International Journal of Infectious Diseases 59 (2017) 141–147

Contents lists available at ScienceDirect

International Journal of Infectious Diseases

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

Comparing laboratory surveillance with the notifiable diseases surveillance system in South Africa

F.G. Benson[a,b,*], A. Musekiwa[c], L. Blumberg[b,d], L.C. Rispel[e]

[a] National Department of Health, Private Bag X828, Pretoria, 0001, South Africa
[b] School of Public Health, Faculty of Health Sciences, University of the Witwatersrand, Parktown, Johannesburg, South Africa
[c] Division of Global Health Protection, United States Centers for Disease Control and Prevention (CDC), Pretoria, South Africa
[d] National Institute of Communicable Diseases, Sandringham, Johannesburg, South Africa
[e] Centre for Health Policy and DST/NRF SARChI Chair, School of Public Health, Faculty of Health Sciences, University of the Witwatersrand, Parktown, Johannesburg, South Africa

ARTICLE INFO

Article history:
Received 5 January 2017
Received in revised form 6 March 2017
Accepted 8 March 2017
Corresponding Editor: Eskild Petersen, Aarhus, Denmark

Keywords:
Notifiable diseases surveillance system
Completeness
Stability
Representativeness
Sensitivity and positive predictive value

SUMMARY

Objective: The aim of this study was to compare laboratory surveillance with the notifiable diseases surveillance system (NDSS) in South Africa.
Methods: Data on three tracer notifiable diseases – measles, meningococcal meningitis, and typhoid – were compared to assess data quality, stability, representativeness, sensitivity and positive predictive value (PPV), using the Wilcoxon and Chi-square tests, at the 5% significance level.
Results: For all three diseases, fewer cases were notified than confirmed in the laboratory. Completeness for the laboratory system was higher for measles (63% vs. 47%, $p < 0.001$) and meningococcal meningitis (63% vs. 57%, $p < 0.001$), but not for typhoid (60% vs. 63%, $p = 0.082$). Stability was higher for the laboratory (all 100%) compared to notified measles (24%, $p < 0.001$), meningococcal meningitis (74%, $p < 0.001$), and typhoid (36%, $p < 0.001$). Representativeness was also higher for the laboratory (all 100%) than for notified measles (67%, $p = 0.058$), meningococcal meningitis (56%, $p = 0.023$), and typhoid (44%, $p = 0.009$). The sensitivity of the NDSS was 50%, 98%, and 93%, and the PPV was 20%, 57%, and 81% for measles, meningococcal meningitis, and typhoid, respectively.
Conclusions: Compared to laboratory surveillance, the NDSS performed poorly on most system attributes. Revitalization of the NDSS in South Africa is recommended to address the completeness, stability, and representativeness of the system.

Introduction

An effective notifiable diseases surveillance system (NDSS) is essential for any country to respond to communicable disease outbreaks.[1] Outbreaks of emerging and re-emerging communicable diseases threaten the health and wellbeing of communities, and when uncontrolled, can lead to a global threat. National and global disease vulnerabilities were demonstrated by the 2014–2016 Ebola virus disease outbreak,[2] the 2016 Zika virus outbreak,[3] and the 2016 yellow fever outbreak.[4] When a country deals effectively with an outbreak at source, it prevents the spread of the disease beyond its borders, thus preventing spillovers into neighbouring countries and beyond.

All countries need to evaluate their surveillance system regularly to ensure an effective NDSS. Several countries have done so using the 2001 framework developed by the United States Centers for Disease Control and Prevention.[5] A 2009 review of NDSS evaluations in 20 high-income countries (HICs) and 12 low- and middle-income countries (LMICs) found weaknesses in data quality in HICs and resource constraints, health infrastructure challenges, and sub-optimal NDSS functioning in LMICs.[6] Several comparative studies have examined the attributes of surveillance systems,[7–14] including comparisons of electronic reporting versus traditional reporting systems,[7,10,13] different electronic systems with each other,[8,9] and active surveillance with passive surveillance systems.[11,12] In Africa, evaluation studies have focused on the implementation of the integrated disease surveillance and response (IDSR).[15–17] These studies support the findings of the

* Corresponding author. Tel: +27823724199.
E-mail addresses: frewbenson@gmail.com, frew.benson@health.gov.za (F.G. Benson), ydm4@cdc.gov (A. Musekiwa), lucilleb@nicd.ac.za (L. Blumberg), Laetitia.Rispel@wits.ac.za (L.C. Rispel).

http://dx.doi.org/10.1016/j.ijid.2017.03.007

2009 NDSS review that health system challenges impede the effective functioning of the NDSS.[6]

South Africa is a member state of the World Health Organization (WHO) that adopted the IDSR in 1998, but is one of the few African countries that has never implemented the IDSR. The NDSS in South Africa is a paper-based system that tracks 33 medical conditions. In terms of existing legislation, all health care providers are obliged to notify these conditions to their local authority, who in turn report them to the district, district to province, and province to national.[18] The NDSS relies on the clinical skills of health care providers to diagnose the list of communicable diseases based on clinical suspicion and to request laboratory confirmation. Case definitions are only used during outbreaks and for active surveillance.[18] There are no legal provisions for laboratories to notify communicable diseases.[19]

There has been no systematic and objective evaluation of the NDSS in South Africa since its inception in the 1970s. There have only been a few evaluations of the surveillance systems at the provincial level in South Africa,[20–22] one on the NDSS in one South African province and two evaluation studies on tuberculosis (TB) surveillance in two Western Cape districts. These studies were focused on limited settings and hence cannot be generalized to the entire country. Although a South African study compared notifications and laboratory surveillance for hepatitis B for the period 1985–1988,[23] this was more than 28 years ago, and the South African health system has undergone major changes since the 1980s. South Africa is in the process of reforming its health system through the phased introduction of a National Health Insurance system,[24] and the establishment a National Public Health Institute that will be responsible for disease surveillance.[25] An evaluation of the current status of the NDSS is timely and will feed into the reform processes.

There is a dearth of studies comparing national notification systems with laboratory surveillance, especially in LMICs, because many countries require and rely on laboratories to report notifiable diseases. Only one Swedish study that compared the parallel systems of clinical and laboratory notifications, performed in 2005, could be identified.[14]

The purpose of this study was to describe and compare the South African NDSS and laboratory system in terms of data quality, stability, representativeness, sensitivity and positive predictive value (PPV) for the tracer diseases of measles, meningococcal meningitis, and typhoid, as part of a larger doctoral study aimed at generating new information on the performance of the NDSS.

Methods

Study design

This was a retrospective records review using data from the National Health Laboratory Services (NHLS) – the national public sector laboratory service provider – and the records of notifications held at the National Department of Health. The study sample constituted all records for the selected study period, January 1, 2013 to December 31, 2013.

Selection of tracer conditions

Three tracer diseases were selected for the comparative study: measles, meningococcal meningitis, and typhoid. Measles and meningococcal meningitis were selected as they are endemic in all provinces,[26,27] highly contagious, and distinct and easily identifiable diseases for which early notification on clinical grounds[18] and a public health response is needed. Measles is also a re-emerging, vaccine-preventable disease that has been targeted for elimination[28,29]; it caused two recent major outbreaks that affected all provinces, one in 2003–2005[30] and the other in 2009–2011.[31–33] Typhoid is less clinically distinct, but is also endemic in South Africa and has caused considerable morbidity and mortality, which are largely preventable through public health measures.[34,35] These factors make the tracers good indicators to measure the attributes of the NDSS.

Measurement and data collection

A record review form was developed to extract socio-demographic, travel, and clinical information from the laboratory and notification records. The record review form was piloted for both systems using three records for each of the tracers for the year 2012. During the pilot study, it was found that due to the high level of incomplete information in the records, case-matching between the two systems was difficult without including names; hence, the record review form was revised to include names.

All available data for the study period on the tracer diseases from the two data sources were included in the study sample. All records with inconclusive diagnostic information were excluded from the laboratory records.

Data analysis

Data were captured in Excel for cleaning and assessment of data quality (measured by the percentage of completeness of all data on the record review form), as well as stability (reliability of the system in providing a diagnosis – percentage of cases with a diagnostic result) and representativeness (percentage of provinces represented in the system). The data were exported into Stata 14 for further analysis. Frequency and summary tables were computed to describe the age, sex, and provinces of reported and laboratory cases. Variables measured were summarized for each case, such as completeness, using medians (ranges). The non-parametric Wilcoxon test was used to compare the completeness of the two systems. Reliability and representativeness were determined as indicated under measurement, and the Chi-square test was used to compare the two systems. All tests were conducted at the 5% significance level.

Each positive case, negative case, and case without laboratory result in the NDSS database was name-searched and matched (names, age, sex, date and place of occurrence) with the NHLS database to determine sensitivity (the proportion of cases detected by the surveillance system) and PPV (the proportion of reported cases that actually have the communicable disease under surveillance). The NHLS database was used as the gold standard to compare with the NDSS. Table 1 shows the calculation of sensitivity and PPV.

True-positives were defined as either (1) positive NDSS cases and positive laboratory cases, or (2) no result in the NDSS and positive laboratory case. True-negatives were defined as either (1) negative NDSS cases (suspected cases are notified) and negative laboratory cases, or (2) no result in the NDSS and negative laboratory case. False-positives were defined as positive NDSS cases that were not positive laboratory cases, and false-negatives

Table 1
Calculation of sensitivity and positive predictive value[a].

	Laboratory surveillance		
NDSS	Positive	Negative	Total
Positive	True-positive (A)	False-positive (B)	A + B
Negative	False-negative (C)	True-negative (D)	C + D
Total	A + C	B + D	

NDSS, Notifiable Diseases Surveillance System.
[a] Sensitivity = A/(A + C); positive predictive value = A/(A + B).