Use of syndromic surveillance data to monitor poisonings and drug overdoses in state and local public health agencies

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ABSTRACT

Background The incidence of poisoning and drug overdose has risen rapidly in the USA over the last 16 years. To inform local intervention approaches, local health departments (LHDs) in North Carolina (NC) are using a statewide syndromic surveillance system that provides timely, local emergency department (ED) and Emergency Medical Services (EMS) data on medication and drug overdoses.

Objective The purpose of this article is to describe the development and use of a variety of case definitions for poisoning and overdose implemented in NC's syndromic surveillance system and the impact of the system on local surveillance initiatives.

Design, setting, participants Thirteen new poisoning and overdose-related case definitions were added to NC's syndromic surveillance system and LHDs were trained on their use for surveillance purposes. Twenty-one LHDs were surveyed on the utility and impact of these new case definitions.

Results/Conclusions Ninety-one per cent of survey respondents (n = 29) agreed or strongly agreed that their ability to access timely ED data was vital to inform community-level overdose prevention work. Providing LHDs with access to local, timely data to identify pockets of need and engage stakeholders facilitates the practice of informed injury prevention and contributes to the reduction of injury incidence in their communities.

INTRODUCTION

The incidence of poisoning and drug overdose has risen rapidly in the USA over the last 16 years.[1] In North Carolina (NC), the number of deaths has increased over 350% since 1999.[2] Most public health surveillance efforts for poisoning and drug overdose have focused on mortality data or data collected through sampling methods that have prolonged periods between data collection and analysis.[3][4] While fatality data are useful for national and state-level surveillance, the number of fatalities is typically too low at a county and regional level to provide a basis for monitoring trends. Community coalitions mobilising around poisoning and drug overdose events have sought county and regional surveillance data on non-fatal overdoses. To meet this need, local health departments (LHDs) in NC have been leveraging an existing syndromic surveillance system, traditionally used for public health emergencies and communicable disease outbreaks, to improve surveillance and inform prevention efforts for non-fatal poisoning and drug overdose

events. Numerous complexities exist in the use of non-fatal data for poisoning and overdose surveillance, including regional and local variations in the most appropriate codes to use in a case definition. The purpose of this paper is to describe the NC experience with the use of syndromic surveillance system for near real-time poisoning and drug overdose surveillance by local public health agencies.

SYNDROMIC SURVEILLANCE

Syndromic surveillance is the ongoing, systematic collection, analysis and reporting of the timeliest data available from any type of data source (clinical and non-clinical) to provide actionable public health information.[5] The key elements of a syndromic surveillance system are the rapid identification and flagging of a wide range of potential public health concerns, be they foodborne illness, infectious diseases or injury. The timeliness of the data is paramount. The North Carolina Disease Event Tracking and Epidemiologic Collection Tool (NC DETECT) is NC's statewide syndromic surveillance system. NC DETECT provides near real-time analysis of statewide emergency department (ED) visit data, Emergency Medical Services (EMS) data from the Prehospital Medical Information System (PreMIS) and call data from the Carolinas Poison Center (CPC). NC DETECT is funded primarily by the North Carolina Division of Public Health (NC DPH) Communicable Disease Branch with Public Health Emergency Preparedness funds from the CDC.

As of 15 December 2015, 122 qualifying hospital-affiliated EDs submitted ED visit data to NC DETECT twice daily. Free-text elements (eg, chief complaint and triage notes) are available in near real–time, while some elements (eg, diagnosis and external cause of injury codes) may take longer to become available to system users. In general, 75% of NC DETECT ED visits receive at least one diagnosis code within 2 weeks of the initial visit and these data are considered complete after 6 months. Each year, NC DETECT receives about 4.8 million ED visits, 20% of which are injury related.[6]

PreMIS is the statewide data repository for EMS agencies.[7] PreMIS receives a comprehensive record of each EMS encounter in NC, from which NC DETECT receives a subset of data elements once a day, including patient demographics (eg, age, sex, county of patient residence), dispatch and chief complaints, incident location, medications administered, transport destination and provider

impression. CPC provides hourly data feeds to NC DETECT, including exposure calls, medicine identification and requests for information. CPC data include patient demographics, substances involved and recommended therapies. A summary of data sources is presented in figure 1.

NC DETECT data are available to NC public health practitioners through a secure, Web-based application. Users can access record-level data for ED visits, EMS responses and CPC calls from their jurisdiction and are able to view aggregate data at the state and county level outside of their jurisdiction. Since NC DETECT data are updated at least once a day, users have access to near real-time surveillance data to inform local public health efforts.

CASE DEFINITIONS FOR POISONINGS AND DRUG OVERDOSE

There is no national consensus on a case definition for non-fatal poisonings and drug overdose.[8 9] An NC DETECT workgroup, therefore, reviewed case definitions for poisonings and drug overdoses to determine the best initial approach for non-fatal overdose surveillance in NC. Workgroup members represented the NC DPH, the UNC Injury Prevention Research Center (IPRC), the Carolina Center for Health Informatics (CCHI) in the Department of Emergency Medicine at UNC Chapel Hill and NC DETECT end users. Case definitions from the CDC and the Safe States Injury Surveillance Workgroup were reviewed.[10 11] Given the wide variation of the case definitions among these national groups, the NC DETECT workgroup decided to develop case definitions specifically for use in NC, with the expectation that they may be revised over time and may eventually inform surveillance approaches in other states. The case definitions shown in table 1 were developed in May 2014, added to NC DETECT from May to November 2014 and updated in September and October 2015 to incorporate International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) codes. These initial case definitions focus primarily on ED visits, with one case definition monitoring EMS runs for the use of naloxone, a medication that can be used to reverse opioid overdoses.

While many syndromic surveillance systems rely primarily on free-text chief complaint data for injury surveillance,[12] the NC DETECT workgroup based NC's overdose definitions on ICD-9-CM and ICD-10-CM codes as well as free-text chief complaints. ICD-9-CM and ICD-10-CM codes will identify overdose events that may not be documented adequately in the free-text data received. Prior to 1 October 2015, NC DETECT received up to 11 final diagnosis codes and up to five external cause of injury (E-codes) for each ED visit. With the transition to ICD-10-CM codes on 1 October 2015, NC DETECT may receive a larger total volume of codes for each ED visit depending on hospital coding practices during the transition to the new coding system. Another new feature of ICD-10-CM is the addition of a character ('A', 'D' or 'S') at the end of each ICD-10-CM code. This character indicates whether the visit was the initial encounter ('A'), subsequent encounter ('D') or sequela due to the event ('S'). Since LHDs are interested in the burden of poisoning and drug overdose in their jurisdiction, we decided to include all initial and subsequent encounters due to the injury. The ICD-10-CM 'sequela' designation is comparable with what was coded as a 'late effect of injury' in ICD-9-CM; therefore, codes ending in this designation were excluded from the updated case definitions for continuity purposes. As ICD-9-CM and ICD-10-CM codes are included in the syndromic surveillance national standard supported by the CDC,[13] it is expected that a majority of syndromic surveillance systems will be able to incorporate these codes into their case definitions. Additional analyses will be conducted in the coming months to evaluate the free-text data and determine if the inclusion of additional free-text terms, for example, specific drug names, improves the sensitivity of these definitions.

The NC DETECT workgroup has not yet conducted a formal evaluation of the poisoning and drug overdose case definitions, given the recent transition to ICD-10-CM. Past studies of NC DETECT case definitions, however, have demonstrated the utility of using NC DETECT data to monitor a wide array of injuries, including animal bites[14] and heat-related illness.[15] In addition, a small medical abstraction study focusing on opioid overdoses was conducted in 2014 using records from three university-affiliated NC hospitals. This study found that among ED visits identified as opioid overdoses using the NC DETECT case definition, the majority (75%) had clinical documentation that supported a diagnosis of opioid overdose.[16]

The decision to present a diverse range of case definitions, rather than a single case definition, allows users to track changes in their local data in near real-time using a variety of metrics. Furthermore, changes in hospital coding can influence the performance of these metrics in monitoring poisoning and drug overdose, and including multiple case definitions provides robustness for users to adjust to the ever-changing landscape of hospital coding nuances. Finally, there are many contributing factors to drug use and potential overdoses, from organised large-scale drug diversion and polydrug abusers to long-term care of pain patients who combine medicines. Multiple reports allow local users to be more fully informed about trends in many aspects of the epidemic.

NC DETECT also includes a variety of reports to monitor emerging drugs that are not readily identified through ICD-9-CM or ICD-10-CM codes. These new reports are easily incorporated into the NC DETECT platform and allow authorised users to track ED visits for substances such as bath salts, synthetic marijuana (eg, SPICE, K2) and alcoholic energy drinks. A variety of reporting formats, including line listing data, tabular data and graphs, are available to view these case definitions. Dashboards provide users with at-a-glance views of graphs based on the different case definitions, with comparison with the previous year. NC DETECT data are easily downloaded into other applications (eg, Microsoft Excel, R) for further analysis and review. Authorised users can access detailed line listing information for all case definitions back to 2009 for their jurisdictions and can view aggregate county-level data for all of NC.
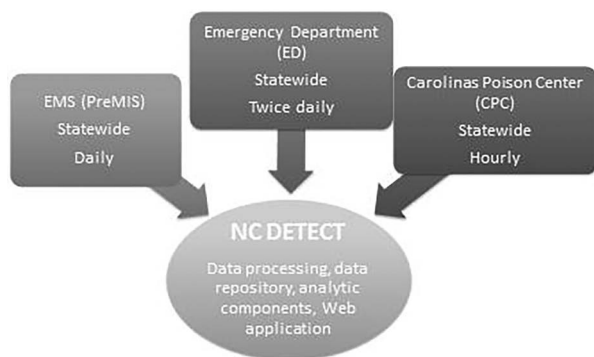

Figure 1 North Carolina Disease Event Tracking and Epidemiologic Collection Tool (NC DETECT) data sources. EMS, Emergency Medical Services; PreMIS, Prehospital Medical Information System.

Table 1 Definitions for non-fatal overdose and poisoning developed and implemented in NC DETECT

Syndrome	Case definition	Description
1. Acute Alcohol Poisoning (ICD-9/10-CM)	ICD-9-CM: 980 (0.0–0.9); E860 (0.0–0.9). ICD-10-CM: T51 (all extensions, excluding encounters for sequela)	Acute toxic effects from the consumption of all types of alcohol, including ethyl alcohol and methyl alcohol. Does not include ED visits for chronic health effects of alcohol use and abuse
2. Poisoning (ICD-9/10-CM)	ICD-9-CM: 960–989 (0.0–0.9) E850-E869 (0.0–0.9), E950-E952 (0.0–0.9), E962 (0.0–0.9), E979.7, E980-E982 (0.0–0.9). ICD-9-CM:T36-T65 (all extensions, excluding encounters for sequela, underdosing or adverse effects)	Acute poisoning from consumption of drugs, alcohol and/or other toxic substances (eg, pesticides, disinfectants, poisonous plants, etc). Includes all intents but excludes chronic effects of exposure, medical misadventures and/ or the adverse effects of substances properly administered in therapeutic or prophylactic dosages
3. Unintentional Poisoning (ICD-9/10-CM)	ICD-9-CM: E850-E869 (0.0–0.9) ICD-10-CM: T36.0X1-T65.891; (include codes only with the second to last character of 1; exclude encounters for sequela)	Acute unintentional poisoning due to drugs, alcohol and/or other toxic substances. Excludes medical misadventures and/or the adverse effects of substances properly administered in therapeutic or prophylactic dosages
4. Heroin Overdose (ICD-9/10-CM)	ICD-9-CM: 965.01; E850.0; E935.0 ICD-10-CM: T40.1 (all extensions, excluding sequela)	Acute heroin overdoses with any intent
5. Heroin-related (ICD-9/10-CM or keyword)	ICD-9-CM: 965.01; E850.0; E935.0 ICD-10-CM: T40.1 (all extensions, excluding sequela) Free text: 'HEROIN', 'HERION', 'HEROINE' and/or 'HERIONE'	Heroin-related ED visits. This definition includes ED visits for emergency (eg, poisoning/overdose) and non-emergency ED visits (eg, detoxification and rehabilitation). Meant to capture ED visits by individuals who have experienced a heroin overdose and/or are at risk for a heroin overdose
6. Medication or Drug Overdose (ICD-9/10-CM or Keyword)	ICD-9-CM: 960–979 (0.0–0.9), E850-E858 (0.0–0.9), E950 (0.0–0.5), E962.0, E980 (0.0–0.5) ICD-10-CM: T36-T50 (all extensions, excluding encounters for sequela, underdosing or adverse effects) Free text: 'Overdose', 'OD', 'O/D'	Acute medication or drug overdose for all intents. Excludes medical misadventures and/or the adverse effects of medications or drugs properly administered in therapeutic or prophylactic dosages
7. Medication or Drug Overdose (ICD-9-CM)	ICD-9-CM: 960–979 (0.0–0.9) E850-E858 (0.0–0.9), E950 (0.0–0.5), E962.0, E980 (0.0–0.5). ICD-10-CM: T36-T50 (all extensions, excluding encounters for sequela, underdosing or adverse effects)	Medication or drug overdose with any intent. Excludes medical misadventures and/or the adverse effects of medications or drugs properly administered in therapeutic or prophylactic dosages
8. Methadone Overdose (ICD-9-CM)	ICD-9-CM: 965.02, E850.1 ICD-10-CM: T40.3 (all extensions, excluding sequela)	Acute methadone overdoses with any intent
9. Opioid Overdose (ICD-9-CM)	ICD-9-CM: 965.0 (0.00–0.09), E850.0-E850.2. ICD-10-CM: T40.0-T40.4 (all extensions, excluding encounters for sequela, underdosing or adverse effects)	Acute opioid overdoses, including illicit drugs such as heroin and prescription medications such as methadone, oxycodone and hydrocodone, taken for any purpose and intent
10. Prescription Opioid Analgesic Overdose (ICD-9-CM)	ICD-9-CM: 965.02, 965.09, E850.1-E850.2 ICD-10-CM: T40.2-T40.4 (all extensions, excluding encounters for sequela, underdosing or adverse effects)	Acute overdoses by opioid analgesics and related narcotics available by prescription with any intent
11. Unintentional Medication or Drug Overdose (ICD-9-CM)	ICD-9-CM: E850-E858 (0.0–0.9) ICD-10-CM: T36.0X1-T50.991 (include codes only with the second to last character of 1; exclude encounters for sequela)	Unintentional medication or drug overdoses. Excludes medical misadventures and/or the adverse effects of medications or drugs properly administered in therapeutic or prophylactic dosages
12. Naloxone	Any mention of Narcan or naloxone in free text	Looks for ED visits where naloxone was administered and mentioned in the ED data
13. EMS: Naloxone	Documentation that naloxone was administered to the patient by the EMS agency	Tracks EMS usage of naloxone

ED, emergency department; EMS, Emergency Medical Services; NC DETECT, North Carolina Disease Event Tracking and Epidemiologic Collection Tool.

SAMPLE NC DETECT OUTPUTS

NC DETECT users from LHDs can view both aggregate data and line-level data. Line-level data from EDs include patient age and sex, ZIP and county of residence, chief complaint, triage notes (if available), initial vital signs, discharge disposition, hospital, payor source and ICD-9-CM/ICD-10-CM codes. Sample line listing report output is shown in table 2 (note that the event details displayed in this table have been modified from the original record in order to prevent deductive disclosure). For overdose surveillance, the combination of free-text chief complaint and triage note data (not shown) with ICD-9-CM/ICD-10-CM codes increases the sensitivity of identifying overdose events compared with free text or ICD-9-CM/ICD-10-CM code data alone.

END USER PERSPECTIVE ON AND USE OF NC DETECT

Local and regional coalitions have been created in NC to address the poisoning and drug overdose epidemic.[17] These coalitions oversee a variety of initiatives related to overdose prevention, including tracking and monitoring local data, evaluation, increasing access to naloxone, encouraging local providers to follow opioid prescribing best practices and to use NC's prescription drug monitoring programme (Controlled Substance Reporting System, CSRS)[18]; addressing drug diversion and safe disposal and convening stakeholders working on this issue. Stakeholders often and ideally include, but are not limited to, LHDs, law enforcement, EMS, substance abuse prevention groups, medical providers, school-based personnel, policy makers, social services, faith-based organisations, pain patients and concerned citizens. Coalitions are often county or regionally based and evolve from existing health department task forces focused on local priority issues, among which drug overdose is increasingly included. These groups include established substance abuse prevention coalitions, school health advisory committees, youth serving agencies, and neighbourhood

Table 2 Sample (modified) line listing report output from NC DETECT ED data

Chief complaint	ICD-9-CM and ICD-10-CM codes
UNRESPONSIVE	965.00—POISONING BY OPIUM (ALKALOIDS) UNSPECIFIED *-* 969.4—POISONING BY BENZODIAZEPINE-BASED TRANQUILIZERS E850.2—ACCIDENTAL POISONING BY OTHER OPIATES AND RELATED NARCOTICS *-* E853.2—ACCIDENTAL POISONING BY BENZODIAZEPINE-BASED TRANQUILIZERS
Patient's fiance states she found patient (pt) on the floor at their home, pt was snoring and would not respond to verbal or physical stimuli. pt appears groggy and is unclear as to where he is or what happened	965.01—POISONING BY HEROIN *-* 796.2—ELEVATED BLOOD PRESSURE READING WITHOUT DIAGNOSIS OF HYPERTENSION *-* 305.5—NONDEPENDENT OPIOID ABUSE
Smoked synthetic marijuana last night now with heart beating hard numbness in chest and arm feels like going to pass out hard to concentrate	995.20—UNSPECIFIED ADVERSE EFFECT OF UNSPECIFIED DRUG, MEDICINAL AND BIOLOGICAL SUBSTANCE
DRUG OVERDOSE Found by family 'passed out' on the couch. EMS reports patient taking a 'handful of oxycodones and 4 beers'. Denies suicidal ideation. Personal medical history of drug abuse. EMS reports stable blood pressure entire time	965.09—POISONING BY OTHER OPIATES AND RELATED NARCOTICS E950.0—SUICIDE AND SELF-INFLICTED POISONING BY ANALGESICS ANTIPYRETICS AND ANTIRHEUMATICS *-* E849.0—HOME ACCIDENTS
Altered mental status	T40.2X1A—POISONING BY OTHER OPIOIDS, ACCIDENTAL (UNINTENTIONAL), INITIAL ENCOUNTER *-* R41.82—ALTERED MENTAL STATUS, UNSPECIFIED

ED, emergency department; EMS, Emergency Medical Services; NC DETECT, North Carolina Disease Event Tracking and Epidemiologic Collection Tool.

Table 3 Survey results by local health department (LHD) (n=21), August 2015

	Count (% of LHDs)
Have data from NC DETECT (ie, emergency department, Emergency Medical Services (EMS)) been included in these surveillance data reports	
Yes	15 (71%)
No	0
I don't know	2 (10%)
No response	4 (19%)
With whom have you shared the overdose/surveillance data reports?	
Coalition members	16 (76%)
Health department staff, including the health director	12 (57%)
Law enforcement agencies	10 (48%)
Schools, colleges and universities	8 (38%)
Mental or behavioural health providers or agencies	7 (33%)
Medical providers	7 (33%)
EMS	6 (29%)
Hospitals, healthcare administrators or system staff	6 (29%)
Media	5 (24%)
Board of Health Members	5 (24%)
County commissioners and other elected officials	4 (19%)
Ageing services, Department on Ageing, senior centres	4 (19%)
Other	10 (48%)

NC DETECT, North Carolina Disease Event Tracking and Epidemiologic Collection Tool.

associations. Some coalitions are newly formed in response to an increased number of overdose deaths in an area. Funding for these active coalitions varies widely and may include federal, state or county funds, foundation or trust grants, school district moneys or community donations.

NC DETECT users from LHDs provide surveillance data and reports to these coalitions. As the new poisoning and overdose case definitions were added to NC DETECT from May to November of 2014, CCHI staff provided group and individual user training via webinars. A user guide specific to overdose surveillance was also developed. Between January and 31 August 2015, LHD users (n=203) logged into NC DETECT an average of 16 times per week, compared with 13 times per week in 2014.

NC DETECT user feedback

Twenty-one NC LHDs with the highest overdose mortality burden in NC participated in a small grant funded by NC DPH in June 2015. Grant participants were expected to incorporate NC DETECT data into monthly surveillance reports used by local overdose coalitions, policy makers and prevention teams. As part of the grant's programme evaluation, the 21 LHDs were surveyed in August 2015 to solicit feedback on the use of NC DETECT for overdose surveillance activities. Multiple respondents per LHD were permitted in order to analyse results by health department as well as user; respondents were not required to answer all questions. Thirty-five respondents

completed the survey, representing 19 of 21 LHDs (90%) participating in the NC DPH grant. Survey results by LHD are shown in table 3.

Fifteen of the 21 LHDs (71%) reported that NC DETECT data were included in their surveillance reports shared with local overdose coalitions and community partners. Stakeholders included in the 'other' category were social services, pharmacies and veterinarians.

Respondents self-reported additional details on their NC DETECT use. These results are provided by respondent (n=35) and not health department, as NC DETECT usage varies within a health department. Usage results are shown in table 4.

As LHD capacity for surveillance is in decline,[19] the relatively small amount of LHD users who report using NC DETECT daily or weekly is not surprising. The survey results do reveal a training gap, however, as NC DETECT provides LHD users with the capability to access aggregate counts and trends for peer counties.

Of respondents who answered the survey question about specific report access, the most common report used for surveillance was the 'Unintentional Medication or Drug Overdose' report (n=18/100%), while the 'Methadone Overdose' report was the least used (n=8/44%). Thirteen respondents (n=72%) reported accessing the heroin-related reports; the use of these specific reports is expected to grow as heroin overdoses continue to increase in NC.

Benefits of syndromic surveillance systems at the local level

Ninety-one per cent (n=29) of survey respondents agreed or strongly agreed that their ability to access timely ED data was vital to inform community-level overdose prevention work. Respondents stated that access to near real-time, local data enables them to be a go-to resource in the community for all stakeholders. Timely, local data allow public health practitioners to monitor trends, find areas of greatest need and deploy local resources quickly and appropriately. "[I]t's a fantastic tool for

Table 4 LHD respondents (n=35) self-reported usage of NC DETECT

	Count (% of respondents)
Do you have an NC DETECT account?	
Yes	25 (71%)
No	7 (20%)
No response	3 (9%)
Have you logged into NC DETECT to view overdose-related data and trends for your county(ies)?	
Yes	19 (54%)
No	6 (17%)
No response	10 (29%)
How often do you login to NC DETECT?	
Daily	0
Once a week	4 (11%)
2–3 times a month	6 (17%)
Once a month	7 (20%)
Every other month	0
Quarterly	1 (3%)
Never	1 (3%)
No response	16 (46%)
Have you used NC DETECT to review overdose-related trends by 5-digit ZIP codes within your county(ies)?	
Yes	8 (23%)
No	10 (29%)
No response	17 (49%)
Have you used NC DETECT to look at aggregate overdose trends for peer counties outside of your health department's jurisdiction?	
Yes	6 (17%)
No	12 (34%)
No response	17 (49%)
Do you review line-level data for overdoses (eg, patient age, patient sex, chief complaint, insurance coverage, disposition)?	
Yes	13 (37%)
No	4 (11%)
No response	18 (51%)

LHD, local health department; NC DETECT, North Carolina Disease Event Tracking and Epidemiologic Collection Tool.

helping understand real-time impact of health issues in our community …[T]he detailed data available through NC DETECT makes it possible to drill down and really define issues and potential root causes/co-presenting factors in ways that are not available through other data sources." Table 5 summarises end

Table 5 End user feedback on the value of timely, local surveillance data

Common theme	Illustrative quotation
Responsive to stakeholders	"Timely and accurate data to partners and internal staff to make informed, data-driven decisions"
Community empowerment	"develop strategic plans with my coalition, educate the coalition and community, and build new partnerships"
Facilitates ongoing evaluation	"Being able to look at current data helps us know if our current initiatives are working or not"
Find areas of greatest need	"Better inform decisions about which populations are most affected and which prevention strategies are most needed"
Importance of local data	"Confidence as to the extent of the issue with more detailed local data"

user feedback on this preliminary use of timely, local syndromic surveillance data. Longer-term impact of the use of NC DETECT poisoning and overdose data to inform local public health action will be measured in future studies.

Survey respondents also provided suggestions for improvements to NC DETECT, including more analysis tools to improve understanding of comorbid factors, embedded data quality indicators to provide a better understanding of data limitations and more prepackaged reports that can be easily downloaded and shared with partners. Underscoring the importance of data timeliness for local groups, some users commented that those hospitals that lag behind others in sending timely data and have delays of up to 48 h should be addressed.

DISCUSSION
The injury pyramid
Mortality data are often used to drive injury policy, but they provide only one piece of the overall injury burden in a community.[20] Due to low case numbers, mortality data are often uninformative for local area surveillance, while morbidity data volume is high enough to provide accurate statistical trends. In NC in 2012, for example, for every one medication or drug overdose death, there were more than nine hospitalisations and nearly 17 ED visits due to medication or drug overdose.[2] As shown in figure 2, the ED and EMS data sources in syndromic surveillance systems like NC DETECT provide the most readily available and timely morbidity information for local community-driven surveillance.

The value of flexible, timely syndromic surveillance systems at the local level
Syndromic surveillance methods and uses continue to evolve to meet the changing surveillance needs of public health. Syndromic surveillance data on non-fatal poisoning and overdose allow local users to review information that is local and timely and capture aspects of the drug overdose epidemic not well reflected by national or state mortality data. Providing LHDs with access to local, timely data to identify pockets of need and engage stakeholders facilitates the practice of informed injury prevention, allows for more responsive planning and contributes to the reduction of injury incidence in their communities. Locally based surveillance is an essential element of contemporary injury prevention practice. The national overdose epidemic is evolving rapidly with the increasing accessibility of heroin from Mexico, the entry of synthetic drugs and the variable cost of and access to prescription opioids.[21] The inherent flexibility of syndromic surveillance systems allows health departments to create a timely picture of current health-related events in their communities and empowers them to achieve their goals of reducing morbidity and mortality through informed interventions. Despite limited resources, health departments can use syndromic data-driven approaches to identify the communities of greatest need in which to distribute naloxone, establish needle exchange programmes, promote public awareness and to provide educational and other prevention programmes.

Because syndromic surveillance systems typically receive all records from a given data provider with no prefiltering, these systems can be used to track unforeseen events. Case definitions can be applied to the central data repository for the syndromic surveillance system to track new drugs, add new street or slang references to existing drugs and monitor potentially tainted drugs without additional burden on the data provider. While often replete with misspellings and abbreviations, systematic,
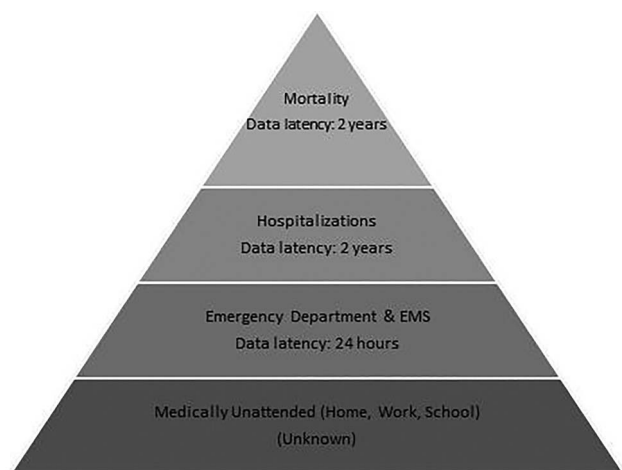
Figure 2 North Carolina data sources and approximate time from event date to availability for overdose and poisoning surveillance.

ongoing analysis of the free-text data in ED-based syndromic surveillance can be mined to shed light on emerging trends much more quickly than other methods.

ICD-10-CM

While ED chief complaint data continue to be used in syndromic surveillance systems to monitor all hazards of interest to public health, including injuries, more jurisdictions are receiving coded diagnostic information in their syndromic surveillance systems as these data elements are included in national syndromic surveillance guidelines.[13] These codes will contribute to improved sensitivity and specificity in syndromic surveillance systems across all jurisdictions in the USA. The transition to ICD-10-CM on 1 October 2015 for diagnostic coding provides public health agencies more detailed data for many types of injuries. For opioid overdose surveillance, however, heroin and methadone continue to be the only opioids with their own codes. All other opioids are categorised into 'poisoning by opium—T40.0x' or 'poisoning by other synthetic narcotics—T40.4X'. The free-text data in ED chief complaints and triage notes can continue to be used to assist in the identification of specific drugs involved in overdose events that result in an ED visit. In addition, future research is needed to evaluate the impact of ICD-10-CM on the sensitivity, specificity and PPV of public health surveillance case definitions used with ED data.

Data quality

While the systematic, ongoing receipt and review of near real-time secondary data provide invaluable information to public health and a baseline understanding of the community so that anomalies can be detected, there are more data quality challenges when collecting data in real time compared with collecting data quarterly or annually. Issues with completeness both in terms of records received and completeness of specific data elements, the accurate processing of updates and data transmission protocols require ongoing monitoring and open lines of communication among data providers and public health informatics staff for efficient resolution of any problems encountered. CCHI and NC DPH are working to improve NC DETECT data quality for injury surveillance as part of a CDC-funded NC Surveillance Quality Improvement Project.[22] In addition to outreach efforts to hospitals and coding staff to explain the importance of accurate injury coding, this project has supported

additional, in-depth data quality analyses that complement the ongoing data quality monitoring that is performed daily and weekly. This work has shown that, on average, less than 10% of NC DETECT ED visits are missing diagnosis codes and among ED visits that receive an injury-related diagnosis code, about 12% are missing a corresponding external cause of injury code describing the mechanism of injury.[23] Data quality monitoring is a laborious, ongoing effort that requires constant vigilance to detect a range of data quality issues caused by a variety of factors, including changes in hospital workflows, human error and updates to electronic health records.

Building workforce capacity

Researchers and health departments are evaluating non-traditional data sources, such as social media data, as a possible mechanism to identify potential public health threats before they result in a medical encounter and in populations that may not seek medical treatment.[24] Evaluation of the value of these data sources to inform public health action specifically for injury prevention is preliminary.[25] As public health receives increasing amounts of data with increasing speed and variety, a sustained public health workforce with data management and analysis skills is paramount. The marked increase in data received by and accessible to health departments is concurrent with reduced resources and workforce in health departments.[26] While syndromic surveillance systems create efficiencies with their flexibility and timely data, informatics training for all levels of existing public health workforce is needed to leverage these and other information sources fully for optimal data-driven decision making.

CONCLUSION

NC DETECT data provide a timely view into the poisoning and drug overdose burden in communities down to the ZIP code level. LHDs include NC DETECT (ED and EMS) data in their poisoning and drug overdose surveillance activities to increase awareness of community-level trends, inform response activities and facilitate data-driven policy development. LHDs also leverage NC DETECT data for intervention/programme planning and community health assessments, including poisoning and drug overdose trends and overall rates of intentional and unintentional injuries. The range of case definitions included in NC DETECT has allowed LHDs and others to monitor local, emerging and evolving poisoning and drug overdose threats in near real-time. With a recently funded CDC award specific to prescription drug overdoses, NC hopes to continue to expand its system to enable identification of high burden areas, increase tracking and monitoring and inform subsequent community interventions. NC DETECT has become a vital tool in NC's public health surveillance efforts to address poisonings and drug overdoses and to inform statewide prevention efforts.

What is already known on the subject

► From 2001 to 2013, there was a fivefold increase in the total number of deaths due to heroin overdose and a 2.5-fold increase in the number of deaths from prescription drugs.

► Forty-six states and Washington DC have access to syndromic surveillance data for their communities.

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