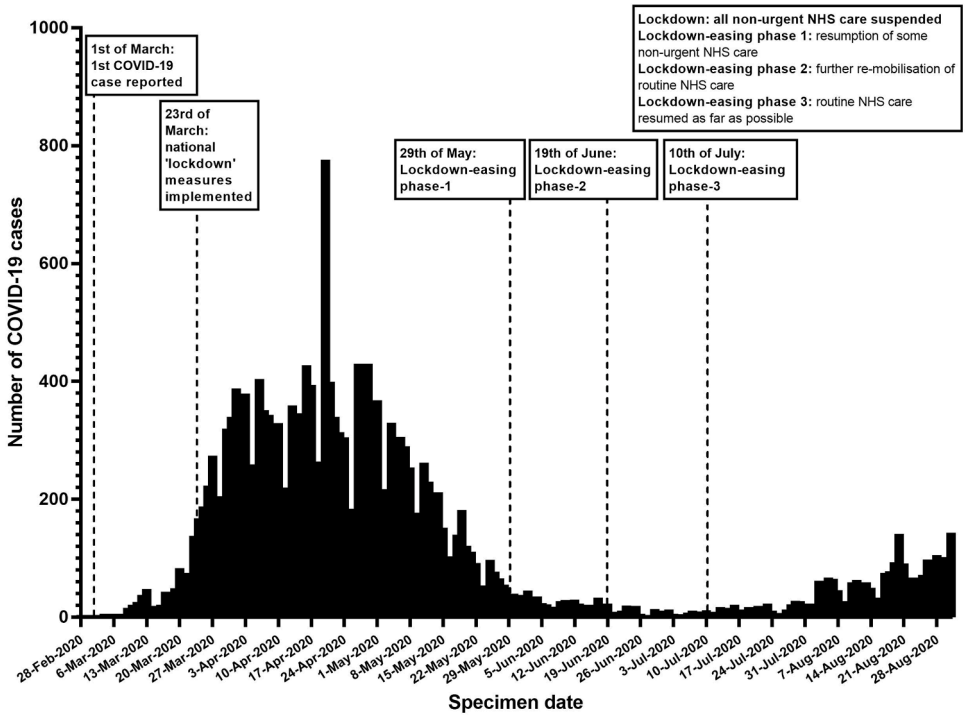

Fig. 1. The number of confirmed COVID-19 cases by specimen date and key dates relating to the first wave of COVID-19 in Scotland.

health, addiction and harm reduction leads. Segmented regression analyses were subsequently completed on four anonymised quantitative data sources, relating to each intervention of interest (NSP, OAT, HIV test, HCV test).

2.2. Data sources

A summary of each data source is provided in Table 1. Data on NSP transactions were available from the neo360® database, a commercial database which is used by NSP sites across mainland Scotland to record NSP attendance and injecting equipment distribution (Public Health Scotland, 2020). NSP data was only available from April 2019 onwards. Data relating to OAT prescriptions were available from the NHS Prescribing Information System (PIS). PIS contains a record of drug reimbursement costs to community pharmacies and drugs prescriptions dispensed in the community in Scotland (Alvarez-Madrazo et al., 2016). Once completed, dispensed prescriptions are submitted for reimbursement and that information is collated and aggregated on a monthly basis. As a result, there can be a time-lag within the PIS data. For example, prescriptions written in February, may not be processed until March (and thus aggregated in March). To account for this lag, PIS data was extracted from September 2018 to the end of September 2020. Data was obtained from PIS, relating to the prescription of the most common OAT formulations in Scotland: methadone 1 mg/1 ml oral solution and buprenorphine 2 mg, 8 mg and 16 mg tablets. Methadone accounts for over 90% of OAT prescriptions in Scotland; however, the prescribing of buprenorphine is becoming more prevalent in some areas nationally (The Scottish Public Health Observatory, 2020).

HIV test data was only available for GGC (the largest NHS Board (52% of the study population) and the location of the ongoing HIV outbreak). Data on the number of HIV tests conducted in GGC for the study period were received from NHS West of Scotland Specialist Virology Centre. The HCV test database, held at Public Health Scotland (PHS), contains a record of the vast majority of positive and negative HCV tests (with comprehensive data from the NHS Boards GGC, LO, TY, and GR that are supplemented by other NHS Boards nationally), which relates to approximately 70% of HCV diagnoses in Scotland (Health Protection Scotland, 2019b). Only tests that were conducted in drug services (including community addiction teams, pharmacy and services that cater to homeless individuals) and prisons were analysed, as these are key settings for the regular BBV testing of PWID.

2.3. Outcome measures

Study outcome measures are described in Table 1. Briefly, relating to NSP, key outcome measures were counts of the number of NSP transactions, counts of the number of needles and syringes (N/S hereafter) supplied and the mean number of N/S supplied per transaction. The mean number of N/S per transaction was calculated by dividing the number of N/S distributed by the number of transactions for each weekly period. In relation to OAT outcomes, for both methadone and buprenorphine, counts of the number of prescriptions, mean quantity prescribed per prescription (mg) and the total quantity of each drug prescribed (mg) were analysed. The mean quantity prescribed per prescription was calculated by dividing the total quantity prescribed each month by the number of prescriptions. Key outcome measures relating to BBV tests were counts of the number of tests. Where available, outcomes were assessed by NHS Board, demographic factors (age and gender) and referral source (Appendix 1–3).

2.4. Statistical analysis

Segmented negative binomial regression was used to assess the change in each outcome as a result of COVID-19 and associated control measures introduced in Scotland (Lopez Bernal et al., 2017; Wagner et al., 2002). Data was aggregated by ISO week (International Organisation for Standardisation (ISO) definition of a week), with the exception of OAT data, which was only accessible aggregated by month. Mean counts per week (or per month for OAT data) pre- and post-lockdown were also calculated. In addition, the percentage difference between equivalent time periods was quantified to compare differences in service provision between 2019 and 2020 (Appendix 4-6). The 23rd of March

Table 1
Summary of data sources used to assess the impact of the first wave of COVID-19 and associated control measures on the provision of interventions fundamental for the prevention of blood-borne viruses among people who inject drugs in Scotland.

Intervention	Data source	Time period	NHS Board	Description	Key outcomes
Needle and syringe provision (NSP)	neo360® database	1st April 2019 – 30th August 2020 Aggregated by ISO week	Greater Glasgow and Clyde, Lothian, Grampian and Tayside	Data on NSP transactions prospectively collected by NSP sites in Scotland (Public Health Scotland, 2020).	• Total number of transactions • Total number of needles and syringes distributed • Mean number of needles/ syringes distributed per transaction
Opioid agonist therapy (OAT)	Prescribing Information System (PIS)	1st September 2018 – 31st September 2020 Aggregated by calendar month	Greater Glasgow and Clyde, Lothian, Grampian and Tayside	PIS data includes all information relating to dispensed medicines and reimbursement payments to community pharmacies in Scotland (Alvarez-Madrazo et al., 2016).	For the drug combinations methadone 1 mg/ml and buprenorphine 2 mg, 8 mg and 16 mg: • Total number of prescriptions • Mean quantity prescribed per prescription (mg) • Total quantity prescribed (mg)
HCV testing	Electronic Communication of Surveillance in Scotland	3rd September 2018 – 30th August 2020 Aggregated by ISO week	Greater Glasgow and Clyde, Lothian, Grampian and Tayside	Database of all HCV tests from Greater Glasgow and Clyde, Lothian, Grampian and Tayside (supplemented by other NHS Boards nationally). Represents approximately 70% of all HCV diagnoses in Scotland. Only tests conducted in drug services/prisons were analysed (Health Protection Scotland, 2019b).	• Total number of HCV tests, by: o Gender o Age at test o NHS Board o Referral source
HIV testing	West of Scotland Specialist Virology Centre	3rd September 2018 – 30th August 2020 Aggregated by ISO week	Greater Glasgow and Clyde	All HIV tests conducted in NHS Greater Glasgow and Clyde. Only tests conducted in drug services/ prisons were analysed.	• Total number of HIV tests, by: o Gender o Age at test o Referral source

2020 (date of first national lockdown) was chosen as the key change point (Fig. 1). The pre- and post-lockdown periods varied depending on data availability and can be viewed in Table 1. For each outcome, a segmented negative binomial regression model was used to estimate the temporal trend in the pre-lockdown and post-lockdown periods, in addition to the change in level between the two periods (i.e. change or 'drop' in service provision between pre- and post-lockdown). For modelling proportional outcomes (e.g. mean number of N/S per transaction), the numerator was included as the outcome variable (e.g. number of N/S) and the log of the denominator (e.g. number of transactions) was included as an offset term in regression models. Results are presented as rate ratios (RR) with 95% confidence intervals (CIs) and associated p-values. All analyses were conducted using Stata 13.

3. Results

3.1. Qualitative findings relating to the impact of the COVID-19 pandemic on BBV prevention service delivery and mitigation measures implemented

The first wave of COVID-19 in Scotland commenced on the 1st of March 2020 (detection of the first case) and lockdown measures ('stay at home' order with exceptions for food shopping, travel to work in essential services or accessing healthcare) were implemented on the 23rd of March 2020 (Fig. 1). Guidance was developed to support services in the redesign of service delivery models (Scottish Drugs Forum, 2020). The Scottish Government and the Chief Medical Officer also issued a letter underlining the importance of maintaining drug treatment services (Scottish Government, 2020).

All interventions were affected by reduced capacity due to physical distancing requirements, building closures, staff sickness, shielding, isolation and deployment to other services. Some NSP sites closed, reduced their opening hours or suspended face-to-face services altogether, and this reduced capacity resulted in increased waiting times and long queues at NSP sites that remained open (e.g. community pharmacies). Mitigation measures included delivery (including through outreach, peers and postal), and 'click and collect' NSP. People attending NSP sites were encouraged to take additional supplies of injecting equipment at each transaction, and the secondary distribution of equipment to peers was actively encouraged (Table 2).

The delivery of OAT was also affected by increased waiting times/queues in community pharmacies. 'Take-home' OAT was expanded and increased supplies were recommended for those deemed appropriate following a risk assessment. Prescribing services also revised frequency of prescription instalment collection (e.g. shift from daily collection to once/twice weekly) to reduce the frequency of attendance at community pharmacies. This was supported by legislative changes which facilitated such changes without the immediate requirement for a new prescription. Delivery of OAT, OAT pick up by a named individual, outreach and peer support were introduced to support individuals shielding/isolating. In some services there was a reduction in capacity to see patients in person and to initiate new OAT patients, however, this was not consistent in all areas. Phone appointments were introduced to replace routine clinics and home visits were carried out in some services. In some settings, there was a shift to buprenorphine prescribing – as buprenorphine was considered safer for new initiation – and take-home OAT doses. Furthermore, trials of long-acting injectable OAT were introduced and expanded in some areas (Table 2).

Relating to BBV testing, in some NHS Boards, all dried blood spot (DBS) testing was temporarily suspended or had extended turnaround times due to reduced capacity. In GGC, the location of the ongoing HIV outbreak, BBV testing was not suspended and laboratory capacity was maintained for those who had a BBV test (but with an increased turnaround time). However, changes to service delivery models significantly reduced face-to-face contact and thus opportunities for HIV (and HCV) testing. This was also an issue in the other NHS Boards, and reduced face-to-face contact with the population was the main barrier relating to the delivery of BBV testing. Mitigation measures included increased assertive outreach, point of care testing and trials of self-sampling DBS

Table 2
Qualitative summary of the impact of COVID-19 and associated control measures on interventions to prevent blood-borne viruses among people who inject drugs and mitigation measures introduced/enhanced in Scotland.

Intervention	Impact of COVID-19 on service delivery	Mitigation measures introduced/enhanced
Needle and syringe provision (NSP)	• Closure, reduced opening hours and face-to-face services ceased/reduced • Reduced footfall at NSP sites • Increased waiting times and queues at NSP sites due to social distancing	• Delivery, postal and 'click and collect' NSP introduced • Extended opening hours (in some services that remained open) • Individuals encouraged to take increased supplies at each transaction • Secondary NSP distribution encouraged • Assertive outreach and linkage with other services (e.g. those delivering food parcels) • Targeted NSP provision in identified high risk areas
Opioid agonist therapy (OAT)	• Reduction in clinical capacity to see patients in person at routine clinics or primary care in some services • Reduced capacity to initiate new OAT patients in some services • Increased waiting times and queues at community pharmacies due to social distancing requirements	• Relaxing of prescribing policies and shift from supervised OAT to take-home (for those appropriate) • Shift from 14-28 day to 28–56 day OAT prescriptions with reduced supervision (with variation between NHS Boards) • Increase in dispensing instalment intervals where clinically appropriate (shift from daily dispensing to once/twice weekly) • Home visits introduced in some services to replace appointments • Phone appointments/video conferencing to replace routine clinics (face-to-face available for those deemed highest risk) • Self-referral in some services • Increased assertive outreach • Peer support and OAT delivery for those shielding/isolating • Increased collection of OAT prescription by nominated individual • Additional COVID-19 clinics (face-to-face) to offer OAT to those not on prescription in some areas • Introduction and expansion of long-acting injectable buprenorphine in some areas • Shift towards buprenorphine prescribing in some areas
Blood-borne virus (BBV) testing	• Dried blood spot testing suspended/reduced due to laboratory capacity in some areas • Third sector BBV testing suspended/reduced • Social distancing resulted in reduced face-to-face contact with PWID and therefore reduced opportunity for testing	• Point of care testing • Self-sampling dried blood spot testing • Delivery/postal testing • Outreach and prioritisation of key risk groups (such as those experiencing homelessness)

NSP = needle and syringe provision; OAT = opioid agonist therapy; BBV = blood-borne virus; PWID = people who inject drugs

Table 3
Impact of the first wave of COVID-19 on blood-borne virus prevention services for people who inject drugs: segmented negative binomial regression analysis modelling the impact of first lockdown (23rd March 2020) in all NHS Boards.

Intervention	Mean per week pre-lockdown	Mean per week post-lockdown	% change	Segmented negative binomial regression					
				Pre-lockdown slope		Change in level		Post-lockdown slope	
				RR (95% CI)	P-value	RR (95% CI)	P-value	RR (95% CI)	P-value
Needle and syringe provision (NSP)[a,b]									
NSP transactions	3134	2204	-30%	0.997 (0.995–0.999)	0.001	0.635 (0.572–0.705)	< 0.001	1.014 (1.008–1.022)	< 0.001
Needles/syringes distributed	37,587	30,924	-18%	0.997 (0.996–0.999)	< 0.001	0.816 (0.750–0.887)	< 0.001	1.006 (1.001–1.012)	0.015
Mean number of needles/syringes per transaction	12	14	17%	1.001 (0.999–1.002)	0.285	1.267 (1.165–1.377)	< 0.001	0.991 (0.986–0.997)	0.001
Opioid agonist therapy (OAT)[c,d,e]									
Methadone prescribing									
Number of prescriptions	22,167	19,309	-13%	0.998 (0.994–1.003)	0.482	0.973 (0.889–1.064)	0.556	0.976 (0.959–0.993)	0.006
Mean quantity per prescription (mg)	1246	1520	22%	1.002 (0.999–1.006)	0.182	1.068 (0.992–1.150)	0.082	1.028 (1.013–1.044)	< 0.001
Total quantity prescribed (mg)	27,607,516	29,208,293	6%	1.001 (0.996–1.005)	0.725	1.035 (0.946–1.134)	0.447	1.004 (0.985–1.022)	0.686
Buprenorphine prescribing									
Number of prescriptions	4790	4949	3%	1.011 (1.006–1.015)	< 0.001	0.999 (0.910–1.096)	0.984	0.986 (0.968–1.004)	0.120
Mean quantity per prescription (mg)	176	204	16%	1.005 (1.001–1.008)	0.004	1.033 (0.967–1.102)	0.336	1.019 (1.007–1.033)	0.003
Total quantity prescribed (mg)	843,844	1008,351	19%	1.015 (1.011–1.020)	< 0.001	1.027 (0.934–1.128)	0.585	1.006 (0.987–1.025)	0.536
HIV testing[f,g,h]									
Number of HIV tests	131	50	-62%	1.005 (1.002–1.008)	0.005	0.062 (0.041–0.094)	< 0.001	1.121 (1.092–1.152)	< 0.001
HIV tests by referral source									
Prison	32	22	-31%	0.999 (0.996–1.003)	0.768	0.164 (0.103–0.261)	< 0.001	1.106 (1.074–1.140)	< 0.001
Drug service	99	28	-72%	1.007 (1.003–1.011)	0.001	0.038 (0.023–1.064)	< 0.001	1.131 (1.094–1.169)	< 0.001
HCV testing[f,g]									
Number of HCV tests	191	64	-66%	1.004 (1.001–1.007)	0.010	0.049 (0.034–0.069)	< 0.001	1.132 (1.106–1.158)	< 0.001
HCV tests by referral source									
Prison	51	28	-45%	0.999 (0.996–1.002)	0.666	0.104 (0.071–0.152)	< 0.001	1.124 (1.097–1.151)	< 0.001
Drug service	140	36	-74%	1.005 (1.002–1.009)	0.003	0.033 (0.021–0.053)	< 0.001	1.136 (1.103–1.171)	< 0.001

NSP = needle and syringe provision; OAT = opioid agonist therapy; [a]NSP pre-lockdown period: 1st April 2019 (ISO week 14) to 22nd March 2020 (ISO week 12); [b]NSP post-lockdown period: 23rd March 2020 (ISO week 13) to 30th of August (ISO week 35); [c]Aggregated by calendar month; [d]OAT pre-lockdown period: September 2018 to February 2020; [e]OAT post-lockdown period: March 2020 to September 2020; [f]HIV and HCV test pre-lockdown period: 3rd September 2018 (ISO week 36) to 22nd March 2020 (ISO week 12); [g]HIV and HCV test post-lockdown period: 23rd March 2020 (ISO week 13) to 30th August 2020 (ISO week 35); [h]HIV testing relates to NHS Greater Glasgow and Clyde only

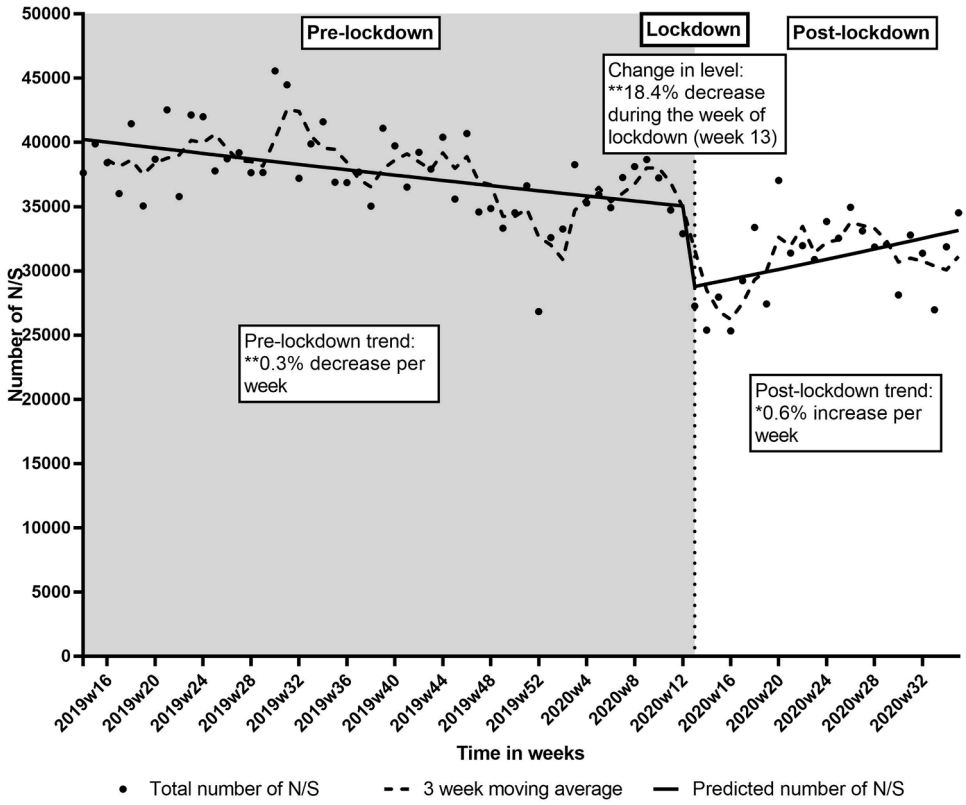

Fig. 2. Impact of first wave of COVID-19 on needle and syringe provision: observed and predicted (from segmented negative binomial regression model) *number of needle/syringes (N/S)* distributed per week, April 2019 – August 2020[11].

testing (Table 2).

3.2. Needle and syringe provision

The mean number of NSP transactions per week and the mean number of N/S distributed per week decreased by 30% and 18%, respectively, between pre- and post-lockdown periods. Conversely, the mean number of N/S distributed per transaction per week increased by 17% for the same period (Table 3). In April 2020 (weeks 14–17), the number of NSP transactions and N/S distributed were 44% and 29% lower, respectively, compared to equivalent periods in 2019. By the end of August 2020 (weeks 34–35), the number of transactions and N/S distributed had increased relative to April 2020 but were still 26% and 15% lower, respectively, compared to the same period in 2019 (Appendix 4).

In segmented regression analyses, there was a significant decreasing trend in the weekly number of both NSP transactions (0.3% decrease; RR = 0.997, 95% CI 0.995–0.999, p = 0.001) and N/S distributed (0.3% decrease; RR = 0.997, 95% CI 0.996–0.999, p < 0.001) pre-lockdown (Table 3; Fig. 2). In the first week of lockdown, there was a significant change in level in the number of NSP transactions (36.5% decrease; RR=0.635, 95% CI 0.572–0.705, p < 0.001), the number of N/S distributed (18.4% decrease; RR = 0.816, 95% CI 0.750–0.887, p < 0.001) and the mean number of N/S distributed per transaction (26.7% increase; RR = 1.267, 95% CI 1.165–1.377, p < 0.001) (Table 3; Fig. 2). Post-lockdown, there was a significant increasing trend in the number of NSP transactions (1.4% increase; RR = 1.014, 95% CI 1.008–1.022, p < 0.001) and the number of N/S distributed (0.6% increase; RR = 1.006, 95% CI 1.001–1.012, p = 0.015) per weekly period (Table 3; Fig. 2). In addition, there was a decreasing trend post-lockdown relating to the mean number of N/S distributed per transaction (0.9% decrease; RR = 0.991, 95% CI 0.986–0.997) (Table 3).

3.3. Opioid agonist therapy

3.3.1. Methadone

The mean number of methadone prescriptions per month fell by 13% between pre- and post-lockdown periods. Conversely, the mean quantity prescribed per prescription and the total quantity prescribed increased by 22% and 6%, respectively, between the same periods (Table 3). By the end of the study period (September 2020), the number of methadone prescriptions was 10% lower, quantity prescribed per prescription was 25% higher and the total quantity of methadone prescribed was 12% higher when compared to September 2019 (Appendix 5a).

Pre-lockdown, the fitted trend for each outcome assessed was stable and there was no significant change in level as a result of lockdown. Post-lockdown, the number of prescriptions decreased by approximately 2% (RR = 0.976, 95% CI 0.959–0.993, p = 0.006) and the mean quantity prescribed per prescription increased by approximately 3% (RR = 1.028, 95% CI 1.013–1.044, p < 0.001) per monthly period (Table 3; Fig. 3a; Fig. 3b).

3.3.2. Buprenorphine

The mean number of buprenorphine prescriptions per month increased by 3% and the mean quantity prescribed per prescription increased by 16% between pre- and post-lockdown periods. Furthermore, the total quantity of buprenorphine prescribed increased by 19% for the same period (Table 3). By the end of the study period (September 2020), the number of buprenorphine prescriptions, mean quantity of buprenorphine prescribed per prescription and the total quantity prescribed was 7%, 15% and 22% higher, respectively, when compared to September 2019 (Appendix 5b).

Pre-lockdown, there was a significant increasing trend in the number of buprenorphine prescriptions (1.1% increase; RR = 1.011, 95% CI 1.006–1.015, p < 0.001), the mean quantity of buprenorphine prescribed per prescription (0.5% increase; RR=1.005, 95% CI

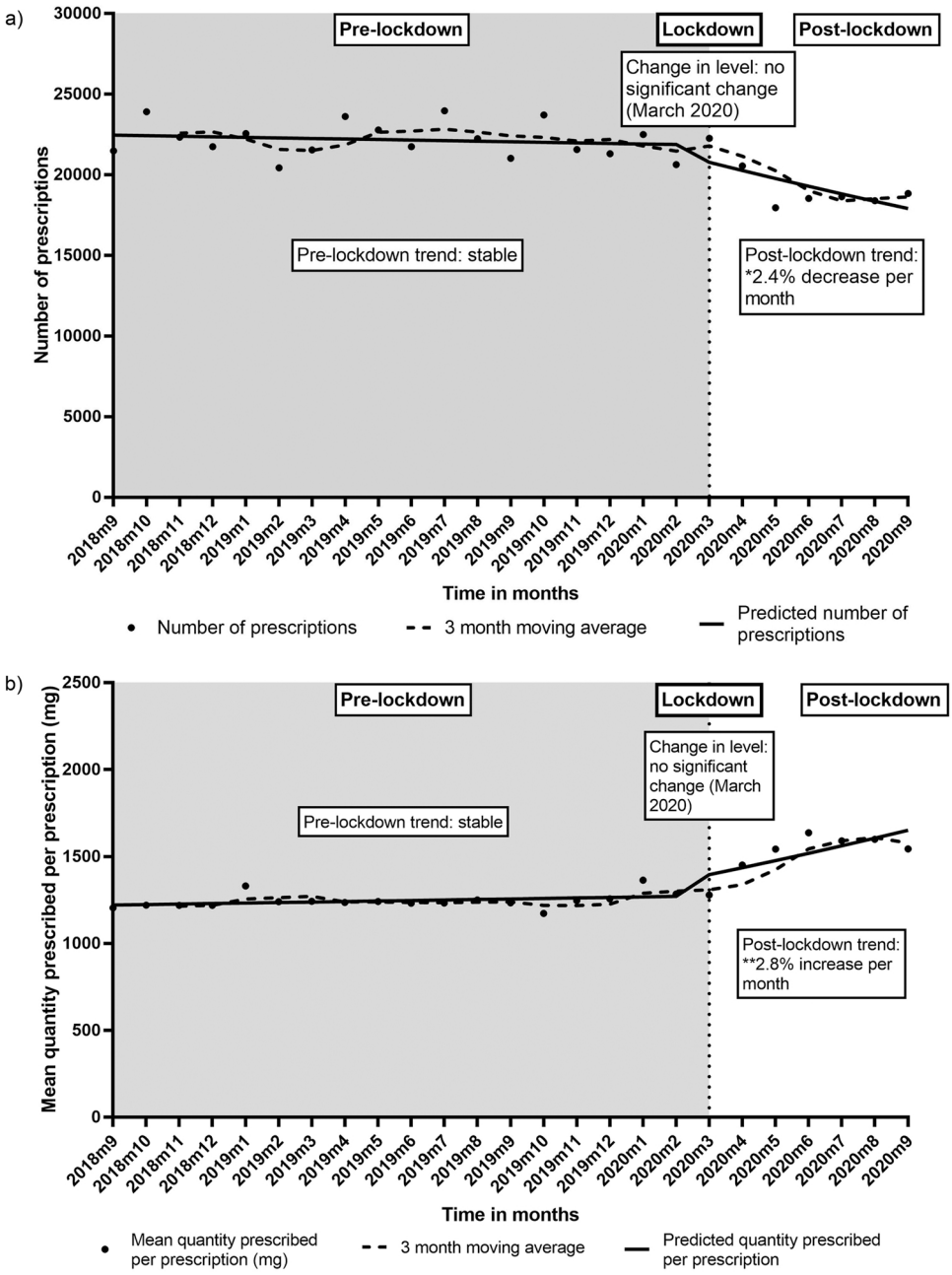

Fig. 3. a. Impact of first wave of COVID-19 on opioid agonist therapy (methadone): observed and predicted (from segmented negative binomial regression model) a) *number of methadone prescriptions* per month, and b) *mean quantity prescribed per methadone prescription* per month, September 2018 – September 2020;[21] .

1.001–1.008, p = 0.004) and the total quantity of buprenorphine prescribed (1.5% increase; RR = 1.015, 95% CI 1.011–1.020, p < 0.001) per monthly period. There was no significant change in level in the week of lockdown for any buprenorphine outcomes. Post-lockdown, an increasing trend was observed relating to the mean quantity of buprenorphine prescribed per prescription (1.9% increase; RR = 1.019, 95% CI 1.007–1.033, p = 0.003) (Table 3).

3.4. HIV testing

The mean number of HIV tests in drug services and prisons per week in GGC dropped by 62% between pre- and post-lockdown periods (Table 3). In the first four weeks of lockdown (weeks 13–16, 2020), there was a 93% decrease in the number of HIV tests conducted compared to the same period in 2019. By the last few weeks in August 2020 (weeks 33–35), the number of HIV tests was 18% lower compared to equivalent period in 2019 (Appendix 6).

In segmented regression analyses, pre-lockdown, there was a significant increasing trend in the number of HIV tests per weekly period (0.5% increase, RR = 1.005, 95% CI 1.002–1.008, p = 0.005). There was a significant change in level relating to number of HIV tests; representing an approximate 94% decrease in the week of lockdown (RR = 0.062, 95% CI 0.041–0.094, p < 0.001). Post-lockdown, a significant increasing trend was observed; the number of HIV tests increased by approximately 12% per weekly period (RR = 1.121, 95 CI 1.092–1.152, p < 0.001) (Table 3; Fig. 4a).

[1] Time period: 1st April 2019 (ISO week 15) to 30th August 2020 (ISO week 35); NHS Board areas: Greater Glasgow and Clyde, Lothian, Grampian and Tayside; lockdown: 23rd March 2020 (week 13); * <0.05; * *< 0.001.

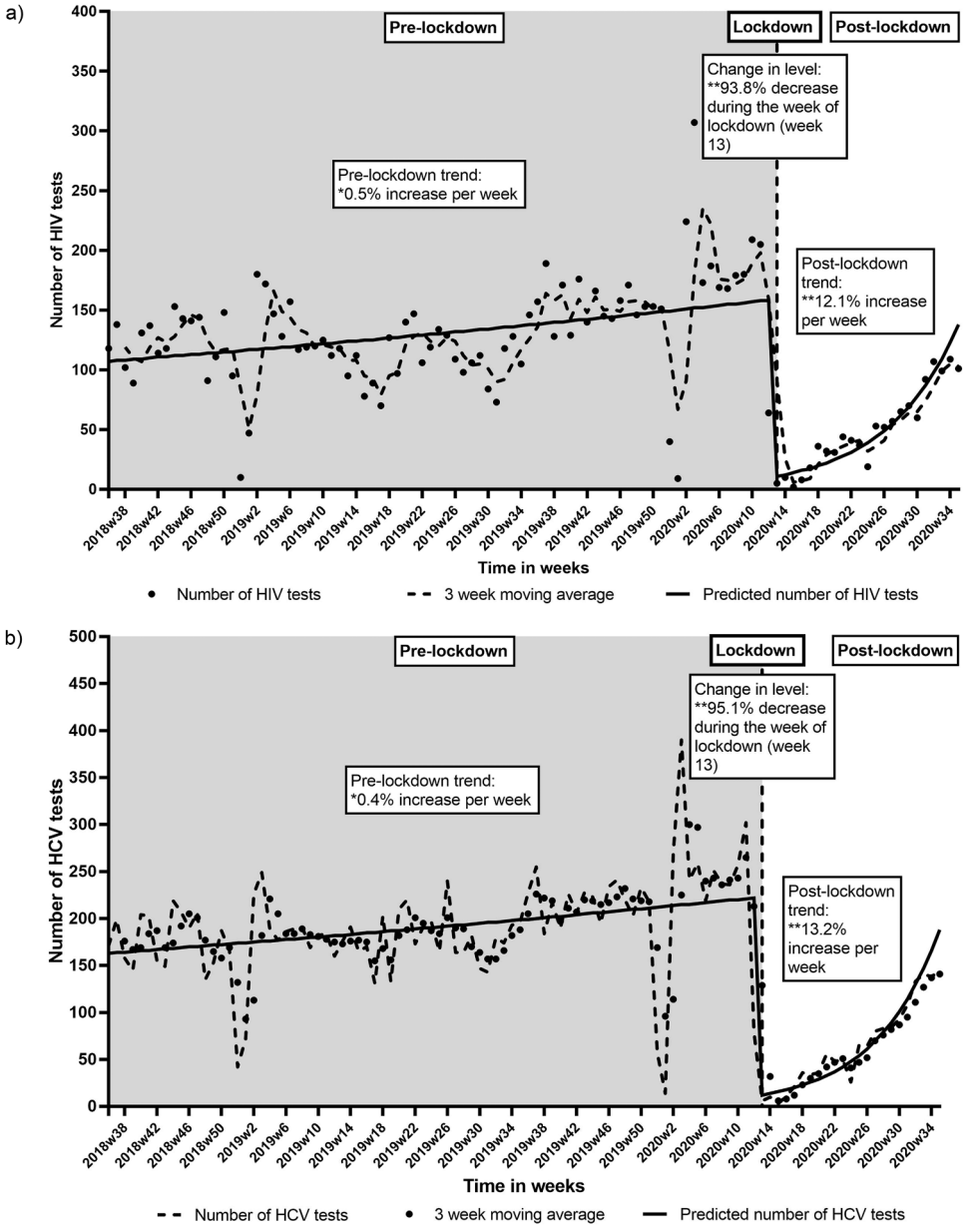

Fig. 4. a. Impact of first wave of COVID-19 on blood-borne virus testing: observed and predicted (from segmented negative binomial regression model) *number of HIV tests* in drug services and prisons, and b) *number of HCV tests* in drug services and prisons September 2018 – August 2020[31].

3.5. HCV testing

Overall, the mean number of HCV tests in drug services and prisons per week dropped by 66% between pre- and post-lockdown periods in all NHS Boards (Table 3). In the first four weeks of lockdown (weeks 13–16), there were 96% fewer HCV tests conducted in drug services and prisons compared to the same period in 2019. In August 2020 (weeks 33–35), there were 25% fewer HCV tests conducted compared to the same period in 2019 (Appendix 6).

In segmented regression analyses, pre-lockdown, there was an increasing trend overall relating to the number of HCV tests per week (0.4%; RR = 1.004, 95% CI 1.001–1.007, p = 0.010). A significant change in level was observed immediately after lockdown (95% decrease; RR = 0.049, 95% CI 0.034–0.069, $p < 0.001$). Post-lockdown, a significant increasing trend in the number of HCV tests was observed per weekly period (13.2% increase; RR = 1.132, 95% CI 1.106–1.158, $p < 0.001$) (Table 3; Fig. 4b).

4. Discussion

Using an interrupted time series study design, we assessed the impact of the first wave of COVID-19 on BBV prevention services for PWID in Scotland. To the best of our knowledge, this research represents the largest study to date to have quantified this impact using empirical routine administrative data across a range of key BBV prevention services for PWID. We found that the delivery of interventions was severely impacted initially during the first wave of COVID-19, most notably in relation to BBV testing in drug treatment and prison settings. There was evidence of recovery and mitigation for all interventions assessed; however, by August 2020 (six months after the first COVID-19 case in

[2] Time period: September 2018 to September 2020; NHS Board areas: Greater Glasgow and Clyde, Lothian, Grampian and Tayside; lockdown: March 2020; * <0.05; ** < 0.001.

Scotland) some interventions (NSP and BBV testing) had not returned to pre-COVID-19 levels. Conversely, overall trends in OAT prescribing remained stable immediately after lockdown measures were introduced and post-pandemic, relative to pre-pandemic trends.

Pre-COVID-19, Scotland had a high NSP coverage compared to other countries, with on average 17 sterile N/S obtained per week per PWID (Health Protection Scotland, 2019c; Larney et al., 2017; Wiessing et al., 2017). In line with quantitative data on NSP provision from the North West of England (Whitfield et al., 2020), we found that NSP provision reduced significantly in the week of the first lockdown, apparent in both the number of NSP transactions (−36%) and the number of N/S distributed (−18%). Some reductions observed may be attributed to reductions or changed patterns of drug use, including the reduced use of image and performance enhancing drugs (Croxford et al., 2021). However, reflecting experiences from other settings, barriers in accessing NSP during lockdown in Scotland also included closure of sites, reduced hours of operation and long waits/queues at NSP sites (Bartholomew et al., 2020; Glick et al., 2020; Kesten et al., 2021; Russell et al., 2021; Whitfield et al., 2020). Mitigation measures introduced in Scotland (including increased assertive outreach, postal NSP, taking increased supplies at each transaction and the encouragement of secondary distribution to peers) have likely been successful – to some extent – in blunting the impact of the initial lockdown and improving provisions in the post-lockdown period. We found likely evidence of taking increased supplies at each transaction and secondary distribution among peers, where a significant increase in the mean number of N/S distributed per transaction was observed in the week of lockdown. Peer and secondary distribution of NSP have also been promoted in other settings internationally to mitigate the impact of COVID-19 (Chayama et al., 2020).

Historically, Scotland and the rest of the UK had moderate coverage of OAT (Larney et al., 2017; Wiessing et al., 2017); the coverage of prescribed methadone (in the last six months) was approximately 69% among current PWID in Scotland (Health Protection Scotland, 2019c). During the pandemic, reports from elsewhere in the UK suggest increased barriers in accessing drug treatment services (Croxford et al., 2021). However, we observed stable trends in the total amount of methadone and buprenorphine prescribed during and after lockdown. Stable trends in OAT prescribing should be interpreted with caution, as prescribing trends could only be assessed on a monthly basis and detail on how prescribing may have been affected in the initial weeks of lockdown was lacking. Furthermore, although the trend was stable, this may be insufficient in relation to demand for OAT which could have increased in the context of a potentially disrupted illicit drug supply (Grebely et al., 2020). The stable trend observed is likely attributable to the mitigation measures introduced, with 'take-home' prescriptions and increased prescription instalment intervals. We found likely evidence of this trend within methadone prescribing practices, where a reduction in the number of methadone prescriptions (approximately 2%) combined with an increase in the quantity prescribed per prescription (approximately 3%) per month was observed.

'Take-home' and changes in OAT prescribing across many countries have been well documented over the course of the pandemic (Brothers et al., 2021; Figgatt et al., 2021; Frank, 2020; Munro et al., 2021). Rigid and often punitive rules surrounding the prescription of OAT have long been criticised (Chang et al., 2020; Frank, 2021; Samuels et al., 2020; Wisse et al., 2021), and the delivery of OAT has become much more flexible during the pandemic, including telephone inductions (from previously required in-person evaluation), more autonomy over treatment options and the introduction and expansion of injectable long-acting slow-release OAT (Brothers et al., 2021; Grebely et al., 2020; Marsden et al., 2020; Samuels et al., 2020). Qualitative research has suggested that changes to OAT prescribing are having positive impacts among PWID, including reduced perceived stigma, increased feelings of trust, and support in healthcare (Kesten et al., 2021; Parkes et al., 2021; Russell et al., 2021). However, increased 'take-home' doses could potentially result in unintended consequences such as increased diversion of prescribed medicines or individuals taking larger/more frequent or irregular doses than prescribed (Bardwell et al., 2021; Schofield et al., 2021). Qualitative research among PWID from the UK found no reports of diversions in OAT doses (Kesten et al., 2021) and a survey from the USA found that diversion of OAT doses was rare (Figgatt et al., 2021). Furthermore, quantitative data from Australia showed reduced OAT diversion and reduced deaths involving methadone compared to pre-pandemic (Coroners Court of Victoria, 2021). However, in Scotland, drug-related deaths in which methadone was implicated increased by 25% between 2019 and 2020 (National Records of Scotland, 2021). The extent to which changes in OAT prescribing contributed to this increase should be investigated.

Prior to the pandemic, the number of BBV tests in drug treatment and prison settings were increasing in Scotland. Latest figures (2017–18) highlighted 49% and 61% of PWID reported an HIV test or a HCV test in the last year in Scotland, respectively (Health Protection Scotland, 2019c). We found that BBV testing was severely impacted during the first wave of COVID-19; a stark drop in testing (over 90%) in drug services and prisons was observed in the first week of lockdown. There was clear evidence of recovery, with the number of tests increasing by approximately 12–13% per week on average post-lockdown. However, increases appear to level off and the number of tests remained below pre-pandemic levels by the end of the study period. Self-reported data from elsewhere in the UK also suggested barriers in accessing BBV testing and similar findings were observed relating to the number of tests in drug services/prisons in England (Croxford et al., 2021; Public Health England, 2020b). Changes in the delivery of harm reduction services to reduce contact with PWID remain the key barrier to improving testing rates. However, increasing BBV testing rates in Scotland is paramount in the context of the ongoing HIV outbreak in Glasgow. Significant gains made pre-COVID-19 in relation to increased HIV test uptake among PWID in response to the outbreak could be in danger of being reversed (Trayner et al., 2021).

The impacts of the pandemic on transmission associated with the HIV outbreak are uncertain due to reduced testing levels. The outbreak in Glasgow is associated with high levels of cocaine injecting, homelessness and public injecting (McAuley et al., 2019; Trayner et al., 2020). These risk factors combined with potentially disrupted OAT treatment schedules and reduced access to NSP could result in an increase in the sharing/reusing of injecting equipment (Jacka et al., 2020), which has been reported in other parts of the UK during the pandemic (Croxford et al., 2021; Kesten et al., 2021). In addition to HIV, this could also impact HCV transmission and associated outcomes. Modelling research estimated that delaying HCV prevention programmes (testing, diagnosis and treatment) by one year could result in 44,800 excess hepatocellular carcinoma cases and 72,300 excess liver-related deaths globally (Blach et al., 2021). The continued monitoring of intervention coverage and injecting risk behaviours is fundamental in the context of subsequent waves of COVID-19 and to ensure that gains made in relation to the control of the HIV outbreak and significant progress towards HCV elimination in Scotland are not eroded (Metcalfe et al., 2020; Palmateer et al., 2021; Trayner et al., 2021).

Disruptions to the provision of harm reduction services, particularly drug treatment, could also have serious consequences for Scotland's ongoing drug-related death epidemic where rates are amongst the highest in the world (National Records of Scotland, 2021). Disruptions to drug treatment have been hypothesised as a contributing factor in the 30% and 62% rise in drug-related deaths between 2019 and 2020 observed in the USA and Canada, respectively (Centers for Disease Control and Prevention, 2021; Kamerow, 2021; Public Health Agency of

[3] Time period: 3rd September 2018 (ISO week 36) to 30th of August 2020 (ISO week 35); NHS Board areas: Greater Glasgow and Clyde (HIV tests), Greater Glasgow and Clyde, Lohian, Grampian and Tayside (HCV tests); lockdown: 23rd March 2020 (week 13); * <0.05; * *< 0.001.

Canada, 2021). In contrast, the number of deaths in Scotland increased by 5% for the same period, and perhaps the adoption of mitigation strategies highlighted in this study has contributed to the smaller increase in drug-related deaths observed. However, further research is required to investigate this and to understand the full impacts of the pandemic on drug-related harms (including HIV, HCV and drug-related deaths), both in Scotland and internationally.

5. Limitations

This study includes a number of limitations. Although our study covered a large geographic area that included urban and rural regions, we did not have data from all of Scotland and impacts of COVID-19 on service provision in the most rural areas of Scotland may have been different. Relating to NSP and OAT, we did not have any data at an individual level and therefore could not identify the number of individuals in receipt of NSP/OAT. Such information would be important to monitor the scale of harm reduction maintenance and other factors like cessation/initiation of drug treatment. Furthermore, we did not have information on prescription instalment intervals or supervised/take-home OAT doses and could only assess broad OAT prescribing trends. NSP data is reliant on data entry from NSP sites, which means data relating to some transactions may be missing. Relating to BBV testing, testing databases did not contain any information on risk factors (i.e. injecting drug use) and therefore some testing activity among PWID may have been missed. Furthermore, this research did not assess the impact of COVID-19 on BBV treatment, another fundamental intervention for the prevention of BBVs among PWID. Relating to OAT, we did not have information on all OAT formulations, and thus could not access the introduction of new medications, such as long-acting injectable OAT.

6. Conclusions

The first wave of COVID-19 in Scotland severely impacted the delivery of key BBV prevention services for PWID, particularly in relation to BBV testing. While there is evidence of service recovery, the continued surveillance of intervention coverage is important in the context of subsequent waves of COVID-19. Further work is required to ensure that the coverage of key interventions is maintained at sufficient levels to ensure previous gains made in relation to the prevention and control of BBVs in both Scotland and other countries globally are not eroded.

Role of the funding source

This project was supported by funding from Public Health Scotland.

CRediT authorship contribution statement

KMAT performed data analysis, interpretation and write up under the supervision of AMc, NEP and SJH. Research questions were proposed by SJH and the study was fully conceptualised by KMAT, AMc, NEP and SJT. AY provided guidance on statistical approaches. All authors provided comments, interpretations of results/conclusions and approved the final submission.

Conflict of interest

SJH has received Honoria from Gilead, un-related to this study. All remaining authors have nothing to disclose.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.drugalcdep.2021.109263.

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