



RESEARCH ARTICLE

REVISED Non-communicable diseases in the Western Area District, Sierra Leone, following the Ebola outbreak [version 2; peer review: 2 approved]

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Abstract

Background: Non-communicable diseases (NCDs) are the leading causes of morbidity and mortality in the world. During infectious disease outbreaks, such as the Ebola virus disease outbreak in West Africa from 2014-2015, the health system is often strained, and diagnosis, management and care of NCDs may be compromised. This study assessed numbers and distribution of NCDs in all health facilities in the Western-Area District, Sierra Leone, in the post-Ebola period (June–December 2015) comparing findings with the pre-Ebola (June–December 2013) and Ebola outbreak (June–December 2014) periods.

Methods: This was a cross-sectional study using secondary data from routine records of aggregate monthly NCD reports. Data were analysed using Open EPI and comparisons were made between the post-Ebola and pre-Ebola/Ebola periods using the chi-square test.

Results: There were 10,011 people reported with NCDs during the three six-month periods, with 6194 (62%) presenting at peripheral health units (PHU). Reported NCDs decreased during Ebola and increased post-Ebola, but did not recover to pre-Ebola levels. Hypertension cases remained fairly constant throughout being mainly managed at PHU. Numbers with diabetes mellitus generally stayed the same except for a significant post-Ebola increase in tertiary hospitals. Small numbers were reported with mental health disorders across all facilities in all time periods.

Conclusion: NCD reporting is recovering in the immediate post-Ebola period. Decentralization of NCD care is welcome and is an effective strategy for management as evidenced by hypertension. To be successful, this must be supported by strengthening other elements of the health system such as training of health workers, robust information and referral systems and reliable medicine supply chains.

Open Peer Review

Reviewer Status

	Invited Reviewers	
	1	2
version 2 (revision) 19 Nov 2019	 report	
	↑	
version 1 06 Jun 2019	 report	 report

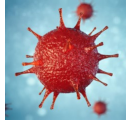
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Any reports and responses or comments on the article can be found at the end of the article.

Keywords

SORT IT, operational research, Sustainable Development Goals, Universal Health Coverage, health systems



This article is included in the **Disease Outbreaks** gateway.



This article is included in the **TDR** gateway.

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Author roles: **Koroma IB:** Conceptualization, Data Curation, Formal Analysis, Investigation, Project Administration, Validation, Visualization, Writing – Original Draft Preparation, Writing – Review & Editing; **Javadi D:** Formal Analysis, Methodology, Resources, Software, Validation, Visualization, Writing – Original Draft Preparation, Writing – Review & Editing; **Hann K:** Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Project Administration, Supervision, Validation, Writing – Review & Editing; **Harries AD:** Conceptualization, Formal Analysis, Funding Acquisition, Methodology, Supervision, Validation, Visualization, Writing – Original Draft Preparation, Writing – Review & Editing; **Smart F:** Methodology, Supervision, Writing – Review & Editing; **Samba T:** Conceptualization, Funding Acquisition, Investigation, Methodology, Project Administration, Resources, Supervision, Writing – Review & Editing

Competing interests: No competing interests were disclosed.

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The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

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REVISED Amendments from Version 1

Based on reviewer comments, we have added clarification on the lack of representation of epilepsy in the data included in the study; implications of results in relation to the treatment gap for mental health; and the need for further research.

Any further responses from the reviewers can be found at the end of the article

Introduction

Non-communicable diseases (NCDs) are the leading causes of morbidity and account for 70% of worldwide deaths, with the major burden felt in low- and middle-income countries (LMICs)¹. The problem is highlighted in the UN Sustainable Development Goals (SDGs), with SDG target 3.4 aiming to reduce premature mortality from NCDs by one-third between 2015 and 2030². Progress is slow with poor health system responsiveness and weak monitoring capacity being important obstacles³.

In 2014–2015, Sierra Leone was hit by a devastating Ebola virus disease outbreak that highlighted the need for resilient health systems^{4,5}. At that time, diagnosis, care and management of NCDs were in the process of decentralization from hospital to primary healthcare settings. In 2017, we reported on the burden and distributions of selected NCDs in a sample of health facilities in the Western-Area District, Sierra Leone, before and during the Ebola outbreak⁶. There was a marked decline in reported NCD numbers in the Ebola compared with the pre-Ebola periods, and this was especially observed for hypertension (HTN) and diabetes mellitus (DM) and in secondary and tertiary hospitals compared with peripheral health units (PHUs). Several recommendations were made that included strengthening the diagnosis, management and monitoring of NCDs in all district health facilities.

We now have comprehensive reports from all the district facilities for six-month periods before Ebola (June–December 2013), during Ebola (June–December 2014) and post-Ebola (June–December 2015) and have taken the opportunity to assess what has happened to NCDs during this time. The study objectives were to assess reported NCD numbers, the distribution of NCDs and their stratification by health facility level in the Western-Area District in the post-Ebola period and compare findings with Ebola and pre-Ebola periods outlined above.

Methods

Data source

This was a cross-sectional study using secondary data from routine records. The setting and district monitoring system have been previously described⁶. In the current study, however, all public health facilities in the Western-Area District, Sierra Leone, were included: 110 PHUs, 9 secondary and 4 tertiary hospitals. The study population included all people reported with cardiovascular disease (CVD), HTN, DM, mental health disorder (MHD) and tumours/cancer in June–December 2013, June–December 2014 and June–December 2015. Data sources were the aggregate monthly NCD reports available at the

Directorate of Policy, Planning and Information, Ministry of Health and Sanitation. The NCD reporting form captures the following morbidities: cardiovascular diseases, diabetes mellitus, hypertension, mental health disorder, and tumour/cancer. Epilepsy is reported through a different process, and is not included in the NCD reporting form.

Data analysis

Data were analysed using **Open EPI** version 3.03 (updated 2014/09/22), with comparisons made between the post-Ebola and pre-Ebola/Ebola periods using the chi square test. $P < 0.05$ was considered to indicate a significant difference.

Ethical approval

Ethics approval was obtained from the Sierra Leone Ethics and Scientific Committee (dated 14 December 2018) and the Ethics Advisory Group, International Union Against Tuberculosis and Lung Disease, Paris, France (EAG number 63/18). As aggregate data were used with no identifiers, the need for informed consent was waived by the ethics committees.

Results

Altogether there were 10,011 people reported with NCDs during the three six-month periods, of whom 6194 (62%) were at PHU, 720 (7%) at secondary and 3097 (31%) at tertiary hospitals. Numbers with the five selected NCDs in the three different time periods are shown in **Table 1**. Key findings were: i) a decrease followed by an increase in NCDs in Ebola and post-Ebola periods with numbers not reaching pre-Ebola levels and this distribution was mirrored for HTN; ii) a large increase in DM in the post-Ebola period; iii) a decrease in CVD and tumours/cancer in the Ebola outbreak which continued to decline or stay unchanged in the post-Ebola period; and iv) small numbers of MHD in all three periods. These changes between the different periods were similar for males and females.

NCD distributions in the three health facility levels are shown in **Table 2**. Key findings were: i) 72% of reported HTN and 94% of reported MHD cases were at PHU, while 83% of reported CVD, 64% of reported DM and 94% of reported

Table 1. Numbers of people with non-communicable diseases in the Pre-Ebola, Ebola and Post-Ebola periods in the Western Area District, Sierra Leone: 2013 – 2015. Pre-Ebola: June to December 2013; Ebola: June to December 2014; Post-Ebola: June to December 2015.

Non-communicable disease	Individuals with non-communicable disease		
	Pre-Ebola, n	Ebola, n	Post-Ebola, n
Cardiovascular Disease	355	300	196
Diabetes Mellitus	282	230	457
Hypertension	3716	1851	2463
Mental Health Disorder	18	7	9
Tumour/Cancer	53	37	37
Total	4424	2425	3162

Table 2. People with non-communicable diseases by level of health facility in the Pre-Ebola, Ebola, and Post-Ebola periods, Western Area District, Sierra Leone: 2013–2015. Pre-Ebola: June to December 2013; Ebola: June to December 2014; Post-Ebola: June to December 2015.

Non-communicable disease	Individuals with non-communicable disease			
	Pre-Ebola, n (%)	Ebola, n (%)	Post-Ebola, n (%)	Total, N
Peripheral Health Units				
Total	2819	1561	1814	6194
Cardiovascular disease	88 (3)**	21 (1)	21 (1)	130
Diabetes mellitus	85 (3)	87 (6)*	69 (4)	241
Hypertension	2626 (93)	1446 (93)	1714 (94)	5786
Mental health disorder	17 (1)	7 (<1)	8 (1)	32
Tumour/cancer	3 (<1)	0 (<1)	2 (<1)	5
Secondary Hospitals				
Total	409	104	207	720
Cardiovascular disease	4 (1)*	6 (6)	8 (4)	18
Diabetes mellitus	46 (11)*	20 (19)	41 (20)	107
Hypertension	358 (88)**	78 (75)	157 (76)	593
Mental health disorder	0 (0)	0 (0)	0 (0)	0
Tumour/cancer	1 (<1)	0 (0)	1 (<1)	2
Tertiary Care Hospitals				
Total	1196	760	1141	3097
Cardiovascular disease	263 (22)**	273 (36)**	167 (15)	703
Diabetes mellitus	151 (13)**	123 (16)**	347 (30)	621
Hypertension	732 (61)**	327 (43)**	592 (52)	1651
Mental health disorder	1 (<1)	0 (0)	1 (<1)	2
Tumour/cancer	49 (4)	37 (5)*	34 (3)	120

The chi-square test was used to compare results of categorical variables in the post-Ebola period with the pre-Ebola and Ebola periods: * $P < 0.05$; ** $P < 0.001$

tumour/cancer cases were at tertiary hospitals; ii) the proportion of reported HTN cases was maintained over the three six-month periods at PHU in contrast to the hospital settings; iii) numbers with DM generally stayed the same except for a significant post-Ebola increase in tertiary hospitals; iv) those with CVD decreased significantly in the post-Ebola period in PHU and tertiary hospitals.

Discussion

The three most common NCDs during the study period were HTN, DM and CVD, with DM assuming greater importance in the post-Ebola period. Reasons are unclear, although DM has been predicted to increase dramatically in the next 10–20 years throughout sub-Saharan Africa⁷. In all three six-month periods it was encouraging to see that HTN was predominately managed at the PHU as opposed to hospitals, suggesting that the process of decentralisation in this area is well underway. The management of DM could benefit from the same approach. The small number

of individuals reported with MHD is of concern, especially given the high prevalence of anxiety, depression and post-traumatic stress disorder following the Ebola outbreak⁸. This finding may reflect underreporting and a persisting treatment gap for MHD^{9,10}.

The strengths of the study are the inclusion of all public health facilities, making this study representative of the district. Limitations include use of routine aggregate data (the accuracy of which could not be verified), the lack of data from the private sector and missing hospital data for 2016 and 2017, which prevented further assessment of the post-Ebola recovery period.

There are important policy recommendations from this study. It is clear that the majority of NCDs in the district are managed at the PHU; this move for decentralisation is in line with Sierra Leone's 2017–2021 National Health Sector Strategic

Plan¹¹. To ensure quality of care, however, the availability of medicines, diagnostic tools, a trained workforce, use of standardised NCD protocols and robust information systems must also be decentralised¹². Health facility reporting forms and processes must also be reassessed to improve consistency of case definitions and ensure complete and accurate records, without which resource management to strengthen NCD care is not possible.

In conclusion, this study shows that NCD reporting is recovering in the immediate post-Ebola period; however, the impact of reporting on service delivery and management requires further research. Decentralisation could be an effective and resilient strategy for management as evidenced by HTN. This encouraging momentum must be accompanied by health system strengthening—particularly for information systems—which will help move the country to universal health coverage and achievement of SDG3.4.

Data availability

Open Science Framework: Kamara_IbrahimK_SORTIT2_NCD_data 2019. <https://doi.org/10.17605/OSF.IO/5Q3AX>¹³.

This project contains the number of cases of each disease for each time period, alongside a data dictionary.

The Sierra Leone Health Management Information Systems, the District Health Information System 2 (DHIS2), is accessible

with a Ministry of Health and Sanitation login through <https://sl.dhis2.org/>. The Directorate of Policy, Planning, and Information (DPPI) can be contacted through Dr. Francis Smart (drfsmart@gmail.com), Director, DPPI, MOHS, with an information request detailing the specific data request and purpose of use. Applicants will be asked to provide details of the reason for the request and details pertaining data request (such as data points, disaggregation, time period). In this case, data access would be granted to persons who request data for research purposes if they can provide appropriate ethical approval documentation.

Acknowledgements

This research was conducted through the Structured Operational Research and Training Initiative (SORT IT), a global partnership coordinated by the Special Programme for Research and Training in Tropical Diseases at the World Health Organization (WHO/TDR) and implemented with partners. The training model is based on a course developed jointly by the International Union Against Tuberculosis and Lung Disease (The Union) and Médecins sans Frontières (MSF). The specific SORT IT programme which resulted in this publication was jointly developed and implemented by: WHO/TDR, the Sierra Leone Ministry of Health, WHO Sierra Leone, the Centre for Operational Research, The Union, Paris, France; the Alliance for Public Health, Ukraine; the Institute of Tropical Medicine, Antwerp, Belgium; and Sustainable Health Systems, Freetown, Sierra Leone.

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Version 2

Reviewer Report 21 November 2019

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Jeffery Edwards

Department of Global Health, School of Public Health, University of Washington, WA, USA

I approve of the revised version.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Public health, NCDs, Ebola, HIV/TB, infectious diseases

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Version 1

Reviewer Report 22 July 2019

<https://doi.org/10.5256/f1000research.20320.r49599>

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Priyakanta Nayak

Field Epidemiology Training Program (FETP), Centers for Disease Control and Prevention, Dhaka, Bangladesh

This is a good study, a kind of situational analysis of NCD in Sierra Leone during Ebola episodes. The methodology is good and the investigator has done a good job in evaluating the NCD reports across the PHUs.

The only concerned thing here is the conclusion. This is very generalized and did not necessarily explain

about the artifacts. Its obvious that it would be increased awareness and increased surveillance/screening activities as a result of the endemic but the same can not be generalized to the overall scenario. I recommend more clarity in the conclusion.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Infectious Disease Epidemiology, Emergency Outbreak Preparedness & Response, Tuberculosis, HIV, Malaria, Neglected Tropical Disease (Leishmaniasis and Lymphatic Filariasis), NCD, Workforce and Institutional Development, Operational Research

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Author Response 26 Oct 2019

Katrina Hann, Sustainable Health Systems, Freetown, Sierra Leone

Zena Nyakoojo
Senior Managing Editor
F1000 Research Ltd.
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34-42 Cleveland Street
London W1T 4LB
UK

Dear Zena Nyakoojo,

RE: Non-communicable diseases in the Western Area District, Sierra Leone, following the Ebola outbreak [version 1; peer review: 2 approved]

We have carefully read through the peer review and have revised our manuscript accordingly. We

see the manuscript as improved as a result of this peer review process, and thank you for your support in taking the process to this stage.

Please find for your consideration the following:

1. A point-by-point response to the comments and suggestions of the reviewers
2. A new revised version of the manuscript, in tracked changes
3. A new, revised version of the manuscript, no tracked changes.

We hope that these modifications meet with your favourable review. Please do not hesitate to request any further changes.

Kind regards,

Ibrahim Baimba Koroma
Directorate of Policy, Planning and Information (DPPI)
Ministry of Health and Sanitation (MoHS)
Freetown
Sierra Leone

Point-by-point response to the reviewer suggestions

Author Response to Reviewer Report for Version 1 from Priyankanta Nayak 22 Jul 2019

Thank you for your thoughtful review of the manuscript and your suggestions. We have responded as below.

1. Reviewer comment:This is a good study, a kind of situational analysis of NCD in Sierra Leone during Ebola episodes. The methodology is good and the investigator has done a good job in evaluating the NCD reports across the PHUs.

Response:

Thank you very much.

2. Reviewer comment:The only concerned thing here is the conclusion. This is very generalized and did not necessarily explain about the artifacts. Its obvious that it would be increased awareness and increased surveillance/screening activities as a result of the endemic but the same can not be generalized to the overall scenario. I recommend more clarity in the conclusion.

Response:

Thank you for this thoughtful reflection. The conclusion only gave a snap shot of the latest developments of NCD reporting during the post-Ebola period and suggested strategies for the health sector to strengthen NCD reporting.

Competing Interests: No competing interests were disclosed.

Reviewer Report 19 July 2019

<https://doi.org/10.5256/f1000research.20320.r49596>

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Jeffery Edwards

Department of Global Health, School of Public Health, University of Washington, WA, USA

I appreciate the opportunity to review this well written and timely manuscript submitted by Koroma et al. It is certainly telling of the impact of the Ebola outbreak and the effects on the health system within Sierra Leone. Although it only uses aggregate data, the analysis is straight forward and highlights the struggles of providing/reporting on healthcare within a developing country.

I believe this manuscript is very much worth of indexing and will add significantly to the growing knowledge base surrounding healthcare system management in developing countries. I would suggest one minor correction and an area which could be further discussed, where there is a gap in services being at least reported, if not provided.

First, the last sentence in the 3rd paragraph is incomplete and needs to be corrected.

Secondly, it is extremely interesting the lack of reporting of mental health visits - across all three levels of care. Additionally, I am curious, as with other African countries, do mental health visits include epilepsy as well? If so, this is an interesting perspective that should be mentioned.

The authors mention that "the small number of individuals reported with MHD is of concern...especially... post Ebola..." I think this could be another key finding, especially if it includes those with epilepsy. The prevalence of MHD and epilepsy in developing countries is unknown and regardless of the Ebola outbreak, the tremendous gap in reporting found in this study suggests that they are under-recognized and under-treated. The authors might want to point this out and provide some recommendations for Sierra Leone and other countries with similar contexts.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

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Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

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Author Response 26 Oct 2019

Katrina Hann, Sustainable Health Systems, Freetown, Sierra Leone

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Senior Managing Editor
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Response:

Thank you very much.

2. Reviewer comment:I would suggest one minor correction and an area which could be further discussed, where there is a gap in services being at least reported, if not provided. First, the last sentence in the 3rd paragraph is incomplete and needs to be corrected.

Response:

Thank you for this direction. We have amended the sentence based on this feedback.

3. Reviewer comment:Secondly, it is extremely interesting the lack of reporting of mental health visits - across all three levels of care. Additionally, I am curious, as with other African countries, do mental health visits include epilepsy as well? If so, this is an interesting perspective that should be mentioned.

Response:

In Sierra Leone, epilepsy is considered as a neurological condition, but it is documented using a separate data capture form and reported into a different programme. Therefore, our study does not capture epilepsy results, and thus, we are limited in our ability to make conclusions on epilepsy specifically.

We have made a clarification on this point in the description of the NCD reporting form in the methods section.

4. Reviewer comment:The authors mention that "the small number of individuals reported with MHD is of concern...especially... post Ebola..." I think this could be another key finding, especially if it includes those with epilepsy. The prevalence of MHD and epilepsy in developing countries is unknown and regardless of the Ebola outbreak, the tremendous gap in reporting found in this study suggests that they are under-recognized and under-treated. The authors might want to point this out and provide some recommendations for Sierra Leone and other countries with similar contexts.

Response:

Thank you for this insight. We have added an additional point on underreporting and the treatment gap in the discussion.

Competing Interests: No competing interests were disclosed.

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