Institution: Liverpool School of Tropical Medicine (LSTM)

Unit of Assessment: UOA2

Title of case study: Improving Lives and Societies by the Targeted Treatment of Lymphatic Filariasis Morbidity in Africa and Asia

Period when the underpinning research was undertaken: 2014 – 2020

Details of staff conducting the underpinning research from the submitting unit:

Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Louise Kelly-Hope	Senior Lecturer, Operational Research	2006 –
Hannah Betts	Data Manager	2014 –
Sarah Martindale	Programme Manager for Ethiopia, Malawi, Liberia, Democratic of Congo	2014 –
Michelle Stanton	Research Assistant Spatial Epidemiologist	2014 – 2016
Hayley Mableson	Programme Manager for Bangladesh, Nepal, Tanzania	2014 – 2019
Thais Caprioli	Research Assistant, Qualitative Research	2018 –
Sian Freer	Chief Operating Officer, CNTD	2006 –
Charles Mackenzie	CNTD Deputy Director	2014 – 2015
Mark Taylor	Professor of Parasitology, CNTD Director (from 2016)	1993 –

Period when the claimed impact occurred: 2014 – 2020

Is this case study continued from a case study submitted in 2014? Y/**N** **NO**

1. Summary of the impact (indicative maximum 100 words)

Lymphatic filariasis (LF) is a mosquito-borne parasitic infection that is endemic in 73 countries globally. In 2000, it was estimated that approximately 1,400,000,000 people were at risk with over 120,000,000 infected and 40,000,000 disfigured and incapacitated by disease. Morbidity management and disability prevention is a central component of the World Health Organization (WHO) objectives for LF elimination, and research at the Centre for Neglected Tropical Diseases (CNTD) has developed innovative tools to estimate patient numbers, assess access to quality health services, and quantify the impact of care on the quality of life. This has resulted in more efficient identification of patients in need of life-changing care and surgery by LF programmes in 7 countries, and the implementation of evidence-based strategies that are helping endemic countries meet the WHO key criteria for LF elimination.

2. Underpinning research (indicative maximum 500 words)

Lymphatic filariasis (LF) is a mosquito-borne parasitic infection of public health importance. LF infection can impair the function of lymphatic vessels and associated tissues, and lead to chronic disabling and disfiguring conditions including hydrocoele (scrotal swelling; affecting approximately 15,000,000 men), and lymphoedema of limbs (skin/tissue thickening; affecting approximately 25,000,000 people). These are most often accompanied by secondary bacterial infections causing acute inflammation or acute dermatolymphangioadenitis (ADLA). These conditions have a significant impact on patients' physical, social, mental and economic wellbeing and the family members who care for them.

LF is a major cause of disability and responsible for 5,250,000 Disability Adjusted Life Years (DALYs) worldwide each year. The WHO's Global Programme to Eliminate LF (GPELF) was launched in 2000 to address this significant burden, with one of its aims being to alleviate suffering through morbidity management and disability prevention (MMDP). In 2015, the WHO advocated that national LF elimination programmes implement a minimum package of care; however, very few countries had information on the clinical burden, health services capacity or methods to assess impact.

To address this critical need, between 2013 and 2020, LSTM's Centre for Neglected Tropical Diseases (CNTD) developed and implemented a research programme to address the MMDP priorities. This was led by Dr Louise Kelly-Hope, working in collaboration with national programmes and research partners in 7 endemic countries, and included the development, piloting, implementation and evaluation of an innovative mHealth reporting tool, field-based decision-making framework, hotspot mapping and assessment surveys. The aims were to enable national programmes to better determine i) patient number estimates, ii) access and quality of health services, and iii) impact on quality of life.

i) Patient number estimates

An Innovative SMS mHealth tool was developed (in 2013/2014), piloted and used for patient reporting by community health workers (CHWs) across 7 endemic countries to send data on local LF cases digitally via phone SMS to the national programme at central level. Quality of SMS data were assessed via an online server and case identification data verified by medical experts [1,2].

Field scenarios and a decision-making framework were developed between 2014 and 2016 from the extensive field-experience in scaling-up the mHealth tool across diverse demographic and endemic settings, and taking into account feasibility, endemicity, population demography, health system structure and integration with other diseases [3].

Morbidity high-risk 'hotspot' maps were developed from the clinical data collected by CHWs, including those reported via the SMS mHealth tool. Spatial analytical methods were used to identify and map high prevalence 'hotspot' areas at district and national levels in 5 countries [2,4]. This work was conducted between 2016 and 2019.

ii) Access and quality of health services

'Accessibility to surgery' maps were developed in 2014/2015 to identify spatial inequalities in access to essential surgical care for men with hydrocoele in Malawi. Spatial analytical methods were used to identify and map hard-to-reach areas that may hinder access [5].

A hospital facility assessment tool (the Hydrocoele Surgery Facility Assessment Tool (HSFAT) was developed to assess the quality and readiness of hospital services available for hydrocoele surgery across 10 aspects. A scoring method was used to quantify the hospital status. Piloting of this tool began in 2018 in 44 hospitals in 3 countries.

iii) Impact on quality of life

Quality of life surveys were developed between 2016 and 2019 to quantify changes in both patients' and caregivers' lives across 6 key domains, including economic productivity. A scoring method was used to quantify impact before and after the patient receives an intervention, such as surgery for hydrocoele or training/wash kits for lymphoedema, in 4 countries [5,6].

3. References to the research (indicative maximum of six references)

Innovative SMS mHealth tool

1. **Stanton MC**, Mkwanda SZ, Debrah AY, Batsa L, Biritwum NK, Hoerauf A, Cliffe M, Best A, Molineux A, **Kelly-Hope LA.** Developing a community-led SMS reporting tool for the rapid assessment of lymphatic filariasis morbidity burden: case studies from Malawi and Ghana. BMC Infect Dis. 2015. DOI: 10.1186/s12879-015-0946-4
2. Mwingira U, Chikawe M, Mandara WL, Mableson HE, Uisso C, Mremi I, Malishee A, Malecela M, Mackenzie CD, **Kelly-Hope LA**, **Stanton MC**. Lymphatic Filariasis Patient Identification in a Large Urban Area of Tanzania: An Application of a Community-led Mhealth System. PloS Negl Trop Dis. 2017. DOI: 10.1371/journal.pntd.0005748

Field scenarios/decision-making framework

3. **Mableson HE, Martindale S, Stanton MC,** Mackenzie C**, Kelly-Hope LA**. Community-based Field Implementation Scenarios of an SMS Reporting Tool for Lymphatic Filariasis Case Estimates in Africa and Asia. Mhealth. 2017. DOI: 10.21037/mhealth.2017.06.06

Morbidity high-risk 'hotspot' maps

4. Karim MJ, Haq R, **Mableson HE**, Sultan Mahmood ASM, Rahman M, Chowdhury SM, Rahman AKMF, Hafiz I, **Betts H, Mackenzie C, Taylor MJ, Kelly-Hope LA**. Developing the first national database and map of lymphatic filariasis clinical cases in Bangladesh: Another step closer to the elimination goals. PLoS Negl Trop Dis. 2019. DOI: 10.1371/journal.pntd.0007542

Access and quality of health services

5. **Stanton MC**, Smith EL, **Martindale S**, Mkwanda SZ, **Kelly-Hope LA**. Exploring hydrocoele surgery accessibility and impact in a lymphatic filariasis endemic area of southern Malawi. Trans R Soc Trop Med Hyg. 2015. DOI: 10.1093/trstmh/trv009

Quality of life survey

6. **Betts H, Martindale S**, Chiphwanya J, Mkwanda S, Matipula D, Ndhlovu P, Mackenzie C, **Taylor M, Kelly-Hope LA**. Significant improvement in quality of life following surgery for hydrocoele caused by lymphatic filariasis in Malawi: a prospective cohort study. PloS Negl Trop Dis. 2020. DOI: 10.1371/journal.pntd.0008314

4. Details of the impact (indicative maximum 750 words)

WHO launched the GPELF in 2000. The strategy had two components but, prior to 2015, the focus had been almost entirely on interrupting transmission via mass drug administration and there was no strategy to address the second component: to alleviate suffering of affected populations. LSTM's CNTD developed the tools to improve the collation of data on LF morbidity which has led to improved health and economic well-being for LF patients and their caregivers, efficiencies in the planning and implementation of MMDP by programme managers and district CHWs, and evidence-based strategies that have strengthened WHOs work to eliminate LF as a public health problem.

In addition to developing many of the tools now routinely used in MMDP programmes in LF endemic countries, CNTD conducted extensive implementation research. Our iterative process involves studying factors affecting implementation, quantifying and describing the impact of the implementation on patients and health systems, and evaluating the sustainability of activities. Hence, many of the sources to support impact come from our own ongoing evaluations.

Impact on patients and caregivers

Patient Estimates and Access to Quality Health Services: The decision-making frameworks our research developed led to greater number of patients being identified. These patients benefitted from being identified by local health workers and being trained in home-based self-care lymphoedema strategies and/or referred to local hospital for hydrocoele surgery. Through our programme, 36,000 health workers in 7 countries were trained in patient searching and lymphoedema care, and 11,343 hydrocoele surgeries, improving the quality of life of men, were performed between October 2015 and March 2019; the lymphoedema and hydrocoele programme is now being expanded to additional African countries via the ASCEND programme [1].

Impact on quality of life: Quality of life surveys conducted across 4 countries found significant positive changes in patients and their caregiver's lives after the patient received an intervention. Lymphoedema patients with moderate to severe conditions in Bangladesh and Ethiopia showed improvement in quality of life following the new enhanced care protocol introduced in 2018, resulting in reduction of disability [2]. Of the 330 patients surveyed after receiving hydrocoele surgery in Bangladesh, Malawi and Nepal between 2013 and 2019, all reported significantly improved quality of life across many aspects including mobility, self-care, psychological health, social participation, and economic productivity. In Malawi, all pre-surgery moderate-severe problems resolved post-surgery [survey of 137 men's lives following surgery in Malawi between 2015 and 2016] [3]. The average annual economic burden per chronic case of LF has been estimated as USD115, the majority of which resulted from productivity costs [4]. Our own research in Malawi has shown that surgery increased the average man's future earning capacity by approximately 24.50 times the cost of surgery [5]. Considering the 11,343 surgeries

performed across 7 countries between October 2015 and March 2019, this has had significant impact on alleviating poverty. This is illustrated by feedback from patients and caregivers such as the following from: *Before the operation I was feeling very weak but now I am able to work and farm. I am healthy again (Patient, Malawi 59 years) [3]; 'I am happy because now my father is able to work and our livelihood has changed (Daughter, Malawi, 32years)*

Caregivers of hydrocoele patients in Malawi also show improvements in their lives following men's surgery with economic productivity increased significantly. Pre-surgery, caregivers were unable to work or attend school for approximately 8.2 days per month, which reduced to 0 days post-surgery [6]. Similar negative socio-economic impacts on caregivers of lymphoedema patients have also been found in Ethiopia before interventions were implemented [7].

Impact on LF programme managers and district and community health workers

Patient estimates: The innovative SMS mHealth tool facilitated the real-time collection of clinical LF data from Malawi, Guinea, Nepal, Bangladesh, Ethiopia, Tanzania and Liberia [8]. Between October 2014 and September 2018, CHWs searched their communities to identify and report over 17,000 lymphoedema cases and 8,000 hydrocoele cases across the 7 endemic countries, using the SMS mHealth tool [8,9]. The SMS mHealth tool provided health workers with a user-friendly tool which was used to report around one third of the cases, supplementing the traditional paper-based data collection methods. This helped to ensure that local-level data reached the LF programme team at the Central level, who also benefitted from having readily collated case estimates to examine and consider the burden on endemic communities and health systems to optimise resource allocation and arrange refresher training where needed.

> *CHW quotes re SMS mHealth tool: "It is fast information, and it is easy to get good data in our catchment area." (Male, Malawi, aged between 26 and 35)*
> *"I am happy that the burden of my community is now known" (Female, Ghana aged between 46 and 55) [9]*

Quality of health facilities: The hotspot maps were used to generate risk maps, identify residual transmission, and target resources appropriately in Nepal, Bangladesh, Ethiopia and Malawi. In 2020, predictive models developed from the Malawi risk maps increased the efficiency and cost-effectiveness of patient searching and reporting in unmapped areas, which helped the national LF programme save approximately 33% of mapping costs, and increase their knowledge of the clinical epidemiology, which facilitated gender- and condition-specific care.

> *''The collaborative work between Ministry of Health, Malawi and LSTM on morbidity mapping has helped the Lymphatic Filariasis Elimination Program understand the clinical epidemiology and distribution of cases. This has helped to save time and resource by targeting essential services to where they are needed most'' John Chiphwanya, Program Manager*

The Hydrocoele Surgery Facility Assessment Tool (HSFAT) helped to ensure quality and readiness of services, and was piloted in Malawi, Bangladesh and Nepal. The tool is now used as a standard assessment tool in a large MMDP programme across 13 West and Central African countries [1]. The 'accessibility to surgery' maps and HSFAT also helped the LF programme identify gaps in their health services leading to improvements to ensure quality of care to patients.

Impact on the Global Elimination of Filariasis

By developing and implementing a framework for morbidity management and disability prevention, we have supported 7 countries to meet two of the key milestones used by WHO to confirm elimination of LF as a public health problem (defining the burden of disease and implementation of a minimum package of care); this was key to the declaration that Malawi was free from LF in 2020 [10].

5. Sources to corroborate the impact (indicative maximum of 10 references)

Impact on patients and caregivers

1. Ascend: Accelerating the Sustainable Control and Elimination of Neglected Tropical diseases in West and central Africa; https://www.sightsavers.org/programmes/ascend/ and **Supporting Letter**
2. Bangladesh study: Douglass J, Mableson H, Martindale S, Jhara ST, Karim MJ, Rahman MM, Kawsar AA, Khair A, Mahmood AS, Rahman AF, Chowdhury SM, Kim S, Betts H, Taylor M, Kelly-Hope L. Effect of an Enhanced Self-Care Protocol on Lymphedema Status among People Affected by Moderate to Severe Lower-Limb Lymphedema in Bangladesh, a Cluster Randomized Controlled Trial. J Clin Med. 2020 DOI: 10.3390/jcm9082444. Ethiopia study: Douglass J, Hailekiros F, Martindale S, Mableson H, Seife F, Bishaw T, Nigussie M, Meribo K, Tamiru M, Agidew G, Kim S, Betts H, Taylor M, Kelly-Hope L. Addition of Lymphatic Stimulating Self-Care Practices Reduces Acute Attacks among People Affected by Moderate and Severe Lower-Limb Lymphedema in Ethiopia, a Cluster Randomized Controlled Trial. J Clin Med. 2020. DOI: 10.3390/jcm9124077
3. Betts H, Martindale S, Chiphwanya J, Mkwanda S, Matipula D, Ndhlovu P, Mackenzie C, Taylor M, Kelly-Hope LA. Significant improvement in quality of life following surgery for hydrocoele caused by lymphatic filariasis in Malawi: a prospective cohort study. PloS Negl Trop Dis. 2020. DOI: 10.1371/journal.pntd.0008314
4. Mathew CG, Bettis AA, Chu BK, English M, Ottesen EA, Bradley MH, Turner HC. The Health and Economic Burdens of Lymphatic Filariasis Prior to Mass Drug Administration Programs. Clin Infect Dis. 2020. DOI: 10.1093/cid/ciz671
5. Sawers L, Stillwaggon E, Chiphwanya J, Mkwanda SZ, Betts H, Martindale S, Kelly-Hope LA. Economic benefits and costs of surgery for filarial hydrocele in Malawi. PLoS Negl Trop Dis. 2020. DOI: 10.1371/journal.pntd.0008003
6. Martindale S, Chiphwanya J, Matipula D, Ndhlovu P, Taylor M, Betts H, Kelly-Hope L. Hydrocoele surgery for lymphatic filariasis: measuring the impact on patient caregivers in Malawi. 2017. 66th American Society of Tropical Medicine Hygiene Annual Meeting, Baltimore, USA https://www.astmh.org/ASTMH/media/2017-Annual-Meeting/ASTMH-2017-Abstract-Book.pdf (#629 on page 196)
7. Caprioli T, Martindale S, Mengiste A, Assefa D, H/Kiros F, Tamiru M, Negussu N, Taylor M, Betts H, Kelly-Hope LA. Quantifying the socio-economic impact of leg lymphoedema on patient caregivers in a lymphatic filariasis and podoconiosis co-endemic district of Ethiopia. PLoS Negl Trop Dis. 2020. DOI: 10.1371/journal.pntd.0008058

Impact on patients and caregivers

8. Meeting reports providing experience of Tanzania and Nepal in implementing MMDP.Tanzania: 2019. Report_2F Digital Tools for Morbidity Management and Disability Prevention https://www.ntdsupport.org/sites/default/files/uploads/docs/resources/2F_Digital%20Tools%20for%20Morbidity%20Management%20and%20Disability%20Prevention.pdf; Nepal: 2018 Report_3A Integrating LF MMDP Activities into National Public Health Systems: Experiences Towards Universal Health Coverage https://www.ntdsupport.org/sites/default/files/uploads/docs/resources/Report_3A_Integrating%20LF%20MMDP%20Activities%20into%20National%20Public%20Health%20Systems.pdf
9. Stanton MC, Mkwanda SZ, Debrah AY, Batsa L, Biritwum NK, Hoerauf A, Cliffe M, Best A, Molineux A, Kelly-Hope LA. Developing a community-led SMS reporting tool for the rapid assessment of lymphatic filariasis morbidity burden: case studies from Malawi and Ghana. BMC Infect Dis. 2015. DOI: 10.1186/s12879-015-0946-4

Impact on the Global Elimination of Filariasis

10. Global programme to eliminate lymphatic filariasis: progress report, 2019. https://www.who.int/publications/i/item/who-wer9543