

UNIVERSITY OF WITWATERSRAND
FACULTY OF HEALTH SCIENCES
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**HEALTHCARE WORKERS' KNOWLEDGE, ATTITUDES, AND PRACTICES ON
THE USE OF THE ELECTRONIC APPLICATION TO REPORT NOTIFIABLE
MEDICAL CONDITIONS - NORTH WEST PROVINCE, SOUTH AFRICA, 2023.**

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A research report submitted to the Faculty of Science - School of Public Health,
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requirements for the Master of Science (MSc) degree in Field Epidemiology

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DECLARATION

I, Keabetswe Evelyn Kodi, declare that this research report is my own, unaided work. It is being submitted for the Degree of Master of Science (MSc) in Field Epidemiology at the Faculty of Health Sciences -School of Public Health, University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

A handwritten signature in dark ink, appearing to read 'Keabetswe Evelyn Kodi', is written above a horizontal line.

(Signature of candidate)

23rd day of September 2024 in Johannesburg

DEDICATION

I dedicate this research report to my beloved children– Odirile Omphemetse, Neoentle Thateho, and Karabo Ipeleng. May this report serve as a testament to you that every dream is within your reach. Through dedication, diligence, and determination, all aspirations can be realized. As you journey through life, embrace this lesson and relentlessly pursue your dreams.

ABSTRACT

Introduction: The compliance of healthcare workers in disease reporting using electronic, real-time surveillance systems is crucial for effective monitoring and control of Notifiable Medical Conditions (NMCs). North West Province has low reporting rate (3.1%) and low number of active App users (4.3%) with fluctuations over time among all the other provinces, despite being the 4th province whereby the NMC Reporting App was first launched in 2018. Hence it is imperative that this study assess the knowledge, attitudes, and practices (KAP) of healthcare workers (HCWs) and factors associated with the use of the NMC Reporting App to report Notifiable Medical Conditions in North West Province in 2023.

Methods: This cross-sectional study utilized a structured, interviewer-administered questionnaire. Stratified random sampling was used to stratify the population by district, with the target sample size for each district calculated proportionally to the number of healthcare workers in that district. Healthcare facilities were randomly selected. Data was collected between September 6 and November 10, 2023. Data were captured on REDCap and analyzed using Stata®18. Descriptive statistics, frequency and percentages were used to summarize participants demographic characteristics. To assess the level of KAP, scores were calculated and categorized into binary outcome variable for each KAP domain. Adjusted Bloom's cut-off value of 75% was used to classify participants' KAP categories into two levels: adequate/inadequate knowledge (for scores ≥ 6 or < 6 out of 8), positive/negative attitude (for scores ≥ 9 or < 9 out of 12) and good/poor practice (for scores ≥ 12 or < 12 out of 16). To assess the association between overall KAP categories and independent variables, Pearson Chi-square or Fisher's exact test (as appropriate) was used. Factors associated with KAP were determined through bivariate and multivariable logistic regression analysis. Independent variables with a p-value ≤ 0.2 in the bivariate analysis were included into the multivariable logistic regression using stepwise method. A p-value of ≤ 0.05 was considered statistically significant.

Results: A total of 343 HCWs' participated, with 81% response rate. Majority of HCWs were aged 30-49 years (55%), with a mean age of 42 years (SD $\pm$ 10.5). A high proportion were females (82%), professional nurses (62%), and from Ngaka Modiri Molema district (47%). Overall, 80% of HCWs had inadequate knowledge, 50% had negative attitudes, and 96% exhibited poor practices towards the NMC Reporting

App utilization. Factors associated with inadequate knowledge were being in the other nurse category (aOR: 2.83, 95% CI: 1.05-7.60, $p=0.038$). conversely, being male (aOR: 0.38, 95% CI: 0.19-0.73, $p=0.004$) was associated with lower odds of having inadequate knowledge. Significant association was found between inadequate knowledge and poor NMC Reporting App practices (aOR 7.03, 95% CI: 2.04-24.22, $p=0.002$) in North West province.

Conclusions

This study revealed inadequate knowledge, negative attitudes, and poor NMC Reporting App practices in North West Province. Inadequate knowledge was a key factor in poor App utilization. Tailored trainings and continued technical support are recommended to improve HCWs' knowledge of App usage and reporting processes, as well as further studies to explore HCWs' perceptions and leadership buy-in of NMC reporting through the App.

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LIST OF ABBREVIATIONS

App	Application
HCW	Healthcare Workers
IHR	International Health Regulations
KAP	Knowledge, Attitudes and Practices
LMIC	Low- and Middle-income countries
<i>mHealth</i>	Mobile Health
NMC	Notifiable Medical Conditions
NICD	National Institute for Communicable Diseases
NMCSS	Notifiable Medical Conditions Surveillance System
NW	North West Province
PDF	Portable Document Format
SA	South Africa
SMS	Short Message Service
WHO	World Health Organization

CHAPTER 1: INTRODUCTION

This chapter gives background information on Notifiable Medical Conditions (NMCs), and highlights the international and national regulations guiding the control and prevention of these NMCs. It also addresses the existing research gaps. The chapter concludes with the study objectives.

1.1. Background of Notifiable Medical Conditions

Notifiable Medical Conditions (NMCs), cause epidemics and outbreaks, with the potential to cause high morbidity and mortality (1). The International Health Regulations (IHR) of 2005 mandates surveillance of NMCs to address the global public health security and trade threat. The World Health Organization (WHO) mandates that member countries establish real-time surveillance systems to effectively monitor and control NMCs. This includes detecting, preventing, and responding to these conditions in a timely manner (2). Established public health surveillance systems should be able to rapidly detect, assess, notify, and report NMCs that may spread internationally and pose public health risks (3). Surveillance acts as the primary means of identifying health threats within the population, assessing the level of morbidity and mortality, and establishing priorities for disease response and control (4).

Global Surveillance of Notifiable Medical Conditions

Many countries worldwide have mandated the notification and reporting of NMCs upon suspicion or diagnosis (5), however, under-reporting of NMCs is still a challenge worldwide (6). Most countries surveillance systems are paper-based which makes them prone to errors such as inaccurate data, and delays in reporting and timely feedback (7). It is crucial for healthcare workers (HCWs) to comply with reporting requirements as they play a pivotal role in the surveillance of NMCs, being responsible for diagnosing and managing these conditions. Compliance by HCWs ensures timely investigation, implementation of control measures and facilitates consistency in morbidity and mortality reporting (8).

An Overview of Surveillance of Notifiable Medical Conditions in South Africa

South Africa (SA), is a member state of the WHO and in alignment with the IHR, amended the National Health Act, which is a framework that considers the mandates

outlined in the Constitution as well as local and international laws pertaining to health services (9). In 2016, a review of the existing notification processes in South Africa led to the revision of regulations governing the surveillance and control of NMCs. The goal was to align these regulations with the International Health Regulations (IHR) and the National Health Act of 2003 (9,10). The updated surveillance and control regulations were gazetted in 2017, mandating laboratories and medical schemes to report NMCs (11). Subsequently, paper-based reporting tools and the NMC Reporting App were developed, piloted in 2017, and officially launched in 2018. The NMC Surveillance System (NMCSS) was restructured according to the mobile health (*mhealth*) concept to enable swift detection, reporting, and response of NMCs. Recognizing the limitation in the flexibility of the NMCSS electronic application, an enhanced NMC Reporting App was launched in 2020.

The Notifiable Medical Conditions Surveillance System (NMCSS) includes two reporting methods: paper-based notification and electronic application notification. Upon suspicion and/or diagnosis of NMCs, HCWs from both the public and private sectors can send a notification using either the paper-based notification or the electronic application to the National Institute for Communicable Diseases (NICD). The electronic application consists of a mobile and web application that allows for real-time reporting of NMCs at the point of diagnosis. NMC notifications done via the electronic application are captured directly into the NMC data mart. Immediately after logging a case, an alert is sent to all relevant disease control personnel at the local, provincial, and national levels to receive the notification via short message service (SMS) and e-mail. These alerts lead to an integrated, effective system enabling real-time reporting and response to NMCs. Paper-based notification forms can be sent via email, fax-to-email, and WhatsApp, however, the latter is used to send portable document format (PDF) files and images of the notification forms. The paper-based notification forms are captured centrally into the NMC data mart by the NMC data clerks (3). Figure 1.1 gives the summary of data flow within the NMCSS.

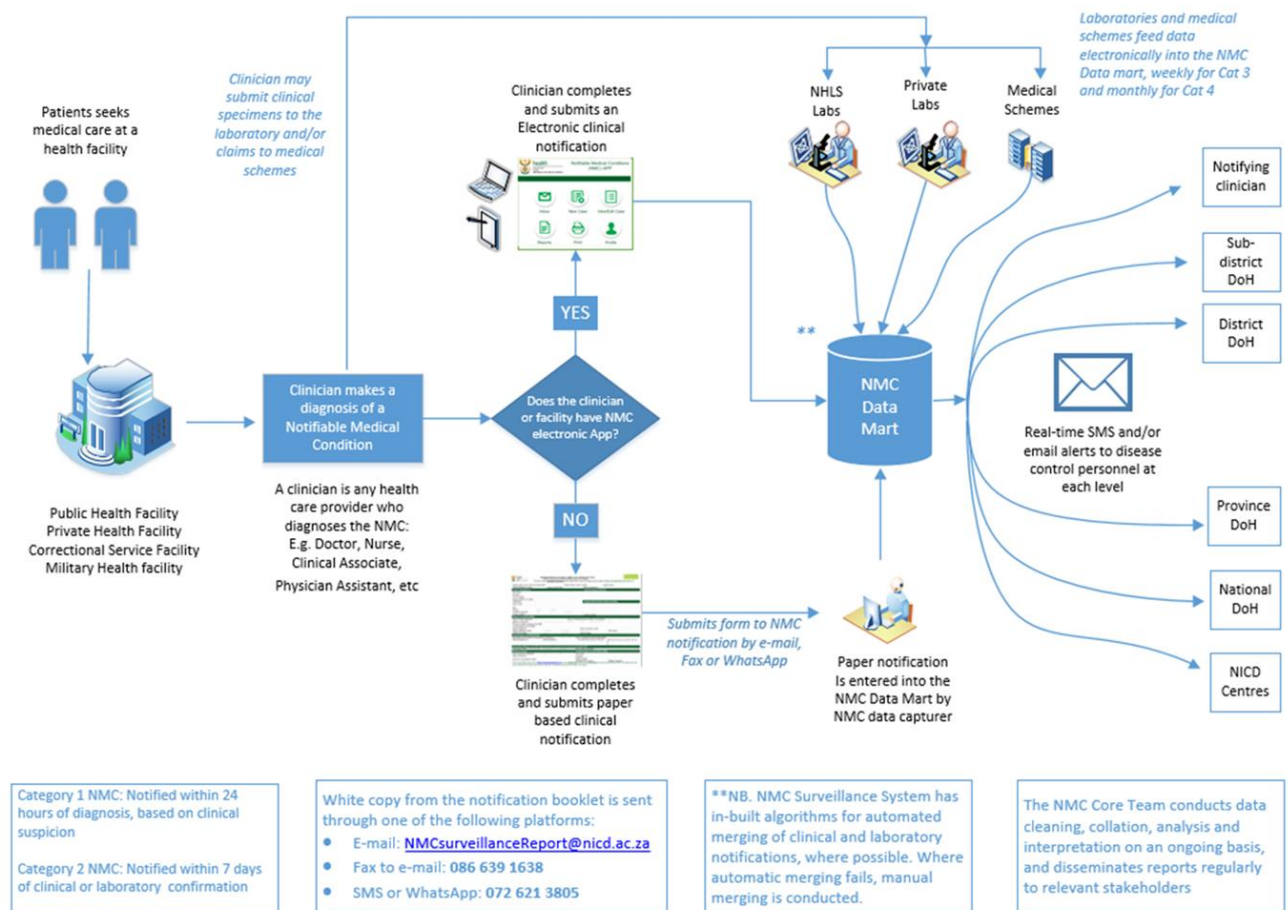


Figure 1.1: Summary of data flow within the NMC Surveillance System (source: <https://www.nmc.nicd.ac.za>)

Currently, 63 NMCs are under surveillance and classified into four categories (Figure 1.2). Category one is notified by HCWs immediately by telephone, followed by either electronic or paper-based notification within 24 hours of suspicion and/or diagnosis. Category two is notified by clinical or laboratory within 7 days of diagnosis by either electronic or paper-based forms. Category three are reported weekly and category four are reported by private and public health laboratories on a monthly basis (9).

In SA, the compliance of HCWs with electronic reporting of NMCs has been substandard, as is the case in many other countries (5). Electronic reporting of surveillance data enables data to be analyzed more easily and rapidly and also provides effective surveillance of multiple diseases at all public health levels and sectors (12).

Category 1 NMC: Must be reported immediately using the most rapid means upon clinical or laboratory diagnosis, followed by a written or electronic notification within 24 hours of diagnosis.	Category 2 NMC: Must be reported through a written or electronic notification, within 7 days of clinical or laboratory diagnosis but preferably as soon as possible following diagnosis.	Category 3 & Category 4 NMC: Reported by private and public health laboratories through an Application Programming Interface (API).
Acute flaccid paralysis	Agricultural or stock remedy poisoning	Category 3 NMC: Reported weekly
Acute rheumatic fever	Bilharzia (schistosomiasis)	Ceftriaxone-resistant <i>Neisseria gonorrhoea</i>
Anthrax	Brucellosis	West Nile virus, Sindbis virus, Chikungunya virus
Botulism	Congenital syphilis	Dengue fever virus, other imported arboviruses of medical importance
Cholera	<i>Haemophilus influenzae</i> type B	<i>Salmonella</i>
Congenital rubella syndrome	Hepatitis A	Shiga toxin-producing <i>Escherichia coli</i>
COVID-19	Hepatitis B	<i>Shigella</i> spp.
Diphtheria	Hepatitis C	Category 4 NMC: Reported monthly
Enteric fever (typhoid or paratyphoid fever)	Hepatitis E	Carbapenemase-producing Enterobacteriaceae
Foodborne disease outbreak	Lead poisoning	Vancomycin-resistant enterococci
Haemolytic uraemic syndrome (HUS)	Legionellosis	<i>Staphylococcus aureus</i> : hGISA and GISA
Listeriosis	Leprosy	Colistin-resistant <i>Pseudomonas aeruginosa</i>
Malaria	Maternal death (pregnancy, childbirth, puerperium)	Colistin-resistant <i>Acinetobacter baumannii</i>
Measles	Mercury poisoning	<i>Clostridium difficile</i>
Meningococcal disease	Soil transmitted helminths (<i>Ascaris Lumbricoides</i> , <i>Trichuris trichiuria</i> , <i>Ancylostoma duodenale</i> , <i>Necator americanus</i>)	
Mpox	Tetanus	
Pertussis	Tuberculosis: pulmonary	
Plague	Tuberculosis: extra-pulmonary	
Polio	Tuberculosis: multidrug-resistant (MDR-TB)	
Rabies (human)	Tuberculosis: extensively drug-resistant (XDR-TB)	
Respiratory disease caused by a novel respiratory pathogen		
Rubella		
Rift valley fever (human)		
Smallpox		
Viral haemorrhagic fever diseases		
Waterborne illness outbreak		
Yellow fever		

Figure 1.2: List of Notifiable Medical Conditions (NMCs) in South Africa

(Source: <https://www.nicd.ac.za/nmc-overview/notification-process>)

1.2. Literature Review

Regulations Governing Notifiable Medical Conditions

The IHR were established in 1969, considering the rising patterns in international travel and trade, alongside the emergence and resurgence of global disease threats and other public health risks (2). Subsequent amendments to the regulations were made in 1973, 1981, 1995, and 2005, with the goal of preventing, controlling, and responding to minimize public health risks, while simultaneously avoiding disruption to international traffic and trade (13). Disease surveillance is among the core functions defined in these regulations.

Disease Surveillance

Disease surveillance is the "ongoing and systematic collection, analysis, and interpretation of health-specific data for use in the planning, implementation, and evaluation of public health practices" (14). Surveillance data are useful for determining the health status of the population, setting priorities for intervention, and evaluation of intervention measures (15). Surveillance of NMCs helps authorities to monitor them in terms of person, place, and time, measure disease trends, develop

interventions and assess the effectiveness of control and prevention measures and facilitate policy development (16). If the IHR are not effectively implemented, it leads to inadequate surveillance systems that struggle to identify epidemics, morbidity, and mortality within the country (8). When any component of the surveillance system, such as accurate diagnosis, reporting, or follow-up investigation, experiences a breakdown, the entire surveillance system becomes ineffective (17). The majority of these surveillance systems operate passively, offering a cost-effective means of covering large areas to gather vital information for monitoring population health. In passive surveillance systems, HCWs or healthcare facilities are relied upon to supply data; however, ensuring data quality and timeliness in this context can be challenging (18).

***m*Health for Disease Surveillance**

Most countries' surveillance systems are paper-based which are prone to errors such as inaccurate data, delays in reporting, and timely feedback (19). The rise of mobile applications (Apps) has become instrumental in facilitating passive disease reporting for HCWs, allowing for real-time data entry and transmission directly from the point of care (23,24). Utilizing Apps for disease reporting has demonstrated enhancements in the timeliness, completeness, and accuracy of data in comparison to conventional paper-based methods (25). The IHR recommends the use of electronic tools to assist in the standardization of data to improve data quality, enhance rapid reporting, and reduce manual data entry associated with paper-based reporting tools. Electronic tools are based on mobile technology called mobile health (*m*Health). *m*Health is defined by the WHO as the utilization of mobile devices by HCWs to strengthen medical services and the delivery of public healthcare. It is recognized as a cost-effective measure for tackling a variety of diseases and healthcare interventions (20). Mobile technology offers several advantages for disease surveillance, including enhanced accuracy, reduced time and cost, improved data quality, and accelerated control of potential epidemics (21). Electronic tools such as Apps provide timely information, facilitate the transmission of data and enable timely responses to public health threats compared to paper-based notification (7). The trend for *m*Health is on the rise in high-income countries (22), but its adoption in low- and middle-income countries (LMICs) is also increasing due to the decline in costs and improved network coverage. *m*Health is now an effective mode of health communication in these countries for epidemic surveillance and response (23,24). The frequent

outbreaks and epidemics, worsened by weak health systems and infrastructure, served as a facilitator for the development and implementation of the Integrated Disease Surveillance and Response (IDSR) strategy in the WHO African region in 1998 (25). This strategy outlines the essential steps for effective surveillance systems and was formulated and adopted as a legitimate approach to implementing the IHR (26). The extent to which IDSR implementation has been carried out varies from country to country within the African region (27). South Africa is yet to implement IDSR.

Assessment of Notifiable Medical Conditions reporting using mobile Apps

Several studies looking at factors associated with KAPs of disease reporting using mobile Apps have been conducted globally. A study conducted in France (2002) revealed high knowledge and poor practice on the use of the electronic surveillance system among HCWs and identified barriers to reporting as technical problems, anxiety due to technology, not remembering to report using the system, and need for technical support (28). A study in Peru (2008), reported factors associated with poor adoption of electronic disease surveillance systems as having limited experience and training in epidemiology and surveillance, continuous movement of trained staff, and lack of resources (phones & internet access) especially in rural/ remote sites, and general operation of the system (29). Furthermore, a study in Jordan (2019), found poor knowledge and poor practices of disease reporting, and factors associated with poor knowledge and poor practices reported as high workload and not being trained on reporting diseases (30).

Factors associated with KAP of reporting NMCs using electronic disease surveillance systems have also been reported in Africa. A study in Ethiopia found favourable attitude towards *mhealth* for disease reporting. Good knowledge of mobile health technology, more than 5 years working experience, having ICT infrastructure, having own smart mobile and having taken computer-related trainings were associated with favourable attitude (31). Another study in Ghana (2020), found low level of knowledge and awareness of disease reporting and mobile network connectivity as some of the barriers related to reporting using mobile Apps (32). A study in the Central African Republic (2018), reported factors associated with poor App-based surveillance system adoption to be connectivity, and lack of trained staff (7).

Most studies in SA, which evaluated HCWs reporting of NMCs using the App were conducted before re-engineering the NMCSS (33–35). These studies revealed poor knowledge and poor practices of HCWs in reporting NMCs. A pilot study (2013) on the use of *mHealth* for reporting indicated poor uptake in reporting despite a positive response towards using *mHealth* in general (6). A study in 2018, identified factors associated with poor mobile reporting as staff shortage, lack of training and lack of infrastructure (36). Poor knowledge and poor reporting practices are major challenges in NMC reporting by HCWs.

The implementation of *mHealth*, relies on the knowledge, attitudes, and perception of HCWs towards *mHealth* use (37). HCWs are pivotal to the reporting of NMCs upon suspicion and/or diagnosis as they serve as the first line of contact with NMCs, however, this process is often incomplete and delayed (38). Reporting and control strategies are strengthened when HCWs are aware, and understand regulations regarding NMC reporting (39).

1.3. Problem statement

Effective control of NMCs relies on robust disease surveillance systems, and *mHealth* applications significantly enhance disease reporting capabilities (40). Routine operational assessment of the NMCSS focusing on NMC reporting across provinces, showed that NW constantly has low reporting rate and low number of App users with fluctuations over time among all provinces despite being the 4th province whereby the App was first introduced in 2018. In August 2022 (Figure 1.3), there were 7,094 notifications, of which 62% (4,373) were clinical notifications from public and private healthcare facilities. The private sector contributed 11% of the total clinical notifications. The highest notifications were reported in KwaZulu-Natal (1,968 cases, 27.7%), followed by Western Cape (1,177 cases, 16.6%) and Gauteng (940 cases, 13.3%). Conversely, Mpumalanga (372 cases, 5.2%) and North West (219 cases, 3.1%) had the lowest notifications (41).

In terms of App usage, North West had only 51(4.3%) active App users, one of the lowest among all provinces. The North West province faces a significant quadruple health burden, particularly from TB, HIV, and non-communicable diseases, with TB being the leading cause of death and a critical notifiable medical condition (42). The low number of notifications (3.1%) and the minimal App usage (4.3%) highlights a critical gap in the disease surveillance system in the NW province. The

underutilization of the NMC Reporting App in North West province undermines the effectiveness of disease surveillance and reporting, potentially leading to delayed responses to outbreaks, inadequate resource allocation, and continued high morbidity and mortality rates from notifiable conditions such as TB. The low reporting rate, especially using the NMC Reporting App could be due to factors associated with the knowledge, attitudes, and practices (KAP) of HCWs in NW province.

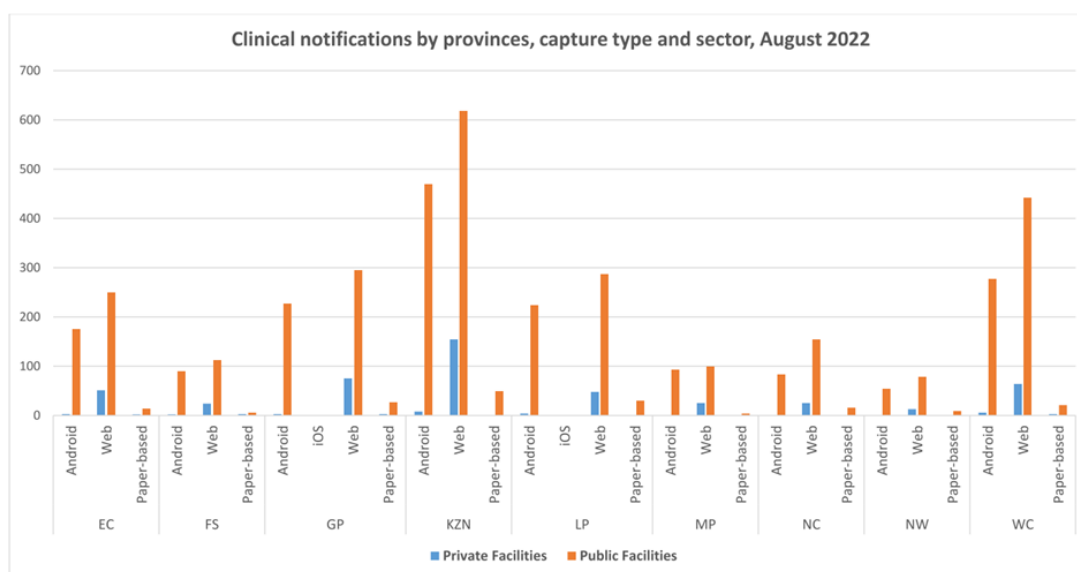


Figure 1.3: Notification reported by healthcare works from facilities, stratified by provinces, capture type and sector, August 2022. (source: <https://www.nicd.ac.za/nmc-overview/nmc-monthly-surveillance-report>).

1.4. Justification

To our knowledge, there are no previous comprehensive studies investigating the factors contributing to the low uptake and use of the NMC Reporting App in the North West province, despite its significant disease burden and early introduction of the App. Assessing HCWs' KAP on the use of the App to report NMCs will help identify gaps or limitations in notifications using the App and assist with the implementation of suitable and targeted interventions for effective response and monitoring of diseases.

1.5. Research question

What are the knowledge, attitudes, and practices of HCWs and associated factors in the NW Province regarding the notification of NMC using the NMC electronic reporting platform?

1.6. Hypothesis

Healthcare workers in the North West Province who have higher levels of knowledge and more positive attitudes towards reporting of NMCs using the NMC Reporting App will demonstrate better reporting practices, influenced by factors such as training, accessibility to the platform, and institutional support.

1.7. Aim

The study aims to assess the knowledge, attitudes, and practices of HCWs and associated factors on the use of the NMC Reporting App to notify NMC in the NW Province in 2023.

1.8. Objectives

- a) To describe the characteristics of participating HCWs who are responsible for reporting NMC in the NW province in 2023.
- b) To assess the level of knowledge, attitudes and practices of HCWs on the use of an electronic application to report Notifiable Medical Conditions in North West Province in 2003.
- c) To determine the level of healthcare workers' knowledge, attitudes, and practices by sector regarding the use of an electronic application for reporting Notifiable Medical Conditions in the North West Province in 2023.
- d) To determine factors associated with HCWs' knowledge, attitudes, and practices on the use of an electronic application to report Notifiable Medical Conditions in North West Province.

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CHAPTER 2: SUBMISSABLE MANUSCRIPT

This chapter contains the manuscript that was written and will be submitted to the [Journal of Public Health in Africa](#). The chapter begins with a declaration and is followed by the manuscript. The manuscript provides details of how the study was conducted, the study results, and a discussion of the findings.

Healthcare Workers' Knowledge, Attitudes, and Practices on the Use of the Electronic Application to Report Notifiable Medical Conditions - North West Province, South Africa, 2023.

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Authors contributions:

KK, LK, and MM contributed to the conceptualization of the project. KK collected, cleaned, and analyzed the data, and wrote the initial draft of the manuscript. LK, KR, and RM provided guidance on data interpretation and offered feedback on the manuscript. All authors reviewed and approved the final version of the manuscript.

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2.1. Manuscript

Abstract

Background: Mobile applications strengthen disease reporting and control strategies and rely on healthcare workers who are well-informed on, practice, and adherence to regulations related to Notifiable Medical Conditions reporting.

Objective: The study aims to assess the knowledge, attitudes, and practices (KAP) of HCWs in North West Province in 2023 regarding the use of an electronic application for reporting NMCs, and to identify associated factors.

Methods: A cross-sectional study was conducted in four districts of NW Province. The KAP scores were calculated and categorized using adjusted Bloom's cut-off criteria. Chi-square tests were used to assess the association between overall KAP categories and independent variables. Bivariate and multivariable logistic regression analyses were used to identify factors associated with KAP. Adjusted odds ratios (AOR) with 95% confidence intervals (CI) were calculated. A p-value of ≤ 0.05 was considered statistically significant.

Results: The study found inadequate knowledge (80%), negative attitudes (50%), and poor practices (96%). Factors associated with inadequate knowledge were being in the other nurse category designation (aOR: 2.83, 95% CI: 1.05-7.60, $p=0.038$). Being male (aOR: 0.38, 95% CI: 0.19-0.73, $p=0.004$) was associated with lower odds of having inadequate knowledge. Inadequate knowledge is a significant factor associated with poor NMC Reporting App practices (aOR 7.03, 95% CI: 2.04-24.22, $p=0.002$) in North West Province.

Conclusion: The study revealed inadequate knowledge, negative attitudes and poor NMC Reporting App practices. Inadequate knowledge is a key factor contributing to poor utilization of the App. We recommend trainings to enhance HCWs' knowledge and technical support towards NMC Reporting App utilization.

Introduction

Effective disease reporting is crucial for surveillance efforts to prevent outbreaks and epidemics resulting from the emergence and re-emergence of infectious diseases and other public health threats (1). Countries are advised to utilize real-time surveillance systems for efficient monitoring and control, aimed at detecting, preventing, and responding to potential threats promptly (2). Electronic reporting of surveillance data, utilizing mobile technology known as *mHealth* (3), enhances accuracy, reduces time and costs, improves data quality, and speeds up the control of potential epidemics (4).

mHealth activity trends are low in Low- and Middle-income countries (LMICs), despite the vast opportunities for using mobile phones due to decreasing costs and increased network coverage (3). This includes opportunities for utilization of *mHealth* technology in healthcare. Studies conducted in LMICs on the use of *mhealth* among healthcare workers (HCWs) have demonstrated poor acceptance and uptake (5). Contributing factors identified in the utilization of *mHealth* for surveillance include knowledge and information gaps, cultural and sociodemographic influences, insufficient training, user mistrust, technological challenges, and cost considerations (6–8). Enhancing reporting and control strategies relies on HCWs being adequately informed, understanding, practicing, and adhering to regulations concerning NMC reporting (10).

South Africa, as a World Health Organization member state launched the improved Notifiable Medical Conditions Surveillance System (NMCSS) in 2020, which consists of paper-based and electronic notification platforms (mobile and web-based) that allow for real-time reporting of NMC at the point of diagnosis (9). HCWs are mandated to report NMCs upon suspicion and/or diagnosis, recognizing their pivotal role as the initial point of contact with such conditions (10). HCWs' compliance will ensure timely investigation and control measures and facilitate consistency in morbidity and mortality reporting (11).

A routine operational assessment of the NMCSS in August 2022 focusing on NMC reporting by province revealed provincial variations, with North West (NW) Province exhibiting the least reporting of NMCs using the App (4.3%) and a low number of active NMC Reporting App users (3.4%) with fluctuations over time (12,13).

NW is one of the provinces where the NMC Reporting App was launched in October 2018, hence it is imperative that a study should be conducted to investigate reasons for the low uptake and use of the NMC Reporting App to report NMCs. The low reporting rate using the NMC Reporting App could be due to HCWs' knowledge, attitudes and practices and associated factors in the NW province. The aim of the study was to assess the knowledge, attitudes, and practices of HCWs and determine associated factors regarding the use of the NMC Reporting App to notify NMCs in the NW Province in 2023. Assessing HCWs KAP to report NMCs will help in identifying gaps or limitations in reporting using the NMC Reporting App and assist with the implementation of suitable and targeted interventions for effective reporting, response and monitoring of NMC in NW province.

Materials and methods

Study design, study setting and study population

A cross-sectional study design was conducted in the four districts in NW Province. North West Province has an estimated 564 healthcare facilities and approximately 8,286 HCWs (14). The target population was HCWs aged 18 years and above, working at selected primary healthcare and hospital facilities in the public and private sectors.

Sample size

The sample size was calculated using the formula $[n = \frac{Z_{\alpha}^2 Pq}{d^2}]$ for cross-sectional studies (15). We assumed that 51% of HCWs had knowledge of NMC reporting, based on findings from a similar study conducted in South Africa (16). We considered a 95% confidence interval and a 5% margin of error, with an expected response rate of 90%. The calculated sample size was 424.

Sampling design

The NW province was purposively selected due to its low NMC reporting rate and limited NMC Reporting App utilization. Stratified random sampling was done to stratify the population by districts. Stratification reduces the design effect and increased precision compared to simple random sampling (17). The target sample

size for each district was calculated proportionate to the population size of the district, i.e. 125 (n=2441) in Dr. Kenneth Kaunda, 123 (n=2416) in Bojanala, 111 (n=2163) in Ngaka Modiri Molema, and 65(n=1266) in Ruth Segomotsi Mompati to get an overall sample size of 424 HCWs. Simple random sampling was used to select healthcare facilities i.e. 1 regional/tertiary hospital, 1 district hospital, 1 private hospital, and 18 primary healthcare facilities/community health centres using a list of healthcare facilities provided by the NW Provincial Department of Health. In each facility, all HCWs who were assessing, diagnosing and/or involved with the notifications of NMCs were targeted on the day of the survey and were requested to participate in the study.

Data collection tool

Data related to HCWs KAP and socio-demographic characteristics were collected using a structured, interviewer-administered questionnaire. The questionnaire (appendix F) was developed in English utilizing Research Electronic Data Capture (REDCap), a secure web-based software platform developed to facilitate data capture for research studies, hosted by the University of Witwatersrand (18). It consisted of 35 questions, nine demographic questions, eight questions on knowledge about the App, six questions on attitudes towards the utilization of the App and twelve questions on practices towards the use of the App. The tool was pre-tested among 42 (10%) HCWs selected through convenience sampling to ensure clarity and ease of use. Cronbach's alpha coefficient was used to evaluate the consistency and validity of the questionnaire. The internal consistency reliability for the instrument was 0.86. Specifically, the internal consistency of Cronbach's Alpha for knowledge, attitudes, and practices was 0.90, 0.92, and 0.72, respectively. These values suggest a correlation among the variables within every domain.

Data collection

The eligible HCWs were informed about the background and objectives of the study and written consent was obtained prior to the commencement of the interviews. Data was captured directly onto REDCap using a laptop or tablet in the facilities that have stable internet connectivity and paper-based questionnaires were used to collect the data in facilities with intermittent/no internet connectivity. Completed paper-based questionnaires were captured onto REDCap by the researcher. The survey was conducted between 06 September and 10 November 2023.

Data management and analysis

Data was exported from REDCap in the form of a Microsoft Excel document. Errors and inconsistencies were checked and corrected before being exported into Stata®18 for coding and analysis.

To describe demographic characteristics of participating HCWs

Demographic variables considered in this study were gender, age, designation, district, health facility sector, type of health facility, and years working in the health facility. Continuous age variable was converted into a categorical variable by creation of age groups. Descriptive statistics including frequency and percentage were used to summarize the demographic data.

To assess the level of KAP of participating HCWs

The overall percentage score was calculated for each KAP domain. For knowledge, which had 8 questions. HCWs' received a score of 1 for the correct answer "Yes" and 0 for incorrect answer "No". The total score range was 0 – 8, with 8 being the maximum obtainable score. The attitudes section had six statements assessed using a Likert scale technique. The responses, initially categorized as strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree, were consolidated into three categories for analysis: disagree, neither agree nor disagree, and agree. The total attitudes score was calculated and ranged from 0 to 12, with 12 being the maximum score. For practices, the section had 12 questions of which eight were used to calculate the practice score. The correct answer "Yes" received 2 points, I don't know/not applicable scored 1 point, and "No" scored 0. Questions relating to paper notification forms use, received a reverse score. The total practice score was calculated and ranged from 0 to 16. The other four practices questions were not included in this analysis.

The overall score for each KAP domain was then converted into percentage scores and further categorized into binary outcomes variables using Bloom's cut-off point criteria, and adapted from other related studies. Bloom's cut-off point criteria is a taxonomy framework used to assess and categorize the level of KAP in a target populations to identify target areas for interventions and to measure effectiveness of programs (19). In this study, an adjusted Bloom's cut-off value of 75% was used to categorize participants' KAP into two levels. In the knowledge domain, a total score

of 75% or higher (i.e., ≥ 6 out of 8) was deemed as adequate knowledge, while scores below 75% (< 6 out of 8) were categorized as inadequate knowledge. Similarly, for attitudes, a score of 75% or higher (i.e., ≥ 9 out of 12) indicated a positive attitude, while scores below 75% (< 9 out of 12) were classified as negative attitudes. Likewise, in the practice domain, a score of 75% or higher (i.e., ≥ 12 out of 16) represented good practice, whereas scores below 75% (< 12 out of 16) were categorized as poor practice (20–22). The association between overall KAP scores and independent variables was evaluated using Pearson's Chi-square or Fisher's exact test, as appropriate. A p-value of ≤ 0.05 was considered statistically significant.

Factors associated with HCWs knowledge, attitudes and practices towards NMC Reporting App utilization

Factors associated with KAP were identified using bivariate and multivariable logistic regression analysis. Independent variables with a p-value of ≤ 0.2 in the bivariate analysis were included in the multivariable logistic regression using the stepwise backward elimination method. This automatic selection procedure was used to identify the most relevant independent variables needed to predict the outcome variable (23).

We calculated adjusted odds ratios along with their corresponding 95% confidence intervals (CIs) and p-values. Independent variables with a p-value of ≤ 0.05 were considered to be significantly associated with KAP regarding the utilization of the NMC Reporting App. Independent variables that showed correlation (multicollinearity) with one another were excluded from the multivariable model. Correlation was evaluated using a correlation matrix. The model fit was assessed using the Hosmer-Lemeshow goodness-of-fit test.

Ethical consideration

The University of Witwatersrand Human Research Ethics Committee (Medical) (M230228: M230725-A-0001) (Appendix C) gave ethics approval. Further approval was received from the North West Department of Health (Appendix D). The purpose and procedure of the study were explained to the HCWs. All HCWs interviewed provided written informed consent (Appendix X). No identifying personal details were collected and confidentiality was maintained by allocating participant identification numbers (PIN) to all survey respondents.

Results

Demographic characteristics of participating HCWs

A total of 343 HCWs (81% response rate) from 52 healthcare facilities participated in the study. Among the HCWs, 82% were females, 55% were in the 30-49 years' age group, with mean age of 42 years (SD $\pm$ 10.5). The majority were professional nurses 62%, worked in clinics, 80%, and were employed in the public sector 96%, Almost half 49%, of the HCWs have been working in the same facility for more than five years. The majority of HCWs, 47%, were from Ngaka Modiri Molema district (Table 2.1).

HCWs KAP towards reporting NMCs using the App

The distribution of HCWs KAP in NW province (Table 2.2), revealed that a substantial proportion of HCWs (80%) had inadequate knowledge of reporting NMCs using the mobile App, with the overall mean knowledge score of 2.4 (SD: 2.7). Only 38% of the HCWs' were aware that they could use the NMC Reporting App without any cost, and 36% knew that the App was compatible with most internet browsers.

Additionally, only a quarter of the HCWs knew how to access and download the App, while 21% knew where to seek support for App-related queries. The public sector demonstrated a higher proportion of inadequate knowledge (81%) compared to the private sector (73%).

Regarding attitudes, half of the participating HCWs had negative attitudes toward using the NMC Reporting App, with an overall mean attitudes score of 7.9 (SD:3.9). However, the majority of the HCWs (64%) found the App useful for reporting, and 58% found the App convenient for reporting. Furthermore, 49% of the HCWs found the App easy and simple to use for NMC Reporting. The public sector demonstrated a negative attitude (51%) towards using the NMC Reporting App compared to the private sector, 40%.

Regarding practices, a high proportion of HCWs (96%) demonstrated poor practices of using the NMC Reporting App, with an overall mean practice score of 5.1 (SD: 2.9). The predominant method of reporting NMCs among HCWs was the use of paper-based case notification forms (66%). Only a minority (18%) of HCWs had

downloaded the NMC Reporting App, and an even smaller proportion, 13% used it for reporting. The private and public sector demonstrated poor App utilization (100% and 96%, respectively).

Association between independent variables and the overall KAP

A statistically significant association ($p=0.005$) was found between the gender of HCWs' and knowledge, with 85% of females having inadequate knowledge compared to 15% of males. Additionally, a statistically significant ($p=0.015$) association was found between designation and inadequate knowledge, with professional nurses having the highest proportion of inadequate knowledge, at 59% compared to other designations. The facility type was also found to be statistically significant ($p=0.034$) associated with attitudes, with a higher proportion of negative attitudes among HCWs working in clinics (75%) compared to those working in hospitals. No significant association was identified between any of the demographic factors and attitudes or practices related to NMC Reporting App utilization (Table 2.3).

Factors associated with HCWs knowledge, attitudes, and practices regarding NMC App utilization

Table 2.4 shows the results of the bivariate and multivariable regression analysis of factors associated with HCWs' poor knowledge, attitudes, and practices of using the NMC Reporting App.

Knowledge

In the bivariate analysis, HCWs in the other nurse category designation (i.e. enrolled and nursing assistants) were three times as likely (OR 3.61, 95%CI: 1.37-9.51; $p=0.009$) to have inadequate knowledge about reporting NMC using the App compared to professional nurses, and the association was statistically significant. Those in the age group 30-49 years were likely (OR 1.82, 95% CI: 0.84-3.97, $p=0.126$) to have inadequate knowledge compared to those in the 18-29 years' age group, although the association was not statistically significant. Males were less likely (OR 0.42, 95% CI: 0.22-0.78; $p=0.006$) to have inadequate knowledge compared to females and the association was statistically significant.

In the multivariate analysis, other nurse category designation were twice as likely (aOR 2.83, 95%CI: 1.05-7.60, $p=0.038$) to have inadequate knowledge compared to

professional nurses, after controlling for gender and age, which is statistically significant at the set 0.05 confidence interval. HCWs in the age group 30-49 years were likely (aOR 1.80, 95%CI:0.43-7.52 p=0.416) to have inadequate knowledge compared to those in the 18-29 years' age group after controlling for gender and designation, and the association is not statistically significant. Additionally, males were less likely (aOR 0.38, 95%CI: 0.19-0.73, p=0.004) to have inadequate knowledge compared to females after controlling for age and designation, which is statistically significant (p=0.004) at the 95% confidence interval.

Attitudes

According to the bivariate analysis, HCWs in the other nurse category designation were twice as likely to have negative attitude (OR 2.22, 95%CI:0.99-2.68, p=0.053) compared to professional nurses, however the association was moderately significant. HCWs working in hospital facilities were likely (OR 1.77, 95%CI:1.03-3.04, p=0.036) to have negative attitude, compared to those in clinics, and the association was statistically significant. Those who have worked in the same facility for more than five years were likely (OR 1.62, 95%CI:0.98-2.68 p=0.059) to have negative attitude compared to those who worked for less than a year, however the association was moderately significant. HCWs in the age group 30-49 years were likely (OR 1.41, 95%CI:0.72-2.75, p=0.303) to have negative attitude compared to those in the age group 18-29 years, and males were less likely (OR 0.91, 95%CI:0.52-1.59, p=0.760) to have negative attitude compared to females, however the associations were not statistically significant.

In the multivariable analysis, there was no statistically significant association between the demographic characteristics and negative attitude.

Practice

In both the bivariate and multivariate analysis, there was no statistically significant association between the demographic characteristics and poor practice.

Association between HCWs knowledge and attitudes towards NMC Reporting App practices

The study identified a statistically significant association (p<0.001) between knowledge and practice. The chi-square value calculated was 25.0 (df=1), with a p-value of <0.001. Given that the p-value is less than 0.05, the null hypothesis is

rejected, indicating a significant association between inadequate knowledge and poor NMC Reporting App practices. Additionally, the chi-square value calculated for knowledge and attitudes was 37.8 (df=1), with a p-value of <0.001. As the p-value is less than 0.05, the null hypothesis is rejected, suggesting significant association between inadequate knowledge and negative attitudes. Furthermore, the chi-square value calculated for attitudes and practice was 10.7 (df=1), with a corresponding p-value of 0.001. Since the p-value is less than 0.05, the null hypothesis is rejected, we can conclude that there is a statistically significant association between negative attitudes and poor practices towards NMC Reporting App utilization.

Furthermore, in the bivariate analysis, both knowledge (OR 7.12, 95% CI: 3.57-14.19, $p < 0.001$) and attitude (OR 14.06, 95% CI: 1.81-108.79, $p = 0.011$) were significantly associated with poor practices of NMC Reporting App utilization. However, the multivariable analysis revealed that inadequate knowledge increased the odds of poor practice by seven times (aOR 7.03, 95% CI: 2.04-24.22), and the association is statistically significant ($p = 0.002$). The confidence interval is narrow, and does not include 1, indicating greater precision in the estimate, and confirming a significant association between inadequate knowledge and poor practice. Poor attitudes (aOR 6.99, 95% CI: 0.84-58.02, $p = 0.071$) were associated with 7 times the odds of poor practices. However, the confidence interval is quite wide and includes 1, indicating that the result is not statistically significant at the 0.05 level. Therefore, while there appears to be an association between poor attitudes and poor practices, the evidence is inconclusive due to the lack of statistical significance.

Discussion

This study assessed the demographic characteristics of HCWs, the level of knowledge, attitudes and practices and determined factors associated with the utilization of the NMC Reporting App in the North West Province.

The research findings indicate that a significant portion of HCWs in NW fall within the 30-49 age group, and are predominantly professional nurses employed in public sector clinics. The age distribution and the prevalence of professional nurses aligns with trends observed in the District Health Barometer (DHB) data, which shows that a

substantial number of nurses and doctors in the country are between the age group of 30-49 (24). Additionally, the majority of HCWs in the study were female, reflecting the gender distribution prevalent in the healthcare system. This finding corresponds with the World Health Organization's (WHO) 2019 report, which indicating that 79% of health workers in healthcare settings are female (25).

The results indicate a gap in the knowledge, attitude and practice of HCWs in the NW province regarding the use of NMC Reporting App. A substantial proportion of HCWs in the NW province have inadequate knowledge about reporting NMCs using the App. This suggests considerable variation in knowledge among HCWs, with high proportion scoring very low on the knowledge scale. The findings are consistent with a study which found that HCWs lack sufficient knowledge and training to effectively use *mHealth* health tools, leading to underutilization of these technologies (26). Only a limited number of HCWs had knowledge that the NMC Reporting App does not cost to use. Similarly, only a low proportion of HCWs are aware that the App is compatible with most internet browsers. This finding is similar to a study that showed that perceived costs and concerns about compatibility with existing systems are common barriers to the adoption of health apps among healthcare workers (27). This low level of awareness could hinder the adoption and use of the App, as HCWs might avoid using it due to cost concerns. Only a quarter of HCWs know how to access and download the App. This lack of knowledge may contribute to underutilization of the App, as HCWs are uncertain about how or where to access the App.

Furthermore, only a minority of HCWs knew where to get support for NMC Reporting App. A similar study found that technical support impacts HCWs adoption of *mHealth*, as it provides ongoing services advice and provide maintenance for the Apps (28). These findings highlight potential barriers to effective use of the App, such as difficulties in downloading the App and resolving technical issues.

The public sector demonstrates a higher proportion of inadequate knowledge compared to the private sector. This is consistent with a study that found that HCWs in the public sector often face more significant barriers to adopting new technologies due to resource constraints and administrative challenges (22). This difference may reflect disparities in training, access to resources, or institutional support between the two sectors. Inadequate knowledge can result in lack of reporting and missed opportunities to detect outbreaks timeously (29).

There study also found negative attitudes towards NMC Reporting App utilization. A similar study found that resistance to new technology often stems from discomfort with change or unfamiliarity with the tool, even when the technology is beneficial. Negative attitudes can persist despite recognition of an App usefulness, particularly if users feel inadequately supported or trained (30). A study conducted in Hawaii (2016) found that positive attitudes significantly increase reporting of NMCs (31).

Despite the overall negative attitudes, the majority of HCWs find the App useful for reporting NMCs. This suggests that while there may be reservations about using the app, many recognize its value in surveillance of NMCs. This positive indicator suggests potential for increasing overall acceptance with targeted interventions to address negative attitudes. Similarly, 58% of HCWs consider the App convenient for reporting. This highlights the practical benefits of the App, which might help mitigate some of the negative attitudes.

Nearly half of the HCWs find the App easy and simple to use, indicating a split in user experience or perceptions. While many HCWs may find the App user-friendly, a significant portion may struggle with its interface or functionality, contributing to the overall negative attitudes. A study (2010) highlights that ease of use is a crucial determinant of technology acceptance in healthcare (32).

The public sector shows a slightly higher proportion of negative attitudes than the private sector. This is consistent with findings of a study which reported that public sector employees often exhibit more resistance to *mHealth* health innovations, possibly due to organizational constraints or less exposure to technology (33).

A significant proportion of HCWs were found to have poor utilization practices of the NMC Reporting App, with predominant method of reporting still being the use of paper-based case notification forms for reporting. A study (2014) found that in many healthcare settings, particularly in LMICs, there is a strong reliance on paper-based systems despite the availability of *mHealth* tools. This is often due to familiarity with paper-based methods, lack of training, and perceived complexity of *mHealth* tools (34).

This reliance on traditional methods suggests resistance or barriers to transitioning to *mHealth* reporting systems. This poor uptake could be attributed to challenges in adaptability and change management, highlighting the need for leadership buy-in to enforce the mandate for reporting and to support the use of the App. Routine

assessment of the NMC surveillance system by provinces have indicated that provinces which have whitelisted the NMC Reporting App on their department intranet have better reporting rates (35). A study by Isere (2015) found that commitment and support from leadership is vital for promoting the culture of compliance and accountability (36).

A minority of HCWs had downloaded the NMC Reporting App, and an even smaller proportion are actively using it for reporting. This low adoption rate underscores significant issues in promoting and integrating the App into routine practice among HCWs. A study (2013) reported that common barriers to the adoption of mobile health applications include lack of access to devices, low *mHealth* literacy, and insufficient training. These barriers can result in continued reliance on paper-based reporting, as seen in this study (37).

Both the private and public sectors demonstrate poor utilization of the App, reflecting a universal challenge across different healthcare settings. A study (2012) found that often HCWs in both public and private sector face challenges in adopting new technologies due to systemic issues such as inadequate infrastructure, resistance to change, and lack of institutional support (38). The 100% poor utilization in the private sector is particularly striking and indicates a complete lack of integration of the App in that sector. This could be attributed to the fact that the re-engineered NMC surveillance system trainings were initially rolled out in the public sector. A study in South Africa (39), found significantly fewer HCWs in the private sector diagnosed and/or reported NMCs, attributing this to the fact that the private sector primarily serves people with medical insurance and communities with lower incidence of communicable diseases compared to the public sector (40). This lack of awareness might mean that it is possible that the case ends up not reported or not timely reported. In South Africa, the private sector is invaluable in the contribution and delivery of health services. Therefore, collaboration between the public and private sector is essential for comprehensive disease surveillance. By sharing information and coordinated efforts, both sectors can collectively enhance their capacity for reporting and responding to public health threats effectively (41). The importance of comprehensive training and ongoing support should be emphasized to improve the adoption and utilization of the NMC Reporting App.

The analysis of associations between demographic factors and KAP of HCWs regarding the NMC Reporting App reveals that there is a statistically significant

association between gender and knowledge about the NMC Reporting App. A higher proportion of females HCWs had inadequate knowledge compared to males HCWs. A study in (2016) reported that gender differences in technology adoption often arise due to variations in access to training, support, and exposure to *mHealth* tools, or other socio-cultural factors(42).

Designation was also significantly associated with inadequate knowledge. Professional nurses exhibited the highest proportion of inadequate knowledge compared to other designations. This is in contrast to the findings of a similar study in (2010) which found professional nurses being more aware of reporting procedures compared to doctors and other nurse categories (11). This finding could be related to the specific training or responsibilities of professional nurses, who may not have as much exposure to or have higher workload as other HCW designations.

Facility type showed a statistically significant association with attitudes towards the NMC Reporting App. HCWs working in clinics had a higher proportion of negative attitudes compared to those working in hospitals. This difference might be influenced by the resources, workload, or institutional support available in clinics compared to hospitals. Excessive workload has been found to affect HCWs performance (43). A study in (2012), noted that HCWs in smaller or less resourced facilities, such as clinics, often have less support for adopting new technologies, leading to more negative perceptions (44).

No significant association was found between any demographic factors and practices towards NMC Reporting App utilization. This suggests that poor practices in using the App are widespread across different demographic groups, indicating systemic issues rather than individual factors as the primary barriers to effective use. A study in (2015) reported that issues like poor infrastructure, lack of consistent training, and inadequate support systems are often more critical than individual characteristics in influencing technology use (45).

Factors associated with KAP of the NMC Reporting App among HCWs indicated that HCWs in the other nurse category designation were found to have inadequate knowledge compared to professional nurses. This shows that nurses outside the professional category may lack access to training or resources that could improve their knowledge about the App. A study in (2009) reported that nurses in other nurse category might have less exposure to continuing education or professional

development opportunities, which could explain their higher odds of inadequate knowledge compared to professional nurses (46). In South Africa, other nurse categories are not mandated by the National Health Act to report (47) and hence they might not have received training on NMC Reporting App.

Females were found to have inadequate knowledge compared to males. The lower odds of inadequate knowledge among males could be due to various factors, such as differences in technology usage or training opportunities. Negative attitudes towards the App are a strong predictor of poor utilization, although the association was not statistically significant. This is consistent with a study (2005) found that attitudes alone may not always directly translate into behaviour (48). A study in (2007) emphasizes the importance of self-efficacy and knowledge in behaviour change. HCWs with inadequate knowledge may lack the confidence to use the App correctly, leading to poor practices (49).

Overall, inadequate knowledge was found to be a statistical significant factor associated with poor NMC Reporting App utilization practices. A study in (2006) found that knowledge is a critical determinant of effective healthcare practice. Without adequate knowledge, HCWs are less likely to adopt new technologies or practices (50). A study that was conducted in the United States (2019) found that training enhanced HCWs awareness and practices to NMC reporting (51).

Strengths and Limitations

To the researchers' knowledge, this is the first study to investigate KAP of HCWs toward use of an enhanced electronic App in reporting NMCs in NW province. However, in interpreting the results of this study, some limitations should be considered. The targeted sample size was not attained due to time and resources constraints, there was unequal distribution of public and private healthcare facilities and uneven distribution of interviewed HCWs across the districts to detect statistically significant differences. Some of the non-significant associations and the wide confidence intervals observed could be influenced by these limitations. Although these limitations may pose a potential challenge to the study's validity, it is crucial to recognize that the primary aim of the study was to identify the knowledge, attitudes, and practices of HCWs regarding disease reporting using the NMC Reporting App. Therefore, this study serves a valuable purpose of informing targeted interventions aimed to improve the effectiveness and monitoring of NMCs.

Conclusion and Recommendation

This study found inadequate knowledge, negative attitudes and poor NMC Reporting App utilization practices in the North West province in 2023. The findings indicated that females and those in the other nurse category designation have inadequate knowledge of NMC Reporting App utilization. Moreover, inadequate knowledge was identified as a key factor contributing to poor utilization of the NMC Reporting App. In light of these findings, we recommend targeted interventions, such as training to enhance HCWs knowledge and technical support to improve both the utilization of the app and reporting practices. Additionally, further studies are needed to evaluate the extent of leadership support within the province and to explore HCWs' perceptions of NMC reporting using the App.

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TABLES AND FIGURES

Table 2.1: Demographic characteristics of participating healthcare workers in North West Province, 2023 (N=343)

Variables	Categories	Frequencies (n)	Percentages (%)
Age group	18-29	45	14
	30-39	169	55
	40-49	95	31
Gender	Female	281	82
	Male	62	18
Designation	Professional Nurse	213	62
	Nurse_other	64	19
	Doctor	37	10
	Other	29	9
Other Designation	Community Health Worker	10	34
	Counsellor	7	24
	Student Nurse	6	21
	Data Capturer/Admin Clerk	5	17
	Pharmacy Assistant	1	3
District	Ngaka Modiri Molema	162	47
	Bojanala Platinum	82	24
	Dr. Kenneth Kaunda	61	18
	Dr. Ruth Segomotsi Mompoti	38	11
Sector	Public	328	96
	Private	15	4
Facility type	Clinic	273	80
	Hospital	70	20
Years in facility	More than 5 years	167	49
	Less than 1 year	98	29
	1-5 years	78	22

Table 2.2. The level of KAP by sector towards NMC Reporting App utilization among HCWs' in North West Province, 2023

HCWs' who answered the question (Yes/Agreed)	SECTOR						P-value
	Total N	%	Public n/N	%	Private n/N	%	
Knowledge							
I know how to access and download the NMC Reporting App	84/340	25	80/325	25	4/15	27	0.857
I know it won't cost me to use the App (the App is reverse billed)	128/338	38	119/323	37	9/15	60	0.071
I know that the NMC Reporting App is compatible with most internet browsers	124/340	36	114/325	35	10/15	67	0.013
I know that NMC Reporting App sends out notification alerts for category 1 NMCs	114/340	34	106/325	33	8/15	53	0.097
I know that I can edit an existing clinical and laboratory notification within the NMC Reporting App	86/343	25	82/328	25	4/15	27	0.884
I know that when a case is captured on NMC App, all relevant people from local facility, sub-district, district and province will immediately get informed about the case	158/340	47	148/325	46	10/15	67	0.109
I know where to get support for the NMC Reporting App query	71/340	21	65/325	20	6/15	40	0.062
I know where to access NMC documents on the NMC reporting App	69/340	20	65/325	20	4/15	27	0.530
Overall knowledge classification							0.476
Adequate knowledge	67/343	20	63/328	19	4/15	27	
Inadequate knowledge	276/343	80	265/328	81	11/15	73	
Attitudes							
I feel comfortable using my own smartphone for reporting Notifiable Medical Conditions	157/333	47	148/319	46	9/14	64	0.261
I find the app convenient for reporting Notifiable Medical Conditions	190/324	58	180/310	58	10/14	71	0.494
I think the app is useful for reporting Notifiable Medical Conditions?	209/326	64	199/312	64	10/14	71	0.612

I find the app easy and simple to use	156/321	49	148/307	48	8/14	57	0.659
I find it easy to navigate through the case notification form on the app	151/322	47	144/308	47	7/14	50	0.934
I would recommend the app to other HCWs?	199/324	61	190/310	61	9/14	64	0.723
Overall Attitudes classification							0.422
Positive attitude	171/343	50	162/328	49	9/15	60	
Negative attitude	172/343	50	166/328	51	6/15	40	
Practices							
Have you downloaded the NMC Reporting App to report Notifiable Medical Conditions	61/340	18	59/325	18	2/15	13	0.634
Have you ever used the App to report a Notifiable Medical Condition case	43/339	13	40/324	12	3/15	20	0.384
Do you still use paper-based notification to report NMCs	221/336	66	208/321	65	13/15	87	0.081
Do you capture NMC notification straight onto the App after diagnoses	51/332	15	49/318	15	2/14	14	0.909
Do you first complete the paper-based form and insert it in the patient file to be captured into the App later	126/329	38	119/315	38	7/14	50	0.554
Are the paper-based notifications forms batched or piled first and later captured onto the NMC Reporting App?	63/331	19	61/316	19	2/15	13	0.310
Do you update the existing laboratory notification with patient clinical details on the NMC Reporting App	74/333	22	69/319	22	5/14	36	0.189
When you have patient outcome, do you update the existing notification with those details on the NMC Reporting App?	63/331	19	58/317	18	5/14	36	0.193
Overall level of Practices							0.414
Good practice	14/343	4	14/328	4	0/15	0	
Poor practice	329/343	96	314/328	96	15/15	100	

Table 2.3: The association of KAP and demographic characteristics of HCWs' towards NMC Reporting App utilization in North West, 2023

Factors		Knowledge (Inadequate) (N=276)			Attitude (Negative) (N=172)			Practice (Poor) (N=329)		
		n	%	P-value	n	%	P-value	n	%	P-value
Age group	18-29	33	13	0.215	19	13	0.564	42	14	0.505*
	30-49	141	57		86	57		162	55	
	≥50	73	30		45	30		91	31	
Gender	Female	234	85	0.005	142	83	0.760	270	82	0.739
	Male	42	15		30	14		59	18	
Designation	Professional Nurse	163	59	0.015*	98	57	0.167	203	62	0.311*
	Doctor	28	10		21	12		34	10	
	Nurse_other	59	21		34	20		63	19	
	Other	26	9		19	11		29	9	
District	Ngaka Modiri Molema	129	47	0.931	82	48	0.884	156	48	0.410*
	Bojanala Platinum	68	24		39	23		76	23	
	Dr. Kenneth Kaunda	49	18		30	17		60	18	
	Dr. Ruth Segomotsi Mompati	30	11		21	12		37	11	
Sector	Public	265	96	0.505*	166	97	0.422	314	95	1*
	Private	11	4		6	4		15	5	
Facility type	Clinic	222	80	0.432	129	75	0.034	263	80	0.496*
	Hospital	54	20		43	25		66	20	
Years in facility	<1 year	79	29	0.732	41	24	0.148	93	28	0.679*
	1-5 years	65	23		41	24		76	23	
	> 5 years	132	48		90	52		160	49	
* indicates values from Fishers exact test; bolded p-values are statistically significant										

Table 2.4: Univariate analysis of factors associated with KAP of HCWs' on NMC Reporting App utilization in North West, 2023

Variables	Categories	Knowledge OR(95%CI)	P-value	Attitude OR(95%CI)	P-value	Practice OR(95%CI)	P-value
Age Group	18-29	1		1		1	
	30-49	1.83(0.84-3.97)	0.126	1.41(0.72-2.75)	0.303	1.65(0.40-6.66)	0.480
	≥50	1.20(0.53-2.72)	0.651	1.23(0.60-2.52)	0.568	1.62(0.34-7.58)	0.537
Gender	Female	1		1		1	
	Male	0.42(0.22-0.78)	0.006	0.91(0.52-1.59)	0.760	0.80(0.21-2.96)	0.740
Designation	PN	1		1		1	
	Doctor	0.95(0.42-2.15)	0.911	1.54(0.76-3.11)	0.229	0.55(0.14-2.13)	0.394
	Nurse_Other	3.61(1.37-9.51)	0.009	1.32(0.75-2.32)	0.318	3.10(0.38-24.71)	0.285
	Other	2.65(0.77-9.51)	0.121	2.22(0.99-5.02)	0.053		
District	NMM	1		1		1	
	Bojanala	1.24(0.62-2.47)	0.538	0.88(0.51-1.50)	0.652	0.48(0.15-1.56)	0.226
	DKK	1.04(0.49-2.18)	0.908	0.94(0.52-1.70)	0.848	2.30(0.27-19.57)	0.443
	RSM	0.95(0.40-2.28)	0.925	1.20(0.59-2.45)	0.606	1.42(0.16-12.18)	0.747
Sector	Public	1		1		1	
	Private	0.65(0.20-2.12)	0.479	0.65(0.22-1.86)	0.425	0.62(0.19-2.06)	0.443
Facility type	Clinic	1		1		1	
	Hopital	0.77(0.41-1.46)	0.433	1.77(1.03-3.04)	0.036	2.04(0.38-10.82)	0.404
Years in facility	<1 year	1		1			
	1-5 years	1.20(0.55-2.61)	0.652	1.54(0.84-2.80)	0.157	1.22(0.37-3.98)	0.731
	>5 years	0.90(0.48-1.69)	0.759	1.62(0.98-2.68)	0.059	11.92(3.61-39.37)	
Knowledge_classification	Adequate knowledge			1		1	
	Inadequate knowledge			7.12(3.57-14.19)	<0.001	11.92(3.61-39.37)	<0.001
Attitude_classification	Positive attitude					1	
	Negative attitude					14.06(1.81-108.79)	0.011
Abbreviation: PN=Professional Nurse; NMM=Ngaka Modiri Mole DKK=Dr. Kenneth Kaunda RSM=Ruth Segomotsi Mompoti							Bolded p-values=Statistical significance

Table 2.5: Multivariable analysis of factors associated with KAP of HCWs' on NMC Reporting App utilization in North West, 2023

Variables	Categories	Knowledge aOR(95%CI)	P-value	Attitude aOR(95%CI)	P-value	Practice aOR(95%CI)	P-value
Age Group	18-29	1		1		1	
	30-49	1.50(0.67-3.34)	0.317	0.81(0.54-1.23)	0.345	1.80(0.43-7.52)	0.416
	≥50	0.83(0.35-1.96)	0.678	0.66(0.38-1.14)	0.142	2.11(0.42-10.62)	0.361
Gender	Female	1		1		1	
	Male	0.38(0.19-0.73)	0.004	0.71(0.39-1.29)	0.265	0.73(0.17-3.00)	0.666
Designation	PN	1		1			
	Doctor						
	Nurse_Other	2.83(1.05-7.60)	0.038	1.89(0.81-4.39)	0.136		
District	Other						
	NMM					1	
	Bojanala					0.33(0.10-1.06)	0.063
Sector	DKK						
	RSM						
	Public						
Facility type	Private						
	Clinic			1			
Years in facility	Hopital			1.52(0.84-2.77)	0.161		
	<1 year			1			
	1-5 years						
Knowledge_classification	>5 years			1.42(0.86-2.34)	0.164		
	Adequate knowledge					1	
	Inadequate knowledge					7.03(2.04-24.22)	0.002
Attitude_classification	Positive attitude					1	
	Negative attitude					6.99(0.84-58.02)	0.071
Abbreviation: PN=Professional Nurse; NMM=Ngaka Modiri Mole DKK=Dr. Kenneth Kaunda RSM=Ruth Segomotsi Mompoti						Bolded p-values=Statistical significance	

CHAPTER 3: OVERALL DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

This chapter gives the overall aim of the study, highlights key findings and concludes with recommendations in terms of the study results utilization and future research.

3.1. Electronic Reporting of Notifiable Medical Conditions

Disease reporting is essential in public health surveillance and outbreak prevention as it facilitates the systematic gathering, analysis, and interpretation of data concerning Notifiable Medical Conditions (18). Mobile applications and electronic reporting systems are being adopted globally to facilitate real-time disease surveillance and reporting, however, usage depends on healthcare workers' acceptance and knowledge of these electronic reporting tools (87). Real-time electronic reporting systems like the Notifiable Medical Conditions Surveillance System (NMCSS) in South Africa allow for more accurate, timely, and efficient reporting and response compared to traditional paper-based systems (1). Healthcare workers are mandated to report Notifiable Medical Conditions upon diagnosis, but uptake of electronic reporting tools can be hindered by knowledge gaps, training needs, technological challenges, and other barriers (88). This study was conducted to assess healthcare workers' knowledge, attitudes and practices related to using the electronic NMC Reporting App for Notifiable Medical Conditions reporting in North West Province, South Africa. The objective was to determine the level of knowledge, attitudes, and practices and associated factors towards NMC Reporting App utilization and to identify limitations and gaps to guide targeted interventions to improve reporting, response, and monitoring of Notifiable Medical Conditions in the province.

3.2. Study key findings

1. High Prevalence of Inadequate Knowledge

There is a substantial proportion of HCWs, especially in the public sector who demonstrated inadequate knowledge of the NMC Reporting App. This lack of knowledge was more pronounced among females HCWs and those in other nurse category roles.

2. Negative Attitudes toward the NMC Reporting App

Approximately half of the HCWs exhibited negative attitudes toward using the NMC Reporting App. This negative attitude was more prevalent in the public sector and among HCWs working in clinics compared to those in hospitals.

3. Poor Practices in NMC Reporting App Utilization

The vast majority of HCWs demonstrated poor practices in using the NMC Reporting App, with a preference for traditional paper-based reporting methods. Despite the availability of the App, very few HCWs had downloaded or used it for reporting.

4. Significant Associations Between Knowledge, Attitudes, and Practices

Inadequate knowledge was strongly associated with poor practices, significantly increasing the likelihood of poor App utilization. While negative attitudes also increased the odds of poor practices, but the association was not statistically significant.

5. Gender and Professional Role Disparities

Females HCWs and those in other nurse category were more likely to have inadequate knowledge compared to their males and professional nurse counterparts. This gender and role-based disparity highlights potential systemic issues in training and resource allocation.

3.3. Public Health Implications

1. Need for Targeted Training and Education:

The high prevalence of inadequate knowledge suggests an urgent need for targeted educational interventions. Training programs should focus on increasing awareness and understanding of the NMC Reporting App, particularly among females HCWs and those in other nurse category designation. Such programs could be integrated into ongoing professional development initiatives.

2. Addressing Attitudinal Barriers:

Although the association between attitudes and practices was not statistically significant, the high proportion of negative attitudes cannot be overlooked. Public health strategies should aim to improve perceptions of the NMC Reporting App by addressing concerns and emphasizing its benefits in streamlining and enhancing disease surveillance efforts.

3. Improving Infrastructure and Support in Clinics

The findings that clinic-based HCWs had more negative attitudes toward the App suggest that these facilities may lack the necessary infrastructure or support to effectively utilize the App. Public health authorities should ensure that clinics are adequately equipped and supported to adopt the NMC Reporting App.

4. Promoting App Utilization:

Given the poor practices in App utilization, public health efforts should focus on promoting the use of the NMC Reporting App through regular follow-ups, and integrating App usage into routine reporting workflows. This could involve providing technical support, and demonstrating the App's value in improving reporting efficiency.

5. Addressing Gender and Role-Based Disparities:

The gender and professional role disparities in knowledge suggest that more equitable access to training and resources is needed. Public health initiatives should aim to empower all HCWs, regardless of gender or role, with the knowledge and skills required to effectively use the NMC Reporting App.

6. Enhancing NMC Reporting App Adoption:

The findings underscore the importance of addressing barriers to the adoption of NMC Reporting App. Public health programs should not only focus on technology rollout but also on ensuring that HCWs have the necessary support, training, and motivation to use these App effectively.

These public health implications highlight the need for a multifaceted approach to improve the adoption and utilization of the NMC Reporting App, ultimately enhancing disease surveillance and control efforts.

3.4. Conclusion and Recommendations

This study highlights significant gaps in the knowledge, attitudes, and practices of HCWs in the North West Province regarding the use of the NMC Reporting App. A substantial proportion of HCWs, particularly those in other nurse category roles, females HCWs, and those working in the public sector, demonstrated inadequate knowledge of the App. Additionally, negative attitudes towards the App were prevalent, particularly in clinic-based settings. These factors were strongly associated with poor practices in App utilization, with many HCWs continuing to rely on

traditional paper-based reporting methods. The findings underscore the need for targeted interventions to improve HCWs' knowledge and attitudes towards the NMC Reporting App. Addressing these gaps through tailored training programs, and enhanced technical support, is essential to promoting the effective adoption of the App. Moreover, addressing gender and role-based disparities in access to resources and training will be critical in ensuring equitable use of the NMC Reporting App across the healthcare system. Overall, this study provides valuable insights into the knowledge, attitudes and practices on the use of the NMC Reporting and offers practical recommendations for enhancing disease surveillance and public health outcomes through improved use of the NMC Reporting App.

3.5. References

1. Nsubuga P, White ME, Thacker, Stephen B E al. Public Health Surveillance: A Tool for Targeting and Monitoring Interventions. Jamison DT, Breman JG MA, editor. Disease Control Priorities in Developing Countries. 2006. 1–22 p.
2. Ventola CL. Mobile devices and apps for health care professionals: uses and benefits. P T. 2014;39(5):356–64.
3. National Institute for Communicable Diseases. Notifiable Medical Conditions [Internet]. National Institute for Communicable Diseases. 2023. Available from: <https://www.nicd.ac.za/nmc-overview/>
4. Revere D, Hills RH, Dixon BE, Gibson PJ, Grannis SJ. Notifiable condition reporting practices: Implications for public health agency participation in a health information exchange. BMC Public Health. 2017;17(1):1–12.

APPENDICES

APPENDIX A: PLAGIARISM DECLARATION



PLAGIARISM DECLARATION TO BE SIGNED BY ALL HIGHER DEGREE STUDENTS

SENATE PLAGIARISM POLICY: APPENDIX ONE

I Keabetswe Evelyn Kodi (Student number: 2606645) am a student registered for the degree of MSc Field Epidemiology in the academic year 2024.

I hereby declare the following:

- I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is wrong.
- I confirm that the work submitted for assessment for the above degree is my own unaided work except where I have explicitly indicated otherwise.
- I have followed the required conventions in referencing the thoughts and ideas of others.
- I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my own unaided work or that I have failed to acknowledge the source of the ideas or words in my writing.
- I have included as an appendix a report from "Turnitin" (or other approved plagiarism detection) software indicating the level of plagiarism in my research document.

Signature: 

Date: 23 September 2024

APPENDIX B: TURNITIN COVER PAGE

HDR-2.docx			
ORIGINALITY REPORT			
13%	11%	7%	3%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS
PRIMARY SOURCES			
1	Submitted to University of Witwatersrand Student Paper	1%	
2	www.omicsdi.org Internet Source	1%	
3	www.science.gov Internet Source	1%	
4	journals.plos.org Internet Source	1%	
5	link.springer.com Internet Source	1%	
6	Prabhjot Kaur Juttla, Moses Ndiritu, Ferdinand Milliano, Alfred Owino Odongo, Magoma Mwancha-Kwasa. "Knowledge, attitudes and practices towards COVID-19 among healthcare workers: A cross-sectional survey from Kiambu County, Kenya", PLOS ONE, 2024 Publication	1%	
7	www.frontiersin.org Internet Source	1%	

APPENDIX C: ETHICS CLEARANCE CERTIFICATE



R14/49 Miss Keabetswe Evelyn Kodi

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M230228 M230725-A-0001

NAME: Miss Keabetswe Evelyn Kodi
(Principal Investigator)

DEPARTMENT: School of Public Health
Healthcare Facilities in North West Province, South Africa

PROJECT TITLE: Healthcare workers' knowledge, attitude, and practices towards the use of the electronic application to report notifiable medical conditions - North West province, South Africa, 2023

DATE CONSIDERED: 24-Feb-2023

DECISION: Approved unconditionally

CONDITIONS: N/A

NOTE: Application Number: MED23-01-057

SUPERVISOR: Mrs L. Chandu, Mr K. Ravhuhali and Mrs R. Mapuroma

APPROVED BY:


Dr M Vorster, Co-Chairperson, HREC (Medical)

DATE OF APPROVAL: 24-Jul-2023 **EXPIRY DATE:** 24-Jul-2028

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATOR(S)

I/we fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report** in the month date of convened meeting each year until study is closed. Failure to submit annual report will result in ethics clearance certificate suspension. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. Unreported changes to the application may invalidate the clearance given by the HREC (Medical). Email a signed copy of ethics clearance certificate to HREC-Medical.ResearchOffice@wits.ac.za


Signature of Principal Investigator

28 July 2023
Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX D: NORTH WEST DEPARTMENT OF HEALTH APPROVAL

 health Department: Health North West Provincial Government REPUBLIC OF SOUTH AFRICA	
1 st Floor, Health Office Park Private Bag X 2068 MMABATHO 2735	RESEARCH, MONITORING & EVALUATION Tel: +27 (18) 391 4501 Email: MbuleloT@nwpg.gov.za www.nwhealth.gov.za

Name of Researcher:	Ms. K.E. Kodi University of the Witswatersrand	HEAD OF DEPARTMENT 2023 -08- 08 NORTH WEST DEPARTMENT OF HEALTH PRIVATE BAG X 2068, MMABATHO, 2735
Physical Address:	_____	
(Work/ Institution)	_____	
Subject:	Research Approval Letter – Healthcare workers' knowledge, attitude, and practices towards the use of the electronic application to report notifiable medical conditions - North West province, South Africa, 2023.	

This letter serves to inform the Researcher that permission to undertake the above mentioned study has been granted by the North West Department of Health. The Researcher must arrange in advance a courtesy meeting with the District Chief Director and the Chairperson of the District Health Research Committee (DHRC) (as per their details below), to introduce their research team/members on the proposed research to be undertaken. The researcher can thereafter proceed to the identified institution/s and/or facility and produce this letter to the Management as proof that the research was approved by the NWDoH.

This letter of permission should be signed and a copy returned to the department. By signing, the Researcher agrees, binds him/herself and undertakes to furnish the Department with an electronic copy of the final research report. Alternatively, the Researcher can also provide the Department with an electronic summary highlighting recommendations that will assist the Department in its planning to improve some of its services where possible. Through this, the Researcher will not only contribute to the academic body of knowledge but also contributes towards the bettering of health care services and thus the overall health of citizens in the North West Province.

Below are the contact details.



Office of the Chief Director: Bojanala District	Chairperson of the DHRC
Dr. K. Segwai	Dr. C.D. Kabongo
Contact person: Goitsewang Khumalo	Contact person: Obakeng Masango
014 592 8906 KhumaloG@nwpg.gov.za	014 592 8906 NMasango@nwpg.gov.za

Office of the Chief Director: Dr Kenneth Kaunda District	Chairperson of the DHRC
Ms. Dineo Moromane	Dr. C. Cachet
Contact person: Mr. Calvin Mmisele	clcachet@gmail.com
018 462 5744 CMmisele@nwpg.gov.za	

Office of the Chief Director: Dr Ruth Segomotsi Mompati	Chairperson of the DHRC
Mr. A. Mvula	Dr. S. Abizu
Contact person: Ms. Kesaobaka Monchwe	Contact person: Tlotlo
053 928 0506/7 (072 679 6440) KMonchwe@nwpg.gov.za	053 927 0458 OSefako@nwpg.gov.za

Office of the Chief Director: Ngaka Modiri Molema District	Chairperson of the DHRC
Ms. M. Mokhutswane-Kaudi	Dr. M. Nong
Contact person: Ms Boitumelo Sethaiso	Contact person: Ms Wame Makara
018 384 0240 BSethaiso@nwpg.gov.za	018 384 0240 WNthaille@nwpg.gov.za

Kindest regards,


Dr. FRM Reichel
Director: RM&E
Date: 8/8/2023


Researcher
Date: 08 Aug 2023

APPENDIX E: JOURNAL GUIDELINES FOR AUTHORS

The Journal of Public Health in Africa

Guidelines for Authors

Manuscript will be carefully scrutinized for evidence of plagiarism, duplication and data manipulation; in particular, images will be carefully examined for any indication of intentional improper modification.

Any suspected misconduct ends up with a quick rejection and is then reported to the [US Office of Research Integrity](#).

Ensure that your work is written in correct English before submission. Professional copyediting can help authors improve the presentation of their work and increase its chances of being taken on by a publisher. In case you feel that your manuscript would benefit from a professional a professional English language copyediting checking language grammar and style, you can find a reliable revision service at:



The Corresponding Author must submit the manuscript online-only through our Manuscript Submission System.

Authors are kindly invited to suggest potential reviewers (names, affiliations and email addresses) for their manuscript, if they wish.

Manuscript preparation

Title Page (first and second pages of manuscript file). REQUIRED for all submissions.

The first page must contain:

title (lowercase), without acronyms;

first name and family name of each author, separated by commas;

affiliation(s) of each author (in English);

acknowledgments;

full name and full postal address of the corresponding author. Phone, fax number and e-mail address for the correspondence should also be included;

three to five key words.

The second page should contain:

authors' contributions, e.g., information about the contributions of each person named as having participated in the study (<http://www.icmje.org/#author>);

disclosures about potential conflict of interests;

further information (e.g., funding, conference presentation ...).

Tables and Figures

If *tables* are used, they should be presented each on a separate page at the end of the manuscript after the references. They must be numbered in the order they are cited in the text of the manuscript; each must be cited in the main text.

If *figures* are used, they must be submitted as .tiff or .jpg files, with the following mHealth resolution:

colour (saved as CMYK): minimum 300 dpi;

black and white/grays: minimum 600 dpi;

one column width (8.5 cm) or 2 column widths (17.5 cm).

A different caption for each figure must be provided at the end of the manuscript, not included in the figure file.

Authors must obtain written permission for the reproduction and adaptation of material which has already been published. A copy of the written permission has to be provided before publication (otherwise the paper cannot be published) and appropriately cited in the figure caption. The procedure for requesting the permission is the responsibility of the Authors; *PAGEPress* will not refund any costs incurred in obtaining permission. Alternatively, it is advisable to use materials from other (free) sources.

Other

If *abbreviations* are used in the text, authors are required to write full name+abbreviation in brackets [e.g. Multiple Myeloma (MM)] the first time they are used, then only abbreviations can be written (apart from titles; in this case authors

have to write always the full name).

If *names of equipment or substances* are mentioned in the text, brand, company names and locations (city and state) for equipment and substances should be included in parentheses within the text.

Ethical considerations

JPHIA requires the following two components related to ethical conduct of research:

1. Ethical Considerations section in main text. An Ethical Considerations sub-section is **REQUIRED** in the Methods section for all studies involving human or animal subjects. Authors must include the following:

- 1) name of Institutional Review Board or ethics committee or institution that reviewed the study,
- 2) study approval number (or statement that a waiver was granted),
- 3) manner (oral, written) in which consent was obtained from HCWs, and
- 4) methods used to protect data and confidentiality of HCWs.

For Original articles and Brief Reports that did not require ethical review or approval, authors must provide a justification or statement in the Ethical Considerations section.

2. Clearance documentation. For studies that involve human or animal subjects, authors must upload a copy of the approval letter, certificate or waiver from their IRB or ethics committee as a supplementary file.

Journal Sections

The manuscript file for all article types must contain the following required elements: a title page, abstract, main text, references, acknowledgements, tables and figures, in that order. Manuscript files must be 1.5 or 2.0 spaced.

DO NOT format the text of the abstract, main text and references in multiple columns.

DO NOT submit required elements as separate files.

Formatting

Manuscripts must be formatted according to the instructions below.

Original Articles

Original articles are full reports of results from original research. They provide an

overview of innovative research in a particular field with or related to the focus and scope of the journal.

Abstract: Maximum 250 words. Must be structured using the headings: *Background, Objective, Methods, Results, Conclusion*.

Main text: Maximum 3500 words. Must be structured using the headings below.

First-level headings: *Introduction, Materials and Methods, Results, Discussion, Conclusion*. NOTE: The *Results* and *Discussion* sections must be presented as separate sections; do not submit manuscripts with the Results and Discussion combined into a single section.

Second-level headings:

The *Materials and Methods* section must contain an *Ethical Considerations* section presented as its first sub-section. See Ethical Considerations section above for detailed requirements.

The *Discussion* must include a *Limitations* section presented as its last section

References: Approximately 30.

Tables/Figures: Maximum 5 total.

APPENDIX F: STUDY QUESTIONNAIRE



UNIVERSITY OF THE
WITWATERSRAND
JOHANNESBURG



SURVEY QUESTIONNAIRE

OFFICE USE ONLY	Date of Interview	
	PIN	
	Facility	
	Name of interviewer	

Section A: Demographics of HCWs (please <u>circle/write</u> the correct answer)		
1.	District	a) Bojanala Platinum b) Ngaka Modiri Molema c) Dr. Ruth Segomotsi Mompati d) Dr. Kenneth Kaunda
2.	Name of facility	
3.	Age	
4.	Gender	a) Male b) Female c) Prefer not to specify d) Other (Specify): _____
5.	Designation	a) Doctor b) Nurse c) Other (specify): _____
6.	Nurse category	a) Professional Nurse b) Enrolled Nurse c) Nursing Assistant
7.	Sector Employed	a) Public b) Private
8.	Type of facility	a) Clinic b) Hospital
9.	How many years have you been working in this facility	a) Less than 1 year b) 1-5 years c) More than 5 years
Section B: Knowledge of HCWs about the App (please <u>circle</u> the correct answer)		
10.	I know how to access and download the App	1. Yes 2. No
11.	I know it won't cost me to use the App (the App is reverse billed)	1. Yes 2. No

12.	I know that the App is compatible with most internet browsers	1. Yes 2. No
13.	I know that App sends out notification alerts for category 1 NMCs	1. Yes 2. No
14.	I know that I can edit an existing clinical and laboratory notification within the App	1. Yes 2. No
15.	I know that when a case is captured on NMC App, all relevant people from local facility, sub-district, district and province will immediately get informed about the case	1. Yes 2. No
16.	I know where to get support for the App query	1. Yes 2. No
17.	I know where to access NMC documents on the App	1. Yes 2. No
Section C: HCWs practices towards the use of Reporting App (please <u>circle</u> the correct answer)		
18.	Have you downloaded the App to report Notifiable Medical Conditions?	1. Yes 2. No
19.	Have you ever used the App to report a Notifiable Medical Condition case?	1. Yes 2. No
20.	Do you still use paper-based notification to report NMCs?	1. Yes 2. No
21.	Which electronic devices do you use to report NMCs?	a) Own smart mobile device b) Work mobile device c) Work computer d) Not applicable
22.	How often do you use the App to notify any NMCs?	a) Daily b) Weekly c) Monthly d) Sometimes e) When needed f) Never
23.	When was the last time you used the App since you were registered?	a) Today b) Yesterday c) A week ago d) A month ago e) More than a year f) Never
24.	Do you capture NMC notification straight onto the App after diagnoses?	1. Yes 2. No
25.	Do you first complete the paper-based form and insert it in the patient file to be captured into the App later?	1. Yes 2. No
26.	When paper-based forms are filed who captures them into the App	a) Myself b) Other(specify): _____ c) I don't know
27.	Are the paper-based notifications forms batched or piled first and later captured onto the App?	1. Yes 2. No 3. I don't Know
28.	Do you update the existing laboratory notification with patient clinical details on the App?	1. Yes 2. No 3. Not applicable
29.	When you have patient outcome, do you update the existing notification with those details on the App?	1. Yes 2. No 3. Not applicable

Section D: Attitudes of HCWs towards app use (tick only 1 option per row)						
	Questions	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
30.	I feel comfortable using my own smartphone for reporting Notifiable Medical Conditions?					
31.	I find the app convenient for reporting Notifiable Medical Conditions?					
32.	I think the app is useful for reporting Notifiable Medical Conditions?					
33.	I find the app easy and simple to use?					
34.	I find it easy to navigate through the case notification form on the app?					
35.	I would recommend the app to other HCWs?					

Thank you for your participation!

APPENDIX G: STUDY INFORMATION SHEET



STUDY INFORMATION SHEET

Study title: Healthcare workers' knowledge, attitude, and practices on the use of the electronic application to report Notifiable Medical Conditions - North West province, South Africa, 2023.

Good Day. My name is Keabetswe Kodi. I am a Master of Science student in Field Epidemiology at the University of Witwatersrand. We would like to invite you to take part in a study to assess the knowledge, attitudes, and practices of HCWs use of the NMC Reporting App to report NMC in the North West Province.

Nature and purpose of the study

Disease surveillance represents constant reporting of Notifiable Medical Conditions (NMCs) for the effective control and elimination, however there are often delays between diagnosis and reporting of NMCs. Completeness and timeous reporting of NMCs are essential attributes of an effective disease surveillance system and it is dependent on healthcare workers' compliance. The knowledge, attitudes and practices of healthcare workers in NMC reporting plays a critical role in the efficient performance of a Notifiable Medical Conditions Surveillance System.

Study Procedure

The study involves answering some questions relating to demographics, knowledge about the NMC reporting App, practices towards App use and attitudes towards App utilization to report Notifiable Medical Conditions.

Risks

There are no risks involved in partaking in the study.

Benefits

There are no direct benefits to you, however the information you provide will help us improve the Notifiable Medical Conditions Surveillance System (NMCSS) in South Africa for the prevention, rapid detection and response and improvement of public health interventions.

Participation is voluntary

Your participation in the study is voluntary and you can refuse to participate or stop at any time without having to provide a reason.

Compensation

There is no payment or cost associated with participation in this study.

Confidentiality

The survey will be anonymized. A PIN will be allocated to your responses. All information obtained during this study will be regarded as confidential. Only the researcher will be able to identify you as a participant. The findings of the research will be aggregated when reporting, therefore your personal information will NOT be identifiable.

Information

If you have any questions concerning the study, you should contact

Keabetswe Kodi, Principal Investigator, telephone no. 067 238 8219, or by e-mail at 2606645@students.wits.ac.za

Lehlohonolo Chandu, Supervisor, on telephone no. 011 386 6354, or by e-mail at lehlohonoloc@nicd.ac.za

Dr. Clement Penny, HREC Medical Chair on telephone no. 011 488 3820, or by email at Clement.Penny@wits.ac.za

Mr Rhulani Mkansi, Committee Secretariat, on telephone nos.: 011 717 2700 or by email at Rhulani.Mkansi@wits.ac.za

APPENDIX H: STUDY CONSENT FORM



CONSENT FORM

Study title: Healthcare workers' knowledge, attitude, and practices on the use of the electronic application to report Notifiable Medical Conditions - North West province, South Africa, 2023.

1. I have been given a Participant Information Sheet which explains the nature and processes involved in this study, which is attached hereto;
2. I was given time to read it, or had it read to me, in the language I best understand;
3. I was given time to ask any questions I wanted to and found any answers given to me to be reasonable and satisfactory;
4. I believe I fully understand why the study is being conducted and what the intended outcomes will be;
5. I understand that there will be no immediate benefit to me, should I agree to participate, nor will I receive any payment; conversely, participation will not cost me anything but my time;
6. I understand that, even if I initially consent to take part in the study, I may subsequently withdraw at any time and would not be required to give any reasons; if that happened, any data collected about me for the study would immediately be destroyed, unless I give consent for it to be retained
7. I have been given a range of contact details, If I require further information or become concerned about any aspect of this study, I am free to speak to any of these contacts.

Contact details:

Keabetswe Kodi, Principal Investigator, telephone no. 067 238 8219, or by e-mail at 2606645@students.wits.ac.za

Lehlohonolo Chandu, Supervisor, on telephone no. 011 386 6354, or by e-mail at lehlohonoloc@nicd.ac.za

Dr. Clement Penny, HREC Medical Chair on telephone no. 011 488 3820, or by email at Clement.Penny@wits.ac.za

Mr Rhulani Mkansi, Committee Secretariat, on telephone nos.: 011 717 2700 or by email at Rhulani.Mkansi@wits.ac.za

Participant Name		Date
Participant Signature		
Researcher's Name		Date
Researcher's Signature		
Witness Name		
Witness signature		