Potential Indicators for the Analysis of the Association between Public Health and Drug Market Policing in the Czech Republic: Review of Public Health Indicators

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BACKGROUND: A number of studies show that an intensification of the policing of illicit drug markets impacts on public health. The impacts are largely seen as negative. **AIMS:** The aim of this article is to describe the basic characteristics of available data and data collection of selected indicators and to review the aspects related to data collection and its context that might influence the selected public health time series in the Czech Republic. The secondary aim is to provide recommendations for future data collection in the Czech public health statistics. **METHODS:** This work is based on research of the specialised databases, reviewing reports published by relevant institutions and additional and selective literature and grey zone materials search. **RESULTS:** The article provides a review of the basic data collection characteristics and identifies different aspects of data collection and its context that have the potential to influence the time series of selected indicators in three different areas: a) treatment entrants, b) non-fatal and fatal intoxications, and c) infectious diseases. **CONCLUSIONS:** The review may assist and facilitate informed analysis and interpretation of drug-related law enforcement indicators individually or in combination with other indicators, using time series analysis as well as comparative approaches.

Keywords | Indicator – Monitoring – Public health – Drug market policing – Czech Republic

● 1 INTRODUCTION

A number of studies have demonstrated that an intensification of drug law enforcement causes negative outcomes in many areas (Bohnert et al., 2011; Booth et al., 2013; Burris et al., 2004; Cooper et al., 2005; Csete et al., 2016; De-Beck et al., 2017; Dixon & Maher, 2005; Fitzgerald, 2005; Friedman et al., 2011, 2006; Kerr et al., 2005; Maher, 1999; Small et al., 2006; Strathdee et al., 2010). The influence of intensive drug law enforcement on public health is found in the context of problematic drug use; cf. Kerr et al. (2005), DeBeck et al. (2017). It has been identified in the following areas: the transmission of infectious diseases, including HIV (Booth et al., 2013; DeBeck et al., 2017; Friedman et al., 2006) and viral hepatitis (Strathdee et al., 2015), the prevalence of fatal and non-fatal overdoses (Csete et al., 20016; Kerr et al., 2005; Bohnert et al., 2011), risk behaviour such as syringe sharing (DeBeck et al., 2017), and barriers to services and treatment (Csete et al., 20016; Kerr et al., 2005). McGallagly et al. (2013) offer a different perspective and pose the hypothesis that law enforcement leads to more treatment entrants. In the Czech Republic, qualitative studies have identified the influence of law enforcement in these domains: worse access to healthcare services (Minařík & Zahradník, 2003; Zábranský et al., 2001), a decrease in the trust between service providers and drug users (Minařík & Zahradník, 2003), a decrease in the availability of sterile injecting equipment (Minařík & Zahradník, 2003), an increase in the risk behaviour of drug users (Zábranský et al., 2001), and an increase in the incidence of hepatitis C roughly six months after an increase in drug market policing (Zábranský et al., 2001).

This study, the second in series of studies on the indicators of public health and drug market policing – see Petruželka et al. (2019) – is focused on the public health indicators. The first study described possible long-term indicators for drug market policing and identified different aspects of data collection and its context that have the potential to influence the indicators. Nine events with such potential were identified in three areas: legislation, the reporting system, and structure and priorities. Both studies consider these indicators because to carry out a long-term trend and time series analysis of the relationship between public health and drug law enforcement, which the authors aim to do in a future study, it is imperative to have an overview of the data collection and aspects related to its context that might influence it. A concise overview of this information focused on changes in time is not yet available in the Czech Republic. It is a basic prerequisite for a time series analysis to have information considering changes in the data collection and the potential impact of these changes on time series (Lopez Bernal et al., 2016). The assumptions about time series related to this are the following: data is recorded in the same manner (Gilmour et al., 2006) and time series have enough time points and are complete (Tabachnick et al., 2019). The criteria of indicator validity and reliability, regarding trends, are related to these assumptions. Among others, these criteria include changes of context (institutions and policies) and local variability (Hartnoll et al., 1998).

The aim of this paper is to describe the basic characteristics of the data collection and to review the aspects related to data collection and its context that might influence selected public health time series in the Czech Republic. The secondary aim is to provide recommendations for future data collection by Czech official bodies. The added value of this work is not only for studies focusing on the relation between public health and policing but also for all those using trend data of selected public health indicators. This review of time series data is also significant for an interpretation of long-term trends or for other analyses using long-term data. Furthermore, this review is relevant to the international use of public health indicators from the Czech Republic because the information provided is not available for non-Czech-speaking researchers. For instance, for an international comparison of these indicators, it is crucial to have better information on the context of the indicators in a given country, which is usually unavailable (Kilmer et al., 2015).

● 2 METHODS AND DATA SOURCES

The public health indicators included in this study were selected on the basis of the following criteria: they were identified in the literature discussed above as related to intensified law enforcement and provided time series based on routine collection from the monitoring systems. These indicators were found in the following areas: a) treatment entrants – the treatment demand indicator (TDI), b) non-fatal and fatal intoxications – hospitalisations and drug-related deaths, c) infectious diseases – viral hepatitis A (VHA), viral hepatitis B (VHB), viral hepatitis C (VHC), and Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS).

The main source of data for this article was a literature search. During the search, we were looking for the following information about the selected indicators: the availability of specific data sets, characteristics of the data collection and its context that might influence the data collection, and changes in these aspects over time. This information was extracted and compiled for the selected indicators. Since the bulk of the relevant literature consists of "grey literature" – in the form of various reports that are not archived in scientific databases and that are published by various institutions working in the relevant area – the literature search consisted mainly of reviewing final reports published by such institutions and searches in scientific databases. The reports and papers of the following institutions were reviewed: the Czech National Monitoring Centre for Drugs and Addiction (NMS), the Department of Addictology of the First Faculty of Medicine of Charles University in Prague and the General University Hospital in Prague, the Institute of Health Information and Statistics of the Czech Republic (ÚZIS ČR), the National Institute of Public Health (SZÚ), the Public Health Authority of the City of Prague, and the Czech Statistical Office. The search in scientific databases was conducted in the Web of Science Core Collection and Scopus (Czech* AND drug* AND one of the following keywords:

treatment demand indicator, hepatitis, HIV/ADS, drug-related deaths, non-fatal drug intoxications, hospitalisation).

● 3 PUBLIC HEALTH INDICATORS

3.1 Data collection systems and data availability

All of the indicators are available in the National drug report – see the latest issue by Mravčík et al. (2018) – and in the reports of the competent institutions that are described below. Furthermore, the data may be requested from the competent institutions. On the international level, the situation is different. TDI, drug-related deaths, and infectious diseases among injecting drug users (HIV/AIDS, VHC, and VHB) are among the five main indicators monitored by the EMCDDA (2018a) and are available in its statistical bulletin (EMCDDA, 2018b). Hospitalisations are not among the five main indicators monitored by the EMCDDA (2018a) and are not included in the statistical bulletin (EMCDDA, 2018b).

TDI is focused on the collection of data on clients entering specialised treatment centres seeking help with drug addiction or drug-related problems (EMCDDA, 2017). The system has undergone two stages of development, which are described in the section focused on changes (see below).

Information on hospitalisations is collected by two systems: the National Registry of Hospitalised Patients (NRHOSP), run by ÚZIS ČR (2018a, 2018b), and the Public Health Sentinel System, run by the Public Health Authority (Füleová et al., 2015, 2016). ÚZIS ČR (2018a, 2018b) gives the following description of NRHOSP: NRHSOP is a nationwide population register based on hospitalisation cases that are reported when a patient leaves a hospital ward, regardless of whether this is due to the patient's release from the hospital or the patient's death or transfer to another ward or another in-patient facility. The reporting unit is an in-patient ward of any healthcare facility in the Czech Republic. Hospitalisation reports are classified according to the International Classification of Diseases (ICD-10). The register only lists hospitalisations longer than 24 hours (Mravčík et al., 2012). The Public Health Sentinel System records overdose cases and other health complications that require urgent hospitalisation (Mravčík et al., 2012). Cases are reported to the system by various types of healthcare providers, including emergency services (Mravčík et al., 2012, Füleová et al., 2016), and reporting is voluntary (Polanecký, 2003).

Drug-related deaths are recorded in the special and general mortality registries. The general mortality registry is run by the Czech Statistical Office (ČSÚ) and pools together data collected by ČSÚ and ÚZIS ČR. ČSÚ receives the data on the basis of information provided by community registries concerning each death recorded in the area. ÚZIS ČR receives data based on Deceased Examination Protocols (ÚZIS ČR, 2018d) that examiners must fill in for each case they attend to. The basic cause of death is coded according to the ICD-10 and subsequent amendments (ČSÚ, 2017). The special mortality registry was developed as a part of the preparation for the PAD study (Zábranský et al., 2001). At first, the system underwent changes and improvements, which were finished in 2001, when the questionnaire was updated on the basis of the EMCDDA standard, and an automatic system of drug-related death monitoring was established. The system remained in operation until 2012. The National Register of Autopsies and Toxicological Examinations Performed at Forensic Medicine Departments (NRPATV) operated by ÚZIS ČR replaced the previous registry as of 2015 (Mravčík et al., 2015, 2016).

Infectious diseases are monitored through the routine collection of data on newly diagnosed cases (mandatory reporting) from healthcare providers. HIV/AIDS monitoring has been the responsibility of SZÚ's National Reference Laboratory for HIV/AIDS since 1985 (ÚZIS ČR, 2012). If an HIV/AIDS test is positive when performed under defined circumstances, the blood sample is sent to the National Reference Laboratory (NRL) for HIV/AIDS, where every such result must be confirmed (MZ ČR, 2018). After the positive result has been confirmed, the patient is referred to an HIV centre for treatment. The HIV centre files a "Report of a new HIV-positive case" with the National Reference Laboratory for HIV/AIDS. The case is also reported to the director of the epidemiological section of the relevant regional public health service. Information about viral hepatitis used to be monitored through the online EPIDAT system and processed by SZÚ until 2017 (ÚZIS ČR, 2012). The data submitted by healthcare providers to the system used to be regularly monitored (Procházka et al., 2011). The new Infectious Disease Information System (ISIN) was launched in 2018 (SZÚ, 2018).

3.2 Aspects of data collection and its context that might influence the data

This section of the article focuses on those aspects of data collection and its context that might influence the indicators but were not identified on the timeline. Considering TDI, here we discuss issues that might be valid for both stages of the development of the system, while the issues related to the specific stages of its development are discussed in the section that focuses on the changes. The validity of the TDI data has been investigated in the context of cannabis use and in the first data collection system, but it is conceivable that those issues are also significant for the current system. A questionnaire study conducted by Mravčík et al. (2003) and follow-up qualitative studies by Šťastná et al. (2004) and Miovský et al. (2004) highlighted a lack of standardisation in the use of definitions when recording specific cases, which was probably due to insufficient training and education of the staff of the reporting facilities.

The data on hospitalisations from NRHOSP is influenced by the fact that doctors code substances, which might lead to inaccuracies (Mravčík et al., 2012; EMCDDA, 2018c; Mravčík, 2018). It is possibly due to the fact that data collec-

tion in this area is not the primary purpose of this information system. In addition to that, the EMCDDA (2018c) notes regional differences in substance coding. The focus of the Public Health Sentinel System is characterised by yearly changes in the coverage of regions and facilities (Mravčík et al., 2012; Füleová et al., 2016) and great regional variation in data collection (Mravčík et al. 2012). This, and also the fact that it includes different medical complications requiring hospitalisation, complicates the interpretation of the trends (Mravčík, 2018).
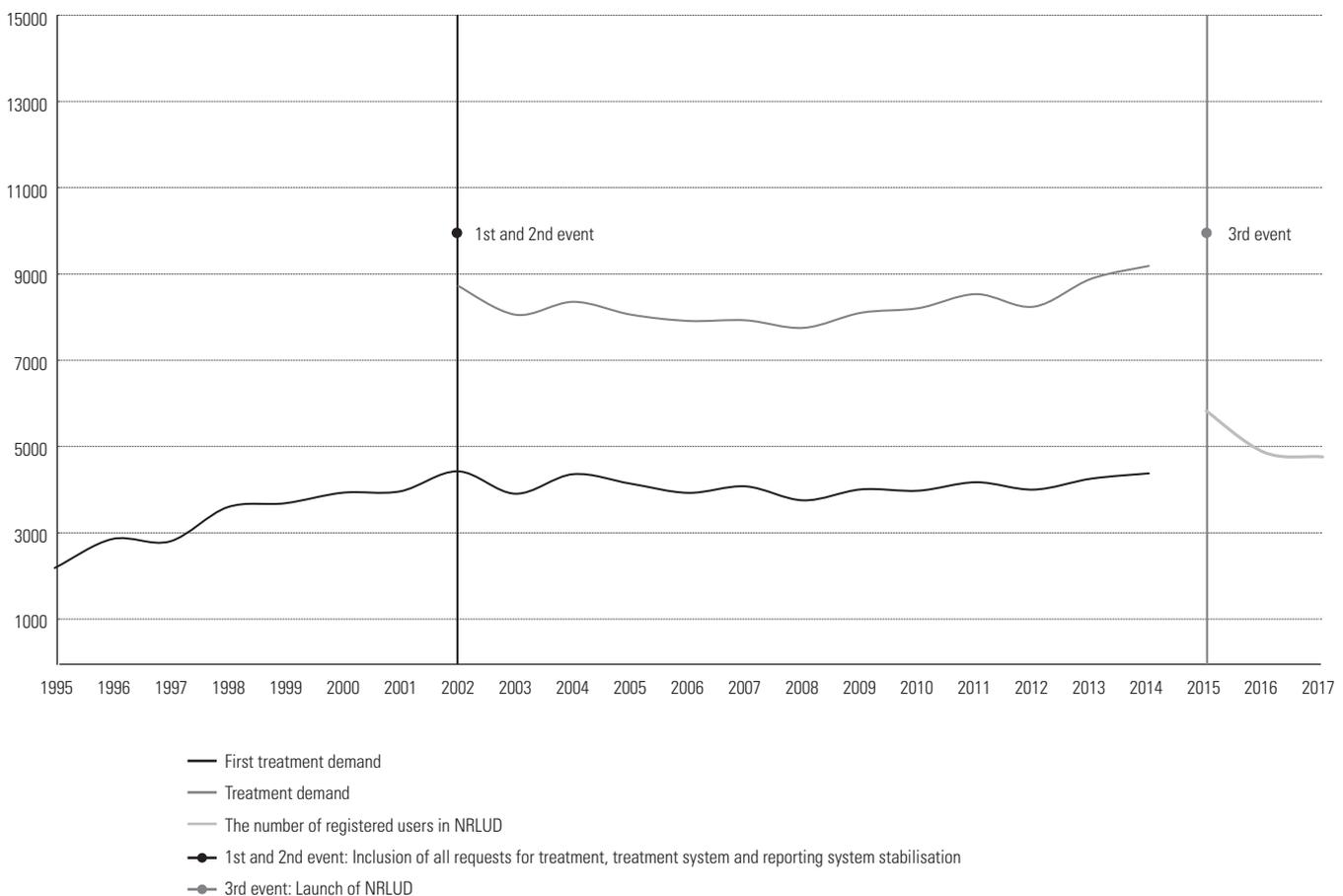
The identification and reporting of viral hepatitis cases is influenced by multiple aspects. The identification of the cases in this area is related to the awareness of the disease among service providers and users. The number of notifications is linked to the awareness of the role of injecting drug use in the spread of viral hepatitis (Zábranský et al., 2002). When interpreting regional differences, one must keep in mind potential differences in the way epidemiological enquiry and reporting are conducted (Mravčík et al., 2012). Furthermore, diseases can be identified in healthcare facilities only if such facilities are actually available and if such cases are reported.

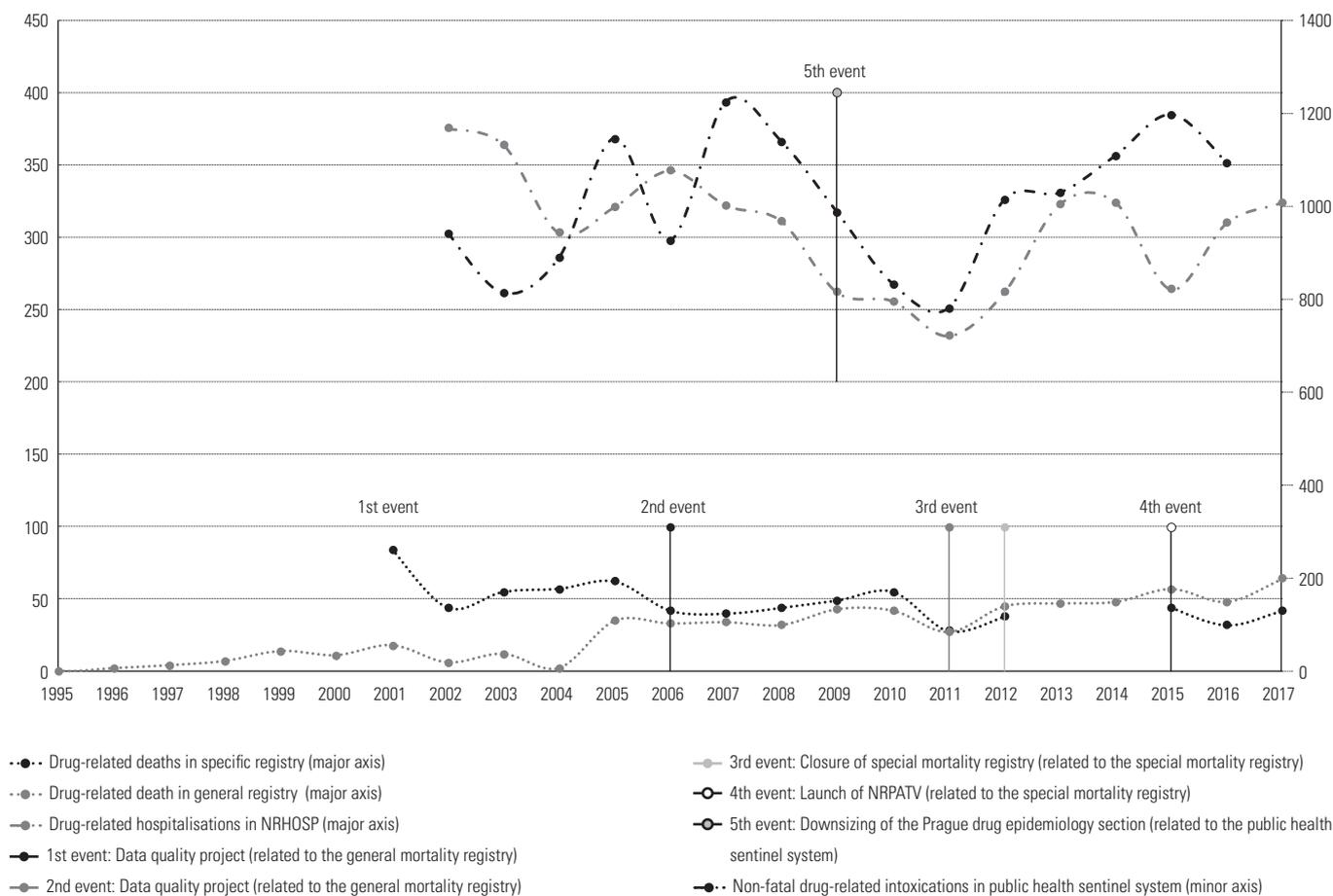## 3.3 Significant changes related to the data collection and its context

TDI

The first two identified events co-occurred in a similar period. The first event consisted of beginning to record all requests for treatment, rather than just first requests (Mravčík et al., 2003). The system also started receiving data from more service providers (such as therapy communities and follow-up treatment centres) which, by virtue of the service they provide, do not register "first requests" (Polanecký et al., 2003). The second event, related to the first event, the stabilisation of the treatment system and of the reporting system, is significant because from 2002 onwards the time series is stable and fit for analysis. On the basis of a study by Kalina (2007), Zábranský (2007) concluded that the treatment system stabilised after 2000. The coverage of the network seems to have stabilised around 2002, reporting discipline improved (Polanecký et al., 2003), and the share of different types of facilities reporting remained similar (Studničková, 2009). (*Figure 1.*)

The treatment demand indicator has undergone two phases of development (see *Figure 1*). During the first stage, data collection and evaluation was organised by a central drug epidemiology section of the Public Health Authority of the

Legend:
— First treatment demand
— Treatment demand
— The number of registered users in NRLUD
—●— 1st and 2nd event: Inclusion of all requests for treatment, treatment system and reporting system stabilisation
—●— 3rd event: Launch of NRLUD

Figure 1 | First treatment demand and treatment demand (source: Füleová, 2015), the number of newly registered users in NRLUD (source: ÚZIS ČR, 2017; 2018d) and significant events related to the monitoring system

Figure 2 | The number of drug-related deaths and non-fatal intoxications for illegal drugs in different data collection systems (source: Mravčík et al., 2018) and significant events related to the monitoring systems

City of Prague (Füleová et al., 2015). The third event related to this indicator, which marked the beginning of the second stage of development, was the launch of the National Register of Therapy of Drug Users (NRLUD), ÚZIS ČR being the responsible institution (ÚZIS ČR, 2017). The new system merged the old monitoring system with the National Register of Users of Medically Indicated Substitution Substances (NRULISL) (Mravčík et al., 2015).

The merging of the systems resulted in the inclusion of opioid substitution users into the system; however, the system also lacks data from a substantial part of the treatment network (Mravčík et al., 2017). In the new system, we can observe a reduction in the level of reporting and in the number of registered users and programmes reporting (ÚZIS ČR, 2016; ÚZIS ČR, 2017; ÚZIS ČR, 2018c). Methamphetamine users from low-threshold services and counselling are not present in the new system as much as in the previous system (Mravčík et al., 2017). This absence is possibly related to the changes in the system that might have influenced reporting discipline and coverage. The launch of the new system was accompanied by some complications that included technical issues and "information noise". Although Nechanská et al. (2015) did not give a detailed description of the information noise, they described the key characteristics of the new system, which were probably the root cause of these issues. The key characteristics include data anonym-

ity and use exclusively for epidemiological and statistical purposes, excluding any use for control or repressive purposes. The technical issues are related to the change in the data collection system. The new system introduced electronic data collection and abandoned paper questionnaires (Nechanská et al., 2014), as well as the system of data collection which had been based on the collaboration of public health authorities with local branches of regional public health authorities, which also included regular meetings, seminars, and annual conferences (Studničková, 2009). In its first year, NRLUD faced certain technical issues but data interface accessibility and data import from the legacy IT systems used by treatment facilities gradually improved in 2016 (ÚZIS ČR, 2017). All the above-mentioned changes in the data collection system unfortunately seriously distorted the recorded trends.

Non-fatal intoxications and drug-related deaths

We identified only one event related to the data collection systems that deal with non-fatal intoxications, namely the downsizing of the Prague drug epidemiology section (Studničková et al., 2010). It is, however, difficult to estimate the influence of this event because the Public Health Sentinel System is unstable and the decrease which we observe (*Figure 2*), seems to be rather a continuation of a previous trend.

Considering drug-related deaths, we have identified four events. Two changes related to the general mortality registry consisted of the implementation of two programmes that were designed to improve the quality of data (aligning national processes with the WHO and automated coding) and to increase the awareness of data collection-related issues among physicians (Poppová et al., 2012). These programmes addressed the previous limitations of the system that related to the lack of quality and homogeneity of certificate and cause coding, which had been performed manually, and to the lack of quality and homogeneity of the certification, caused by inadequate training of physicians and students in proper specification of the cause of death (Kretschemerová, 2006). The other issue related to the manual coding was the responsibility of each employee for a particular region, which could have led to a heterogeneous interpretation of data and could have resulted in regional differences (ibid.). The impact of both events is, possibly, the convergence of values in time series from both mortality registries (Mravčík et al., 2010; 2014). The increase in the number of drug-related deaths in the general registry might be caused by a growing number of stimulant overdose cases which were probably underreported (Mravčík et al., 2016). The convergence of values in both time series is good with regard to the validity of both time series; however, at the same time, it also means that the time series from the general registry does not have stable data collection and reporting. The trends in the period since the first event might be distorted, although it was highlighted that the trends are similar (Mravčík et al., 2014). The data shows (see *Figure 2*) that the first project was marked by a significant convergence of the values, while the impact of the second one is less pronounced.

Two events related to the specific mortality registry were identified. The first event involved the discontinuation of the former data collection in 2012 and the second consisted of the launch of the new National Register of Autopsies and Toxicological Examinations Performed at Forensic Medicine Departments (NRPATV) in 2015 (Mravčík et al., 2015, 2016). Unfortunately, no data is available for the period between both events (Mravčík et al., 2016) and, thus, the assumption that the time series are complete is violated. In the new system, all forensic medicine departments have submitted data to the new register, with the exception of one facility in the Liberec Region, which, however, performs only a very small number of autopsies (Nechanská, 2016). In the previous system, the number of reporting facilities reportedly fluctuated (Mravčík et al., 2009, 2014) and the regional differences that were present were addressed with efforts to unify the methodology and laboratory standards and enhance professional expertise (Zábranský et al., 2004). However, when one looks at the data for 2016, the number of fatal overdose cases recorded in the specific register remained lower than in the general register (Mravčík et al., 2017), which suggests that there might be some change in the new system compared to the old one.
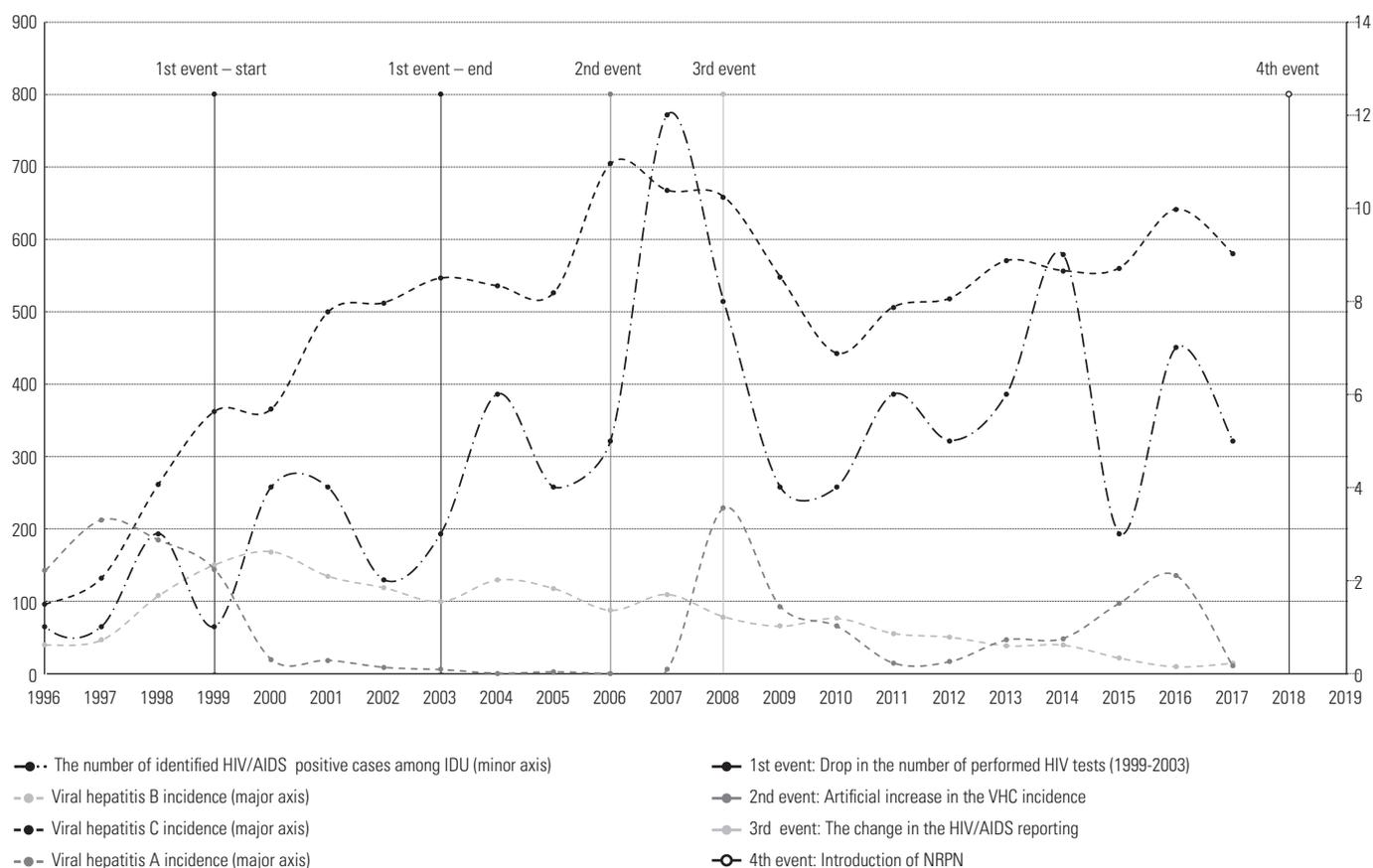
Infectious diseases

Considering infectious diseases, we have identified four events. In relation to HIV/AIDS we have identified two significant events (first and third event). The first is a drop in the number of tests performed on injecting drug users in 1999-2003, which might be seen as problematic because it might have led to underreporting (Mravčík et al., 2006). The third event involved the extension of the data collection system, which allowed for a more detailed analysis of specific cases (the place where users were infected, the source of infection, infection source abroad) (Mravčík et al., 2008), which possibly did not have any significant impact on the time series. Strictly in relation to hepatitis, there was an artificial increase in the number of cases in 2006. This was caused by a review of patient documentation in an in-house outpatient service and counselling office for liver diseases and retrospective reporting to the public health authorities (Mravčík et al., 2007). A total of 172 cases were diagnosed in other facilities and were not reported to the public health authorities, which correlates with the increase in reported VHC infection cases in the Czech Republic by 160-180 cases (Mravčík et al., 2007). For the analysis it is important to take this into account because otherwise it would bias the trends. The fourth event was the launch of the new Infectious Disease Information System (ISIN), (SZÚ, 2018). However, there is not enough information available for it to be possible to evaluate the event. (*Figure 3.*)

● 4 DISCUSSION

The article provides a review of the basic data collection characteristics and identifies different aspects of data collection and its context that have the potential to influence the time series of selected indicators in three different areas: a) treatment entrants, b) non-fatal and fatal intoxications, and c) infectious diseases. This study brings together the above described information from numerous papers and reports which are not yet available in a concise review. For the analysis of indicators over time and, especially, for the time series analysis, it is necessary to have this information at one place. Furthermore, based on this information, we provide recommendation for the data collection.

With the aid of the changes identified in different aspects of data collection and its context, we discuss whether the time series fulfil the assumptions of time series methods, i.e. that data is recorded in the same manner in a given time period (Gilmour et al., 2006) and is complete (Tabachnick et al., 2019). The data collection concerning treatment entrants has undergone significant changes. The time series is fit for use in time series analysis between 2002 (stabilisation of the system) and 2014 (change of the whole system). In relation to the NRHOSP, we did not identify any significant events and in the case of data from the Public Health Sentinel System we found one event; however, it was difficult to estimate the effect of the event. The general mortality registry time series is influenced by two events that might have distorted trends. While the impact of the first event is signif-

Figure 3 | The incidence of selected infectious diseases (Source: Malý et al, 2018 Mravčík et al, 2018) and significant events related to the monitoring systems

icant, the impact of the second one is less pronounced and thus we might use the period from 2006 onwards – though with some reservations. The special mortality registry time series is corrupted by the gap in the data in the period between the closure of the previous registry and the launch of NRPATV (2013-2014). In the case of infectious diseases, the viral hepatitis time series fulfil this assumption if the artificial increase in the number of hepatitis cases is taken into account. The drop in the number of HIV tests that were performed might be seen as problematic for the data collection, and its influence should be investigated further.

This article provides a starting point for other methodological and analytical decisions in the indicator analysis. In the case of the TDI, whether the number of cases related to cannabis can be used is questionable because the data validity is low; cf. Šťastná et al. (2004) and Miovský et al. (2004). The systems that are not specific to illegal drug use, such as NRHOSP, and as was the case for the general mortality registry, might be prone to underreporting, which should be taken into account when, for example, comparing countries or regions. Furthermore, the regional differences in data collection were mentioned in the case of some indicators and thus these indicators should not be used for the regional comparisons.

● 5 CONCLUSION

The usability of different public health indicators for the analysis of long-term trends, not only in relation to law enforcement, is as follows. The TDI indicator is fit only for a certain period (2002-2014). The time series of non-fatal intoxications from the Public Health Sentinel System is unstable and thus not fit for the analysis of trends. We can be optimistic about the use of the hospitalisation data from NRHOSP, although there are some reservations about the quality of the cause coding. Considering drug-related deaths, both indicators have certain limits. The general mortality registry time series is usable only from 2006 onwards and with certain reservations because the project focused on the development of the data collection system. The special mortality registry provided usable time series; however, the data for the years 2013 and 2014 is missing. This is unfortunate for the analysis of the relation between public health and drug law enforcement because in both these years there was an increase in drug law enforcement (Zeman et al., 2017). We are also optimistic about the use of the HIV/AIDS and viral hepatitis indicators, provided that the above-mentioned issues are taken into account.

Recommendations for the improvement of data collection follow. It is imperative that the data collection systems collect data continuously and that the changes to the systems which might be beneficial are carried out in a manner that preserves the data collection to a certain degree. For ex-

ample, the introduction of NRPATV was accompanied by an interruption of the time series. Similarly, the creation of NRLUD brought a number of beneficial changes, merging the systems and broadening the scope of the data that was collected, but the change corrupted the time series. As for NRLUD, it might be significant that the previous system was based on continuous collaboration with local branches and we may assume that this monitoring system, which connected local facilities with regional and national cen-

tres, worked quite well because it allowed for close contact in these networks. One of the recommendations is to focus on building such networks. For the use of the data from such systems, it is significant to record the changes in the data collection as specifically as possible, so that researchers might use it in decision-making. In addition to that, it would be helpful to conduct research on data collection systems, similarly to Šťastná et al. (2004) and Miovský et al. (2004), and to investigate regional differences.

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