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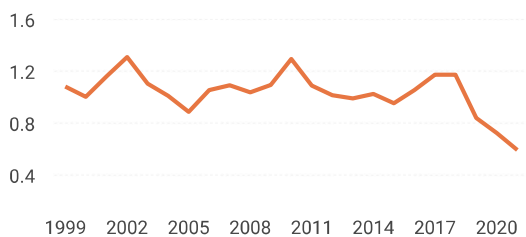
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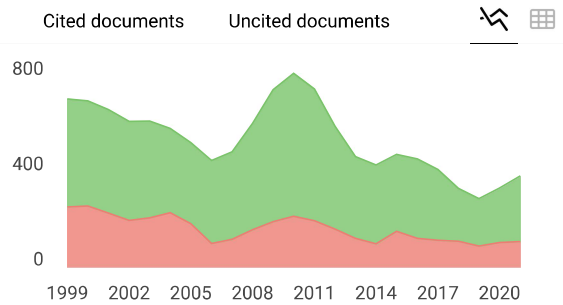
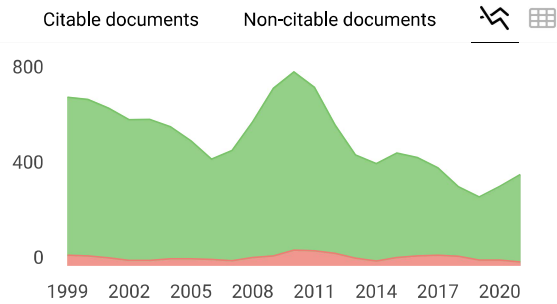
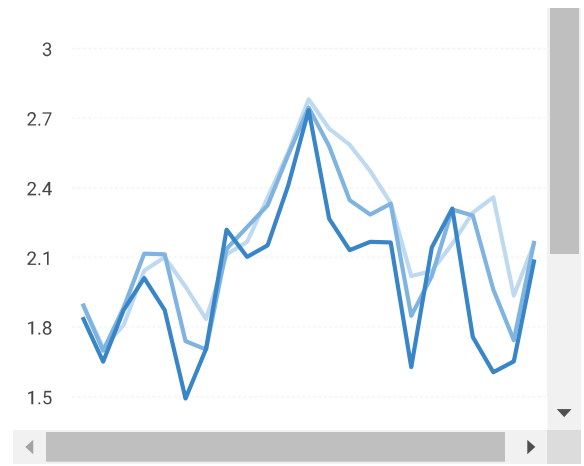
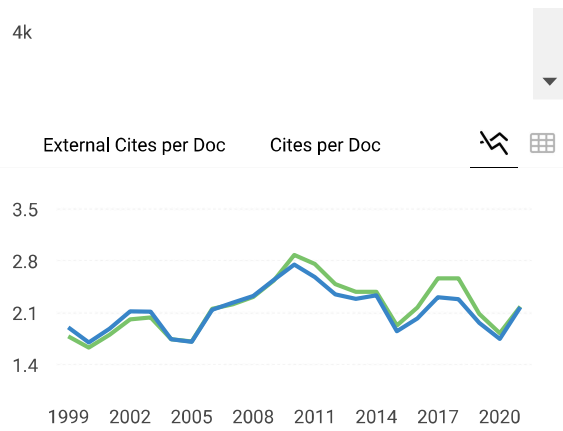
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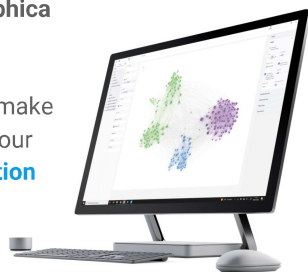
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An assessment of the reported impact of the COVID-19 pandemic on leprosy services using an online survey of practitioners in leprosy referral centres

Barbara de Barros ^{a,*}, Saba M. Lambert ^{a,b}, Edessa Negera ^a, Guillermo Robert de Arquer^c, Anna M. Sales^d, Joydeepa Darlong ^e, Vivianne L. A. Dias^d, Benjamin Jewel Rozario^f, Vivek V. Pai ^g, Medhi Denisa Alinda ^h, M. Yulianto Listiawan ^h, Deanna A. Hagge ⁱ, Mahesh Shah ⁱ, Diana N. J. Lockwood ^a, Stephen L. Walker ^a, on behalf of the Erythema Nodosum Leprosum International Study Group

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Background: The coronavirus disease 2019 (COVID-19) pandemic has led to governments implementing a variety of public health measures to control transmission and has affected health services. Leprosy is a communicable neglected tropical disease caused by *Mycobacterium leprae* and is an important health problem in low- and middle-income countries. The natural history of leprosy means that affected individuals need long-term follow-up. The measures recommended to reduce transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) can create barriers to health services. We evaluated the impact of the COVID-19 epidemic response on leprosy services and disease management.

Methods: We conducted a cross-sectional online survey with healthcare professionals in leprosy referral centres.

Results: Eighty percent of leprosy diagnostic services were reduced. All respondents reported that multidrug therapy (MDT) was available but two reported a reduced stock. Clinicians used alternative strategies such as telephone consultations to maintain contact with patients. However, patients were not able to travel to the referral centres.

Discussion: This study highlights the effects of the initial phase of the SARS-CoV-2 pandemic on leprosy services in a range of leprosy-endemic countries. Many services remained open, providing leprosy diagnosis, MDT and leprosy reaction medications. Centres developed innovative measures to counter the negative impacts of the COVID-19 pandemic.

Keywords: COVID-19, health services, leprosy, leprosy referral centres, neglected tropical diseases, pandemic

Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is reported to have caused > 103 943 000 infections and 2 255 000 deaths¹ through February 2021. The pandemic has led to governments implementing a variety of public health measures to control transmission and has affected health services, economies

and social cohesion. Epidemics can lead to severe impacts on health services. The Ebola virus disease outbreak of 2014–16 was associated with high mortality and had a devastating effect on healthcare workers and healthcare service delivery² in West Africa. It is estimated that deaths due to human immunodeficiency virus, malaria and tuberculosis increased.³ Maternal and

neonatal mortality significantly increased^{4,5} and reduced access to services affected those with chronic non-communicable diseases (NCDs).⁶

Leprosy is a complex, communicable neglected tropical disease (NTD) caused by *Mycobacterium leprae*, which has chronic features giving it similarities to NCDs.⁷ Leprosy remains an important health problem in low- and middle-income countries (LMICs) and 202 185 new cases of leprosy were reported to the World Health Organization (WHO) in 2019.⁸ India reported the largest number of new cases, followed by Brazil and Indonesia.⁸ Leprosy causes a range of clinical presentations and if not diagnosed early can lead to permanent disability.⁹ Multidrug therapy (MDT) is an effective combination of three antimicrobials—rifampicin, clofazimine and dapsone—provided free to patients.¹⁰ MDT is prescribed for 6 or 12 months. However, even with successful treatment, individuals are at risk of developing leprosy immune-mediated complications known as ‘reactions’, which are a risk factor for permanent nerve damage and may be associated with increased mortality.^{11–14} Reactions require immunosuppression, usually with oral corticosteroids, which can cause adverse effects. The natural history of leprosy means that affected individuals need long-term follow-up.^{12–14}

The measures recommended to reduce transmission of SARS-CoV-2, such as isolation, social distancing and restrictions on movement, create barriers to accessing healthcare in addition to those normally present. NTDs disproportionately affect the most socially and economically vulnerable individuals in LMICs, who already experience considerable barriers to accessing health services.^{15,16} The fear of SARS-CoV-2 infection, reduced availability of services due to restructuring of healthcare provision and reduced staffing may limit access or result in the closure of services.

The WHO issued interim guidance for implementation of NTD programmes (including leprosy) on 1 April 2020 that recommended the postponement of NTD surveys, active surveillance activities and community campaigns.¹⁷ In July 2020, guidelines were published recommending risk assessment and thorough planning to restart only essential activities.¹⁸ The impact of service interruptions on NTD control and disability is unknown.

We evaluated the COVID-19 epidemic response, the impact of COVID-19 on leprosy services and disease management and mechanisms of support available for the clients of leprosy services at referral centres.

Methods

A cross-sectional online survey was conducted between 19 May and 7 July 2020. A short, structured, online questionnaire comprised of six sections with 54 questions was designed using RED-Cap (Appendix 1). The responses were a combination of multiple choice and free-text responses. The themes of the questions in the six sections were leprosy service provision; treatment of leprosy during COVID-19; COVID-19 information and control measures; COVID-19 diagnosis, management and precautions; COVID-19 among patients with leprosy and financial support.

The London School of Hygiene and Tropical Medicine Observational/Interventions Research Ethics Committee advised that no ethical approval was necessary because this work is a service evaluation.

Participants

The members of the Erythema Nodosum Leprosum International Study (ENLIST) Group (a network of leprosy collaborating centres),¹⁹ based in institutions supported by Lepira,²⁰ a UK-based charity that supports leprosy work in Bangladesh, India, Mozambique and Zimbabwe, and other leprologists from our networks were invited to participate.

The invitation was distributed by e-mail with a link to the online questionnaire. All participants were informed of the objectives of the evaluation.

Data analysis

All responses were anonymised and analysed using descriptive statistics.

Results

Forty-four invitations to complete the survey were sent to individuals working at institutions in Bangladesh, Brazil, Democratic Republic of Congo (DRC), Ethiopia, India, Indonesia, Nepal, Nigeria, Sri Lanka and the USA.

Twenty-one completed responses were obtained from centres in Bangladesh (n=3), Brazil (n=4), DRC (n=2), Ethiopia (n=1), India (n=8), Indonesia (n=1), Nigeria (n=1) and Sri Lanka (n=1).

Leprosy service provision

There was variation between centres in the range of services provided. All respondents reported some disruption to their services, such as surgical services and community-based activities. Table 1 shows the services normally provided and the extent to which they were affected (not affected, reduced, closed). Sixteen of 20 (80%) leprosy diagnostic services were reduced and only 1 (5%) closed. All respondents reported that MDT drugs were available, but two (13%) reported a reduced stock.

Respondents highlighted that treatment was available but factors such as restrictions on travel changed working practices.

‘Patient movement is restricted due to lockdown situation, so MDT blister is handed over to each patient for 2–3 months together’.

Seven of eight (87%) reconstructive surgery services suspended their activities. Community-based activities, such as active case finding, and delivery of single-dose rifampicin chemoprophylaxis to the contacts of leprosy patients were suspended by 76.9% and 66.7% of the services, respectively.

Six respondents reported suspension of other activities, including slit skin smear (n=1), ulcer management (n=2), rehabilitation (n=2), counselling (n=1), community-based rehabilitation (n=1), income generation activities (n=1), training of medical officers and community healthcare workers (n=2), academic activities (n=1) and research (n=2).

The changes to services were communicated to service users:

‘We called all patients to explain the situation and reschedule them...’.

Table 1. Leprosy services availability during the COVID-19 pandemic

Service normally provided (n)	Institutional impact			
	Service not affected, n (%)	Reduced service, n (%)	Service closed, n (%)	Not answered, n (%)
Leprosy diagnosis (20)	3 (15.0)	16 (80.0)	1 (5.0)	-
MDT provision (15) ^a	13 (86.7)	2 (13.3)	0	-
MDT access (15)	7 (46.7)	6 (40)	2 (13.3)	-
Reaction clinic (18)	5 (27.8)	12 (66.7)	1 (5.6)	-
Reaction inpatient (18)	5 (27.8)	5 (27.8)	2 (11.1)	6 (33.3)
Physiotherapy (18)	1 (11.1)	12 (66.7)	3 (16.7)	1 (5.6)
Orthotics (13)	4 (30.8)	7 (53.8)	2 (15.4)	-
Reconstructive surgery (8)	1 (12.5)	0	7 (87.5)	-
Active case finding (13)	0	3 (23.1)	10 (76.9)	-
Single-dose rifampicin chemoprophylaxis (3)	0	1 (33.3)	2 (66.7)	-

^aMDT provision was characterised as not affected, reduced stock or out of stock.

Table 2. The accessibility of MDT and drug therapy for leprosy reactions during the COVID-19 pandemic in leprosy referral centres

Question	Centres (N=21)		
	Yes, n (%)	No, n (%)	No response, n (%)
Can most patients obtain MDT during social restrictions?	14 (66.7)	4 (19)	3 (14.3)
Can most patients obtain MDT in your institution?	11 (73.3)	2 (13.3)	2 (13.3)
Can most patients obtain MDT in their local clinic?	12 (57.1)	6 (28.6)	3 (14.3)
Were patients taking a larger MDT supply than normal?	10 (66.7)	4 (26.7)	1 (6.1)
Can most patients obtain reaction medication during lockdown?	12 (66.6)	4 (22.2)	2 (11.1)
Can most patients obtain reaction medication in your institution?	13 (72.2)	3 (16.7)	2 (11.1)
Were patients taking reaction medication given a larger supply?	8 (72.2)	5 (27.8)	5 (27.8)
Can most patients obtain reaction medication in their local clinic?	11 (52.4)	7 (33.3)	3 (14.3)

Only one respondent reported staff absence due to COVID-19 illness. Five centres had their staff redeployed to pandemic response activities.

Treatment of leprosy during COVID-19

Table 2 shows responses concerning treatment access. Fourteen of 21 (66.7%) respondents reported that patients could access MDT during social restrictions and 12 (57%) respondents reported patients obtained MDT in their local clinic. Only 11 (52%) respondents reported that reaction medication was provided in local clinics.

Eighteen respondents (85%) reported the provision of reaction medication; all of them provided corticosteroids, 7 (38%) provided thalidomide, 9 (50%) provided clofazimine and 3 (17%) provided other reaction medications such as methotrexate and azathioprine. The thalidomide supply was not affected, however, in one centre, patients were unable to collect the medication. The clofazimine supply was reduced in two (22%) centres and out of stock in one centre (11%).

The supply of oral corticosteroids was reported to be reduced in two centres (11%) because of the impact of the pandemic. Overall, five respondents (28%) stated that patients were unable to collect medication. The difficulty in maintaining a supply of reaction medications is characterised in the following quote:

'Anti-inflammatory drugs availability affected as the drug was in short supply and supply could not be ensured due to restricted transport in view of lockdown'.

The responses about arrangements for monitoring patients during social and travel restrictions showed that clinicians at 15 of 21 (71%) centres contacted patients by telephone. All centres developed strategies to remotely support the welfare of leprosy patients, such as actively contacting vulnerable individuals, establishing telephone helplines or via social media platforms such as WhatsApp. This innovation was described by one respondent:

'We are providing medical orientation about treatment with the patients via WhatsApp'.

All respondents described reduced attendance by patients due to transport and travel restrictions:

'Travel restrictions have been the hugest issue limiting travel for patients and pushing us to think of ways of doing things by distance'.

Thirteen of 21 (62%) respondents reported providing a written summary of the diagnosis and treatment to their patients should the need arise for them to consult a healthcare professional or person in authority about their condition.

COVID-19 public information and control measures

Public information about COVID-19 was available through a variety of media: television, radio, posters and social media platforms such as Facebook and Twitter. All respondents reported some kind of restriction measures implemented by local or national authorities and 17 of 21 (81%) respondents reported measures including social distancing, the use of masks in public places, shielding of vulnerable individuals, travel restrictions and curfews.

Eleven respondents (52%) reported COVID-19 information produced specifically for leprosy patients by a variety of agencies: the WHO country office (n=3), Ministry of Health (n=2), leprosy or other specialist professional society (n=2), International Federation of Anti-Leprosy Associations (ILEP)/ILEP Technical Committee (ITC) document (n=3) or produced by clinicians at the institution (n=3).

COVID-19 diagnosis, management and precautions

The criteria used to diagnose COVID-19 varied among the respondents. Seven centres (33%) reported the use of clinical criteria: symptoms, signs and low oxygen saturation. Various tests of infection were reported to be available: nasal/throat swab polymerase chain reaction (PCR) tests (n=18), enzyme-linked immunosorbent assay serology tests (n=5) and point-of-care tests (n=3). In five centres, both PCR and serology tests were available.

Measures to reduce the risk of transmission of SARS-CoV-2 in leprosy clinics were described in the majority of organisations. All but two centres recommended some type of personal protective equipment: masks (n=14), surgical masks (n=11), filtering face piece 3 (FFP3) or N95 respirators (n=9), visors or goggles (n=9), aprons (n=8), gowns (n=6) and disposable gloves (n=14).

'We spaced the appointment time and guided the use of masks to all patients of the institution'.

COVID-19 patients were managed at six of the centres (28%) that provided general medical care as well as leprosy services.

COVID-19 and leprosy patients

Six individuals with leprosy at 5 of the 21 (23.8%) centres had been diagnosed with COVID-19. No deaths related to COVID-19 in this group were reported. One respondent expressed surprise about the low numbers of leprosy patients affected:

'...we are surprised that patients in use of prednisone and thalidomide are not been widely affected by COVID-19'.

The respondents expressed concern about immunosuppression for the management of leprosy reactions exacerbating SARS-CoV-2 infection:

'We also try as far as possible to avoid using immunosuppressants'.

Financial support

Financial support was provided for leprosy-affected individuals to mitigate the effects of COVID-19 in all countries but one by a variety of agencies both governmental (n=8) and non-governmental (n=3), including affected persons organisations (n=1). Funds were also raised by voluntary contributions from communities (n=8) to provide financial support. One respondent outlined various strategies, including food donation, obtaining masks and hand sanitizer and providing information about government schemes.

Discussion

This study highlights the impact of the initial phase of the SARS-CoV-2 pandemic on leprosy services in a range of leprosy-endemic countries. Many services remained open, providing leprosy diagnosis, MDT and leprosy reaction medications. However, patients were unable to travel to the centres. Other services such as reconstructive surgery were closed. Referral centres developed innovative measures to counter the negative impact. Our data confirm the concerns of researchers and organisations regarding the impact of COVID-19 on NTDs,²¹ including leprosy.²²⁻²⁴ Mahato et al.²⁴ emphasised the impact of social distancing, travel restrictions and lockdown measures on healthcare access, community activities and stigma on leprosy-affected individuals in Nepal.

COVID-19 and the public health measures implemented created barriers to the access of leprosy services due to difficulties in travelling to centres for care and reduced or closed services. There was a reduction of all services essential to the case management of leprosy and other strategic interventions outlined in the WHO NTD Roadmap, both clinic and community based.²⁵ Community activities are not only important for early case detection, but also facilitate the reduction in stigma and promote well-being for affected individuals and their families.

MDT and drugs used to treat leprosy reactions were mostly available in the referral centres and some at local healthcare facilities. Travel restrictions suggested that more individuals needed to rely on local services to provide essential care, such as diagnosis and management. Reduced access to leprosy care due to COVID-19 will result in additional delays in the diagnosis of leprosy and its complications. The closure of inpatient services for the management of leprosy reactions has a greater impact when there are travel restrictions in settings where patients have to travel considerable distances. The chronic complications of leprosy, such as neuropathic ulceration and osteomyelitis, if left untreated, lead to loss of tissue and function. It may be that on resumption of normal activity there may be a more severe

burden of such complications requiring treatment. A survey of National Leprosy Programme managers initiated in April 2020 by the Global Partnership for Zero Leprosy (GPZL) reported that 34 respondents highlighted similar issues concerning MDT supply and access, reaction medication and ulcer and disability care.²⁶

Travel restrictions and health systems focussing on treatment and control of COVID-19 has resulted in reduced detection of leprosy and may result in an increased burden of disability in the coming years.²⁷

Before the pandemic, in one cohort, 40% of multibacillary patients with normal nerve function at the time of diagnosis of leprosy developed leprosy reactions and/or nerve function impairment that required prompt management.²⁸ The expertise to diagnose leprosy reactions and institute treatment is not widely available and may lead to delays that increase the risk of permanent nerve damage and disability.²⁹ In individuals already established on MDT and/or leprosy reaction treatment, it is uncertain whether monitoring for adverse effects would be maintained. There is the potential for those on long-term corticosteroids to experience an interruption of treatment with the risk of severe adrenal insufficiency. A consultation process with leprosy-affected individuals and their organisations was conducted by the GPZL in April and May 2020. It received no reports of patients being provided with extended courses of reaction medication, in contrast to some National Leprosy Programme representatives reporting dispensing up to a 3-month supply of MDT.³⁰

Our non-systematic data of low numbers of leprosy service users being affected by COVID-19 is in keeping with retrospective data from Brazil during the same period.³¹ However, Santos et al.³¹ reported that all four leprosy-affected individuals died due to COVID-19, in contrast with no deaths reported by our respondents. None of these 10 cases were associated with leprosy reactions. Antunes et al.³² postulated that SARS-CoV-2 infection may trigger leprosy reactions, but data supporting this has not yet emerged. The restricted access to diagnosis and no requirement for reporting leprosy reactions means there may be no conclusive answer.

We are not aware of any reports of a significant association between severe COVID-19 and treatment for leprosy reactions despite this being a concern of our respondents and others.^{33,34} Interestingly, a report of nosocomially acquired SARS-CoV-2 infection in a 26-year-old man with erythema nodosum leprosum treated with methotrexate and systemic corticosteroids describe a mild COVID-19 illness and favourable outcome.³⁵ Since our data were collected, short-course dexamethasone has been shown to reduce mortality in hospitalized patients with COVID-19.³⁶

The responses to our questionnaire illustrate innovative strategies and versatility employed by organisations providing services to leprosy-affected individuals. The frequency of clinic visits was reduced, medical summaries were given to patients and MDT was supplied for longer periods. The use of technology to facilitate telemedicine and provide non-clinical support to service users demonstrates a potential positive impact of the COVID-19 pandemic.³⁷ The incorporation of some adaptations of service delivery may have long-term benefits to service users, staff and organisations.

The limitations of our study are that it was conducted in the early phase of the COVID-19 pandemic and data were only pro-

vided on a single occasion. Respondents may not have included important examples of the impact of COVID-19 that were not specifically covered by the questions in the survey. The respondents' organisations provide leprosy services in referral settings and so we are unable to provide a complete picture of the impact of COVID-19 on leprosy in local settings. Nevertheless, we have gathered data from clinical settings in a wide variety of leprosy-endemic settings that demonstrate the impact of COVID-19 on services and the changes required to meet a range of challenges.

The development of efficacious vaccines against SARS-CoV-2 is very welcome, however, it is unclear when these will be widely available in many leprosy-endemic settings.³⁸ Leprosy services have been identified among the essential services that should be protected during the COVID-19 pandemic.³⁹

The maintenance of essential leprosy services and minimising barriers to access of services needs to be a priority for all agencies involved in their delivery. Measures to combat the transmission of COVID-19 will be necessary for the foreseeable future. Our data complement those generated by the GPZL. The need for continued advocacy is required to ensure policymakers are aware of the disproportionate impact public health measures may have on economically vulnerable and stigmatised individuals who need access to long-term health interventions provided by specialist services.

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