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20 April 2015
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The Burden of Tuberculosis Among Acute Emergency-Affected Displaced Populations

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Burden of Tuberculosis Among Acute Emergency-affected Displaced Populations

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B.S., Cornell University
2011

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An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
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Master of Public Health
in Global Health
2015

Abstract

Burden of Tuberculosis Among Emergency-affected Displaced Populations

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Background: A large proportion of the world's population is affected by disasters, both natural and man-made. By 2013, there were 51.2 million people forcibly displaced. Little is known about the burden of tuberculosis (TB) among displaced persons. And quantification of the TB burden in this population is needed with potential implication to prevent TB-associated morbidity and mortality during humanitarian emergencies.

Methods: Data from countries with emergencies in 2009, 2011, and 2013 resulting in $\geq 50,000$ newly internally displaced persons (IDPs) and population estimates of IDPs, newly returning IDPs and newly-returning refugees were used to determine the number of cases of TB and the proportion of TB burden. Estimates were then aggregated by WHO region, emergency type, and World Bank country economic classification.

Results: Forty-five countries fit the case definition with a total displaced population ranging from 17,814,666 in 2009 to 29,906,491 in 2013. Most experienced both conflicts and natural disasters in the 3-year study period, with the African Region accounting for the most ($n=18$). Natural disasters produced the greatest number of new IDPs (>35 million) and the greatest number of IDPs with TB (55,846). Although countries experiencing conflict only did not have the greatest number of IDPs (>19 million), the burden of TB was greatest in these countries, with IDPs accounting for 1.8% of the TB burden compared with 0.4% for natural disasters and 1.6% for both emergencies. The proportion of TB burden paralleled the World Bank's economic classifications, with 0.03% TB burden among IDPs in high-income countries, 0.32% upper-middle, 0.94% lower-middle, and 1.32% in low-income countries.

Discussion: These estimates illustrate the high TB burden among emergency-displaced populations. The most notable finding was the 4-fold greater TB burden among IDPs from conflicts as compared to natural disasters. New IDPs have disrupted TB care and treatment, necessitating the need for quick remedies to ameliorate their excess TB-related morbidity and mortality. As such, our findings underscore the importance of implementing TB control programs as soon as possible in the acute phase of an emergency.

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CHAPTER 1: Introduction

Humanitarian emergencies and public health issues are interrelated. These events – both conflict and natural disasters – exacerbate the effect and magnitude of infectious diseases because of overcrowding, malnutrition, diminished government and public health infrastructure, and displacement.

In 2012, 76 million people were designated by the United Nations (UN) as needing assistance because of humanitarian crisis.³ Persons displaced during the *acute* phase of an emergency are particularly susceptible to negative health effects associated with displacement. This is because the early stages of an emergency are when the public health infrastructure is abruptly disrupted, resulting in displaced persons not receiving treatment. Moreover, because of the particularly tumultuous nature of the acute phase of an emergency, infectious diseases spread more easily.

Tuberculosis (TB), one of the world's leading public health issues and a top infectious disease killer, affects populations in emergency settings. However, the burden of TB has not been quantified for newly internally displaced populations (IDPs) affected by acute or exacerbated emergencies.

Objectives and Aims

The **objective** of this study is to assess and quantify the burden of TB among new IDPs during acute emergency settings.

Included in this objective are several **aims**:

1. Identify countries for three years that have experienced an acute emergency (i.e., acute or newly exacerbated conflict or natural disaster);
2. Quantify the affected IDPs for each country and emergency, including new internally displaced persons (IDPs), returning refugees, and returning IDPs;
3. Estimate the number in the total population with TB disease per year in each country;
4. Estimate the number of emergency-affected people with TB per year in each country;
5. Estimate and quantify the proportion of the national TB burden found in emergency-affected people per year in each country; and
6. Determine whether the burden of TB among emergency-affected IDPs varies by World Health Organization (WHO) region, type of emergency (i.e. conflict or natural disaster or both), or World Bank economic classification.

CHAPTER II:

Comprehensive Review of the Literature

I. Introduction

Tuberculosis (TB) is a global public health threat, ranking second in mortality after infection with human immunodeficiency virus (HIV)¹. In 2013, there were approximately 9 million new TB cases with 1.5 million deaths.¹ Despite the decline over the last decade – largely attributed to effective diagnosis and treatment interventions – TB-associated mortality is unacceptably high given it is preventable.¹ Concurrently, much of the world’s population is affected by emergency crises (natural or man made), resulting in large numbers of internally displaced persons (IDPs) and refugees.² By the end of 2013 there were approximately 51.2 million people forcibly displaced (including 33.3 million IDPs); 6 million more than 2012.³ TB disproportionately affects emergency-affected people.⁶

II. Humanitarian Crises

In 2012, 76 million people were designated by the United Nations (UN) as needing assistance because of a humanitarian emergency.³ A humanitarian crisis, according to the International Federation of Red Cross and Red Crescent Societies, is any situation in which there is “total or considerable breakdown of authority resulting from internal or external conflict and which requires an international response that goes beyond the mandate or capacity of any single agency and/or the ongoing UN country program (IASC).”²

III. Tuberculosis Prevention and Control

A. Global

More than two decades after the World Health Organization (WHO) declared TB a global public health emergency,⁴ today TB follows only HIV as the leading global killer from an infectious disease,⁵ and in 2013, there were an estimated 9 million new cases and 1.5 million associated deaths. While the majority of TB morbidity and mortality occurs among males, women and children also bare a high burden, accounting for more than 30% and 6% of new cases and deaths, respectively.¹

In 2013, approximately 3.5% of new cases and 20.5% of previously treated cases were multi-drug resistant (MDR) (c.f., Table 1), of which 9% were extensively drug resistant (XDR), a proportion that has not changed over several years.¹ Moreover, of the 9 million persons who developed TB in 2013, more than 1.1 million (13%) were also HIV-infected, with the African region accounting for nearly four out of every five HIV-positive TB cases and deaths among HIV-infected people¹ (c.f., Figure 1).

The majority of new TB cases occur in the South-East Asian and Western Pacific regions (56%), and a ¼ cases are found in the African regions (c.f., Figure 2), for which the highest rates of cases and deaths were documented in 2013¹ (c.f., Table 2). It is in these countries that issues of resistance and poor treatment outcomes are of most concern, particularly among vulnerable populations like IDPs and refugees.

B. Tuberculosis among Emergency-affected People

TB exists all over the world, although the burden of TB is notably high among displaced populations in emergency settings – specifically IDPs and refugees.⁶ It is important to make a distinction between these two groups: while both IDPs and refugees are forced to flee their

homes due to emergencies or conflict, IDPs remain in their home countries while refugees cross international borders.³

Humanitarian emergencies (e.g., conflict, natural disasters) often result in large influxes of people moving from high TB-burdened countries, changing the incidence and prevalence of TB.³ Today more than ever, IDPs and refugees forced to migrate or immigrate overlap geographically; for instance, in 2012, all but one country (Mozambique) of the 22 high TB-burdened countries was either a country of origin or a country of asylum. Of the 10.5 million refugees in 2012, 42% originated from and 37% resided in a high TB-burdened country, and 27% of IDPs resided in seven of the 22 high-burden countries⁴ (c.f., Table 3).

According to the WHO, of the one-third persons with latent TB infection (LTBI), about 10% eventually develop active disease.¹ Disproportionate rates of LTBI have been documented among IDPs in post-natural disaster or conflict settings (e.g., El Salvador's civil war).⁷

A recent systematic review examined the burden of TB in crisis-affected populations and found elevated rates of TB incidence and prevalence.⁶ Some documented prevalence rates may be the result of increased monitoring, detection, or even health assessments on behalf of non-governmental organizations (NGOs). Other studies showed high rates of TB-associated mortality and drug-resistant TB (both MDR and XDR) among displaced populations.⁸⁻¹¹

IV. Factors Contributing to TB

In general, IDPs have worse health outcomes than refugees because of a disproportionate lack of protection and accessibility; both groups are negatively affected in emergency settings. Overcrowding,⁷ diminished environmental conditions, lack of governmental authority, HIV infection, disrupted health services, malnutrition,¹⁹ and treatment non-adherence all contribute not only to further transmission and higher TB rates, but also to progression from latent to active disease in

these groups.⁶ This has significant implications, as globally, about one-third of the population has latent TB, with a 10% lifetime risk of developing active TB disease.⁵

A. Non-prioritization in Acute Phases

In the acute phases of a humanitarian emergency, TB is often not one of the infectious diseases prioritized; it does not contribute to significant mortality during the early stages. Neglect to focus attention and resources toward TB mitigation and control can lead to rapid increases in both TB-related morbidity and mortality.¹³

B. Limits in Treatment and Testing

A major risk factor for drug-resistant TB is seeking care from non-regulated physicians or pharmacies. This oftentimes includes non-recommended treatment regimens and poor-quality medication as evidenced in Somalia.¹⁴ Moreover, diagnostic testing can be difficult during and post-humanitarian emergencies. In the past, smear microscopy was performed in the *best-case* scenario, but there has been a relatively recent shift toward using Xpert®, as seen with the typhoon Haiyan (c.f., Figure 3). The International Organization for Migration (IOM) found this device to be more user-friendly and easy to use, although unfortunately it is not always available in acute phases or in sufficient quantities during emergencies.¹⁵

C. Stigma

Stigma can have a profound effect on whether displaced persons 1) become infected with TB and 2) develop disease. Over the last several decades, TB has negative connotations such as “white plague,” referring to the pallor and atrophy commonly seen in TB patients.¹⁶ Moreover, TB is often associated with HIV co-infection, itself a highly stigmatized disease.¹⁷ Because of shame and fear – amidst an already profound sense of isolation in an environment of weakened

authority and infrastructure – patients often delay seeking care or seek it sporadically, resulting in treatment non-adherence and a multitude of negative outcomes.¹⁸⁻¹⁹

V. Prevention Measures

The same principles for preventing TB transmission and progression used in non-emergency settings should be applied to emergency situations. The foremost is properly ensuring adherence to anti-TB medication. Because emergency settings make adherence difficult for a host of reasons, various mechanisms exist to ensure continuous treatment regimens; one is the use of “runaway bags,” filled with anti-TB medication and given to TB patients.²⁰

The 2008 WHO’s public health strategy for resource-limited countries pinpoints three main components in the reduction of TB impact among HIV-infected persons – 1) intensive TB case finding (ICF); 2) isoniazid preventive therapy (IPT) for persons with LTBI or living in areas with >30% LTBI prevalence; and 3) infection control (IC) measures for vulnerable patients, health care workers, the community, and those living in congregate settings.²¹

While ICF may not be realistic in emergencies, the other two may be. For instance, infection control, which does not require sophisticated infrastructure, is essential for displaced populations²¹, and includes²²:

- Prompt case detection;
- Airborne precautions; and
- Treatment for suspected and confirmed TB cases.

Moreover, healthcare facilities in these settings must prioritize administrative measures, environmental controls, and the use of respiratory protective equipment.²²

VI. TB Control Programs

There are well-established criteria for establishing TB control programs in emergency settings, and various private-public partnerships have been successful in providing treatment,²⁶ although challenges exist (e.g., lack of institutional development, difficulty in transitioning to national programs and ensuring national and WHO compliance, provider turnover, and sustainability).²³⁻

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The WHO has set forth minimum requirements for TB programs in emergency settings²⁴:

A. WHO criteria used to determine whether a TB program is needed

1. Epidemiologic data indicate that TB is a health concern;
2. The acute emergency phase is over;
3. Basic needs are met;
4. Essential clinical services are available; and
5. Basic health services are accessible to a large part of the population

B. WHO's criteria for implementing TB programs

1. Political commitment with sustainable monetary means;
2. Case detection with quality-assured bacteriology;
3. Standardized treatment with supervision and patient support;
4. An effective drug supply and management system; and
5. Monitoring and evaluation system with impact measurements.

C. WHO's criteria for implementing TB control programs

To effectively implement a control program in emergency settings, it is critical to coordinate with local officials and partners. They must develop a detailed protocol for implementation and

outline patient management (e.g., diagnosis criteria, treatment categories and regimens, and follow-up guidelines). The protocol must also establish a reporting system, a drug management system, identify distribution and supply chains, and detail contingency planning for potential program interruptions.²⁴ (c.f., Figure 4).

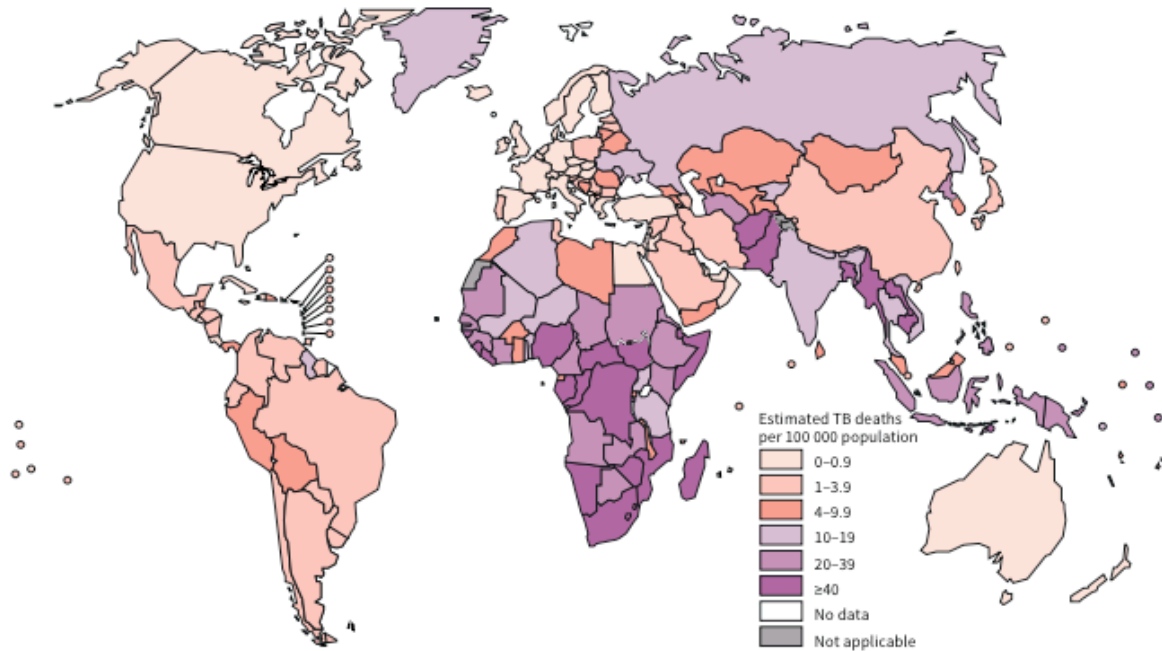
VII. Conclusion

Humanitarian emergencies pose substantial threat to internally displaced persons and refugees in terms of TB transmission and progression, both arising from a multitude of factors common in emergency settings. Because these groups are more susceptible to becoming infected with TB and progressing to active disease, it is vital that TB control programs be implemented as soon as possible during an emergency, preferably in the acute phase. Rapid implementation can help decrease rates of TB and TB transmission and can help lower the chances of drug resistance. Not only should TB control programs be a key component of emergency responses, but barriers (e.g., health system weaknesses, lack of effective regimens, and insufficient funding) that hamper the response should also be addressed and prioritized.

Appendix

Figure 1.

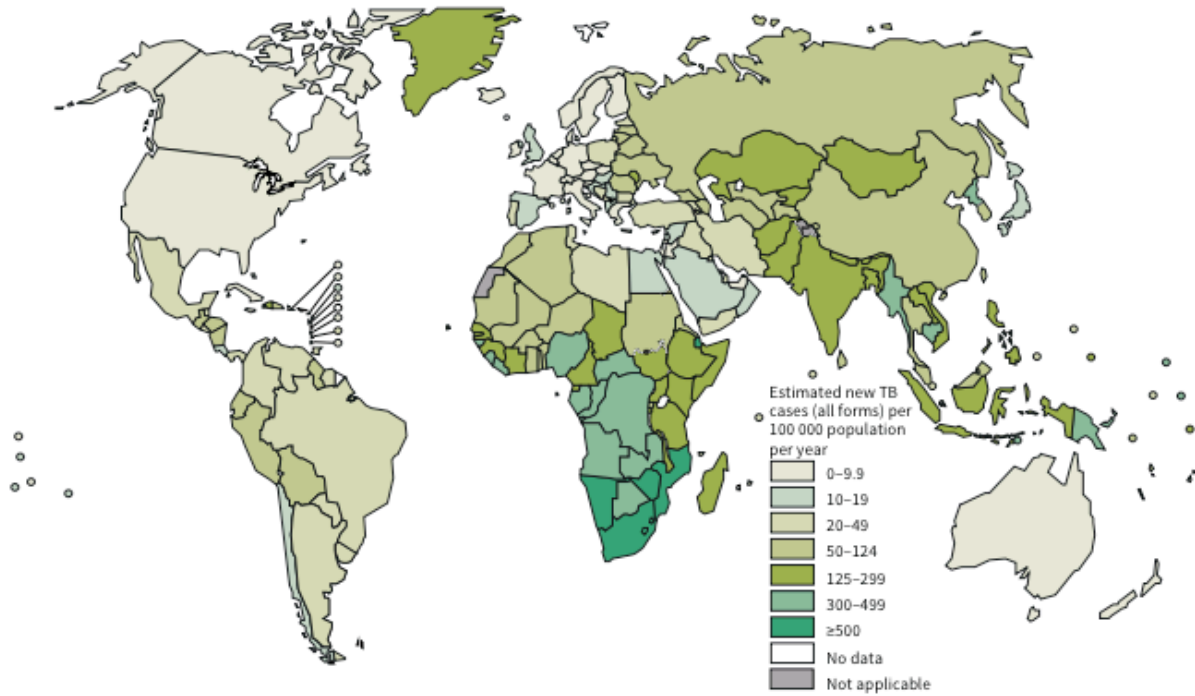
Estimated TB mortality rates excluding TB deaths among HIV-positive people, 2013



World Health Organization, 2014. Global Tuberculosis Report, 2014. Geneva, Switzerland: WHO Press.

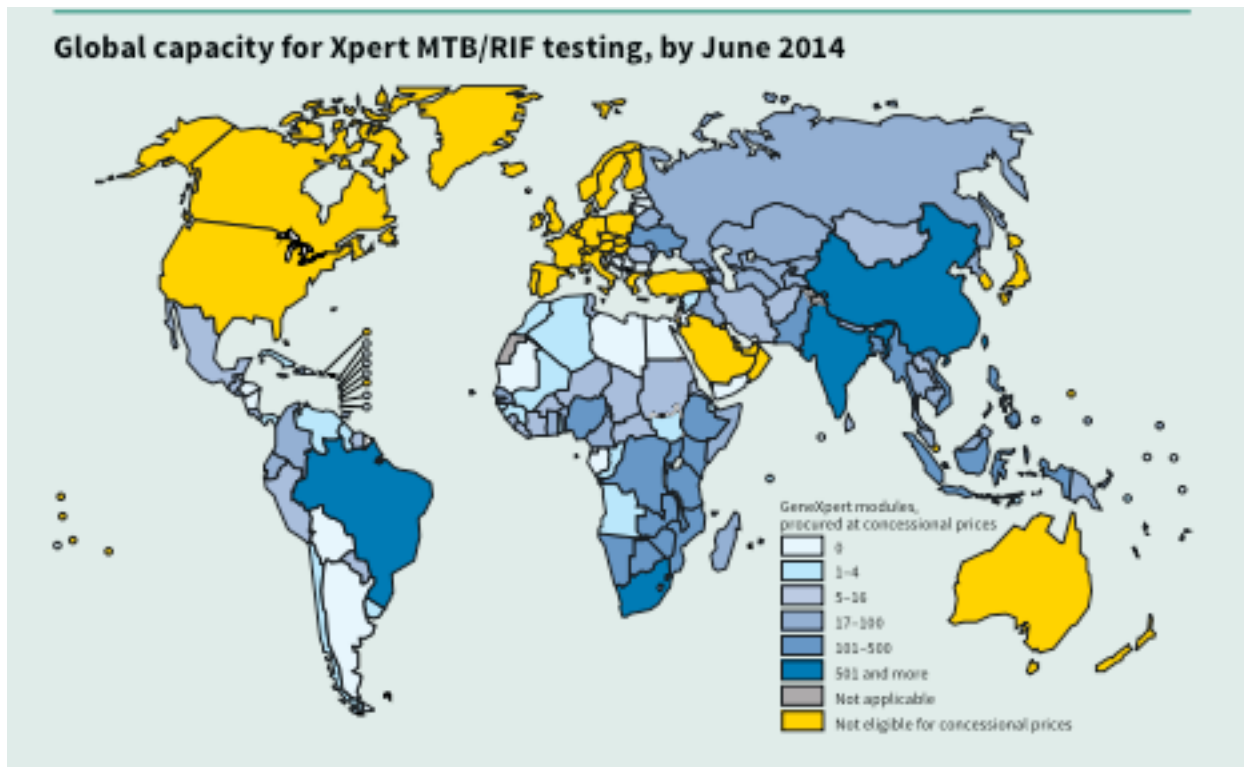
Figure 2.

Estimated TB incidence rates, 2013



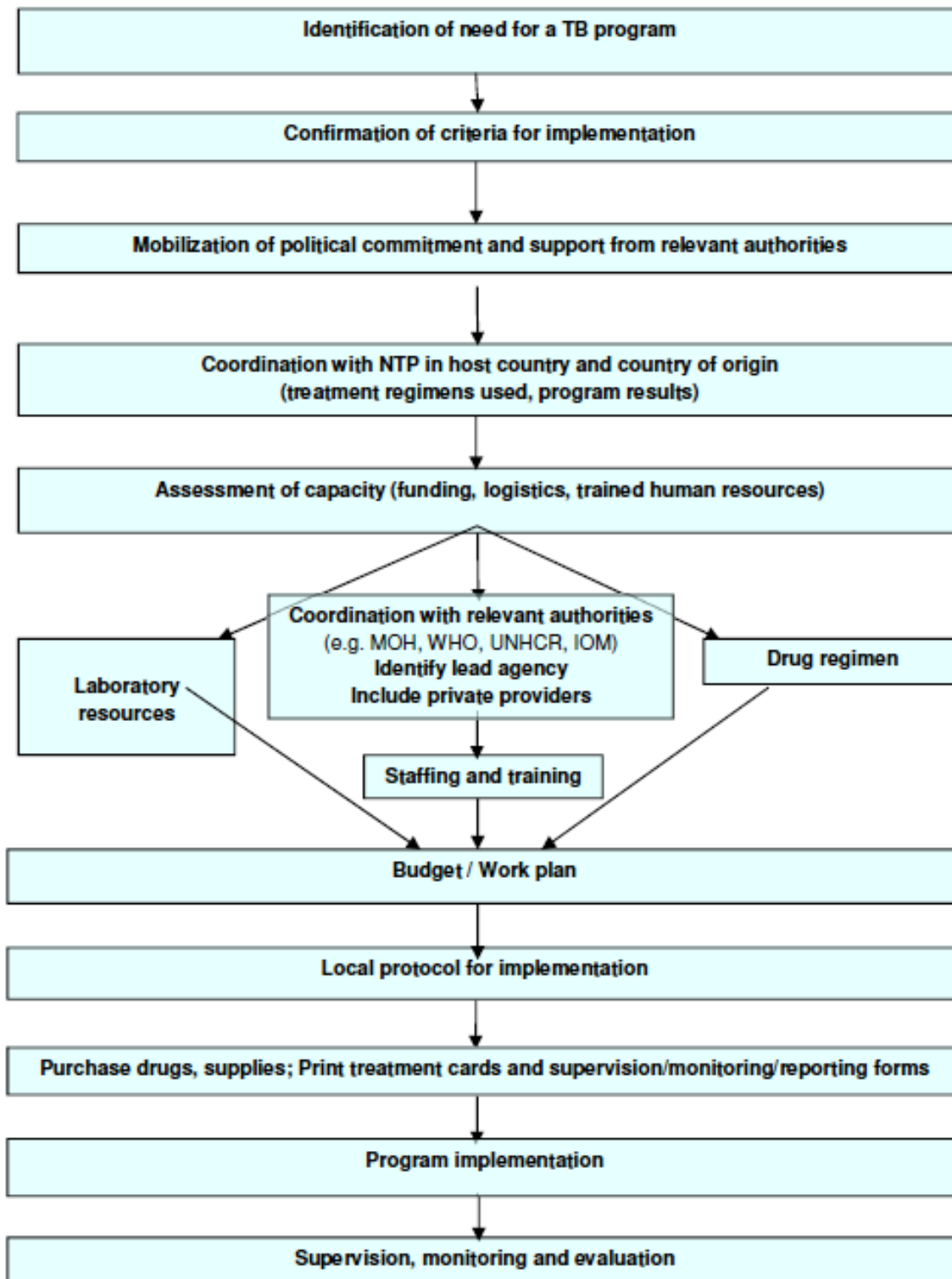
World Health Organization, 2014. Global Tuberculosis Report, 2014. Geneva, Switzerland: WHO Press.

Figure 3.



World Health Organization, 2014. Global Tuberculosis Report, 2014. Geneva, Switzerland: WHO Press.

Figure 4. Key steps in implementation of a TB program in emergency settings



World Health Organization, 2008. WHO Three I's Meeting – Report of a Joint World Health Organization 18 HIV/aids and TB Department Meeting. 2-4 April, 2008, Geneva, Switzerland

Table 1.

Estimated proportion of TB cases that have MDR-TB, globally and for 27 high MDR-TB burden countries and WHO regions

	ESTIMATED % OF NEW TB CASES WITH MDR-TB ^a	CONFIDENCE INTERVAL	ESTIMATED % OF RETREATMENT TB CASES WITH MDR-TB ^a	CONFIDENCE INTERVAL
Armenia	9.4	7.0–12	43	38–49
Azerbaijan	13	10–16	28	22–34
Bangladesh	1.4	0.7–2.5	29	24–34
Belarus	35	33–37	55	51–57
Bulgaria	2.3	1.3–3.8	23	17–31
China	5.7	4.5–7.0	26	22–30
DR Congo	2.6	0.01–5.5	13	0.2–28
Estonia	17	12–24	48	32–63
Ethiopia	1.6	0.9–2.8	12	5.6–21
Georgia	11.0	9.7–13	38	34–42
India	2.2	1.9–2.6	15	11–19
Indonesia	1.9	1.4–2.5	12	8.1–17
Kazakhstan	25	24–26	55	54–56
Kyrgyzstan	26	23–31	55	52–58
Latvia	8.8	6.6–12	26	18–35
Lithuania	11	9.5–14	44	39–49
Myanmar	5.0	3.1–6.8	27	15–39
Nigeria	2.9	2.1–4.0	14	10–19
Pakistan	4.3	2.8–5.7	19	14–25
Philippines	2.0	1.4–2.7	21	16–29
Republic of Moldova	24	21–26	62	59–65
Russian Federation	19	14–25	49	40–59
South Africa	1.8	1.4–2.3	6.7	5.4–8.2
Tajikistan	13	9.8–16	56	52–60
Ukraine	14	14–15	32	31–33
Uzbekistan	23	18–30	62	53–71
Viet Nam	4.0	2.5–5.4	23	17–30
High MDR-TB burden countries	4.0	2.3–5.7	22	13–31
AFR	2.4	0.2–5.0	13	0.02–27
AMR	2.2	1.3–3.0	13	4.9–22
EMR	3.6	2.3–5.0	22	12–32
EUR	14	9.7–19	44	36–52
SEAR	2.2	1.8–2.7	16	12–20
WPR	4.4	2.6–6.3	22	18–26
Global	3.5	2.2–4.7	21	14–28

^a Best estimates are for the latest available year. Estimates in italics are based on data from countries from the same epidemiological region.

World Health Organization, 2014. Global Tuberculosis Report, 2014. Geneva, Switzerland: WHO Press.

Table 2.

Estimated epidemiological burden of TB, 2013. Best estimates are followed by the lower and upper bounds of the 95% uncertainty interval. Numbers in thousands^a

	POPULATION	MORTALITY ^b		HIV-POSITIVE TB MORTALITY		PREVALENCE		INCIDENCE		HIV-POSITIVE INCIDENT TB CASES	
Afghanistan	30 552	13	8.4–16	<0.1	<0.1–0.1	100	54–170	58	51–65	0.2	0.2–0.2
Bangladesh ^c	156 595	80	51–110	0.2	0.1–0.2	630	330–1 000	350	310–400	0.4	0.2–0.5
Brazil	200 362	4.4	2.5–6.8	2.1	1.5–2.7	110	54–200	93	83–110	13	13–13
Cambodia	15 135	10	6.3–14	0.6	0.5–0.8	110	91–130	61	55–67	2.3	2.1–2.6
China	1 385 567	41	40–43	0.7	0.2–1.3	1 300	1 100–1 500	980	910–1 100	4.5	4.3–9.9
DR Congo	67 514	46	22–53	6.4	0.2–24	370	190–610	220	200–240	16	9.8–75
Ethiopia	94 101	30	16–47	5.6	3.6–8.0	200	160–240	210	180–260	22	19–32
India ^d	1 252 140	240	150–350	38	31–44	2 600	1 800–3 700	2 100	2 000–2 300	120	100–140
Indonesia ^e	249 866	64	36–93	3.9	2.2–6.2	680	340–1 100	460	410–520	15	8.7–20
Kenya	44 354	9.1	5.5–12	9.5	7.5–12	130	69–200	120	120–120	48	47–50
Mozambique	25 834	18	9.4–26	38	27–51	140	78–230	140	110–180	81	64–100
Myanmar	53 259	26	16–38	4.3	3.3–5.3	250	190–320	200	180–220	17	16–18
Nigeria	173 615	160	68–270	85	47–140	570	430–730	590	340–880	140	81–220
Pakistan	182 143	100	45–170	1.0	0.5–1.6	620	520–740	500	370–650	2.6	1.2–3.4
Philippines	98 394	27	25–29	<0.1	<0.1–<0.1	430	380–490	290	260–330	0.3	0.2–0.3
Russian Federation	142 834	17	17–18	1.4	1.0–1.9	160	74–290	130	120–140	7.9	6.9–9.1
South Africa	52 776	25	15–38	64	47–83	380	210–590	450	410–520	270	240–310
Thailand	67 011	8.1	4.9–12	1.9	1.3–2.4	100	48–170	80	71–90	12	10–13
Uganda	37 579	4.1	2.2–6.6	7.2	5.0–9.9	58	32–91	62	56–73	32	29–38
UR Tanzania	49 253	6.0	3.4–8.2	6.1	4.8–7.5	85	45–140	81	77–84	30	29–31
Viet Nam	91 680	17	12–24	2.0	1.2–2.9	190	79–350	130	110–160	9.4	8.0–12
Zimbabwe	14 150	5.7	3.6–7.4	22	17–27	58	33–89	78	67–91	56	48–66
High-burden countries	4 484 710	960	810–1 100	300	250–350	9 300	8 200–11 000	7 400	7 100–7 800	910	820–990
AFR	927 371	390	300–500	300	250–350	2 800	2 400–3 200	2 600	2 300–2 900	870	790–960
AMR	970 821	14	12–17	6.1	5.5–6.8	370	290–460	280	270–300	32	31–33
EMR	616 906	140	90–210	1.8	1.3–2.4	1 000	880–1 200	750	620–890	5.1	4.0–6.4
EUR	907 053	38	37–39	3.8	3.2–4.4	460	350–590	360	340–370	21	20–22
SEAR	1 855 068	440	330–550	48	42–55	4 500	3 500–5 700	3 400	3 200–3 600	170	150–190
WPR	1 858 410	110	100–120	4.8	3.7–5.9	2 300	2 000–2 500	1 600	1 500–1 700	23	19–26
Global	7 135 628	1 100	980–1 300	360	310–410	11 000	10 000–13 000	9 000	8 600–9 400	1 100	1 000–1 200

^a Numbers for mortality, prevalence and incidence shown to two significant figures. Totals (HBCs, regional and global) are computed prior to rounding.

^b Mortality excludes deaths among HIV-positive TB cases. Deaths among HIV-positive TB cases are classified as HIV deaths according to ICD-10 and are shown separately in this table.

^c Estimates of TB disease burden have not been approved by the national TB programme in Bangladesh and a joint reassessment will be undertaken following completion of the prevalence survey planned for 2015.

^d Estimates for India have not yet been officially approved by the Ministry of Health & Family Welfare, Government of India, and should therefore be considered provisional.

^e As this report went to press, estimates for Indonesia were being revised based on the results of the 2013–2014 national TB prevalence survey. Updated estimates will be published online. See also [Box 2.1](#).

World Health Organization, 2014. Global Tuberculosis Report, 2014. Geneva, Switzerland: WHO Press.

Table 3. Refugees from or residing in high TB burden countries, 2012

High TB burden country	Origin no.	Asylum no.
Afghanistan	2,586,152	16,187
Dem. Rep. of Congo	509,290	65,109
Myanmar	415,371	-*
Vietnam	336,939	-
China	193,453	301,037
Russian Fed.	110,588	3,178
Ethiopia	74,968	376,393
Pakistan	49,785	1,638,456
Zimbabwe	22,101	-
Nigeria	18,021	3,154
Indonesia	15,523	1,819
India	14,258	185,656
Cambodia	14,024	-
Bangladesh	10,161	230,697
Kenya	8,950	564,933
Uganda	5,608	197,877
Tanzania	1,122	101,021
Brazil	1,076	4,689
Philippines	986	141
South Africa	420	65,233
Thailand	381	84,479
Mozambique	160	-
Total	4,389,337	3,840,059
Percentage of total refugees, 2012	41.8%	36.6%

* A dash (-) indicates that the value is zero or not available.

Source: United Nations High Commissioner for Refugees, 2013.

Gayer, M. & Temporado Cookson, S. (2015) Tuberculosis in Humanitarian Emergencies. In Press.

Table 4.

Ten countries that account for 74% (2.4 million) of the estimated “missed” cases globally, 2013. The number of missed cases is defined as the difference between the estimated number of incident cases and notified (new and relapse) cases in 2013

COUNTRY	SHARE OF TOTAL MISSED CASES (%)	CUMULATIVE SHARE OF TOTAL MISSED CASES (%)
India	27	27
Nigeria	15	42
Pakistan	7	49
Bangladesh	5	54
South Africa	4	58
Indonesia ^a	4	62
China	4	66
Democratic Republic of the Congo	3	69
Ethiopia	3	72
Mozambique	2	74

^a As this report went to press, estimates of TB disease burden in Indonesia were being revised based on the results of the 2013–2014 national TB prevalence survey. Estimates of the number of missed cases will also be produced. Updated estimates will be published online.

World Health Organization, 2014. Global Tuberculosis Report, 2014. Geneva, Switzerland: WHO Press.

CHAPTER III: Manuscript

Contribution of the Student

The work herein is the product of a secondary data collection and analysis performed by the student. The original concept and methodology was provided by thesis co-chair Dr. Susan Cookson, from the Centers for Disease Control and Prevention. The student performed all work independently, including the collection of data from publically available sources, analysis of the data, summation of results in tables, and all writing. Advisement was provided throughout this process by the student's thesis committee co-advisors.

Burden of Tuberculosis Among Emergency-affected Displaced Populations

Anna R. Tate,¹ Scott J.N. McNabb,¹ Susan T. Cookson²

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Background: A large proportion of the world's population is affected by disasters, both natural and man-made. By 2013, there were 51.2 million people forcibly displaced. Little is known about the burden of tuberculosis (TB) among displaced persons. And quantification of the TB burden in this population is needed with potential implication to prevent TB-associated morbidity and mortality during humanitarian emergencies.

Methods: Data from countries with emergencies in 2009, 2011, and 2013 resulting in $\geq 50,000$ newly internally displaced persons (IDPs) and population estimates of IDPs, newly returning IDPs, and newly returning refugees were used to determine the number of cases of TB and the proportion of TB burden. Estimates were then aggregated by WHO region, emergency type, and World Bank country economic classification.

Results: Forty-five countries fit the case definition with a total displaced population ranging from 17,814,666 in 2009 to 29,906,491 in 2013. Most experienced both conflicts and natural disasters in the 3-year study period, with the African Region accounting for the most ($n=18$). Natural disasters produced the greatest number of newly internally displaced persons (IDPs) (>35 million) and the greatest number of IDPs with TB (55,846). Although countries experiencing conflict only did not have the greatest number of IDPs (>19 million), the burden of TB was greatest in these countries, with IDPs accounting for 1.8% of the TB burden compared with 0.4% for natural disasters and 1.6% for both emergencies. The proportion of TB burden paralleled the World Bank's economic classifications, with 0.03% TB burden among IDPs in high-income countries, 0.32% upper-middle, 0.94% lower-middle, and 1.32% in low-income countries.

Discussion: These estimates illustrate the high TB burden among emergency-displaced populations. The most notable finding was the 4-fold greater TB burden among IDPs from conflicts as compared to natural disasters. New IDPs have disrupted TB care and treatment, necessitating the need for quick remedies to ameliorate their excess TB-related morbidity and mortality. As such, our findings underscore the importance of implementing TB control programs as soon as possible in the acute phase of an emergency.

INTRODUCTION

Tuberculosis (TB) remains a significant global public health issue, ranked as the second leading cause of mortality due to a single infectious agent after the human immunodeficiency virus (HIV). In 2013, there were an estimated 9 million new TB cases and 1.5 million associated deaths.¹ Despite a decline in worldwide prevalence over the last decade – largely attributable to effective diagnosis and treatment – TB-associated mortality remains unacceptably high given it is preventable.¹ The TB burden is notably high among displaced persons in humanitarian emergency settings;² quantification of the burden is an important opportunity to prevent TB-associated morbidity and mortality in these populations.

A substantial proportion of the world's population is affected by humanitarian crises,ⁱ³ resulting in high numbers of both internally displaced persons (IDPs) and refugees.ⁱⁱ By the end of 2013, there were approximately 51.2 million people forcibly displaced (including 33.3 million IDPs), 6 million more than in the previous year.⁴ IDPs tend to have worse health outcomes than refugees because of a disproportionate lack of protection and healthcare accessibility. Over-crowding, diminished environmental and security conditions, co-morbidities (e.g., HIV infection), disrupted health services, malnutrition, and non-adherence to treatment contribute not only to greater TB rates, but also to progression from latency to active TB.⁵⁻⁷ Globally, about one-third of the population has latent TB, with a 10% lifetime risk of developing active TB disease.⁸⁻⁹ However, because TB is believed to not be an infectious disease affecting individuals in the acute phases of

ⁱ We use the definition of humanitarian crisis provided by the International Federation of Red Cross and Red Crescent Societies, which defines it as any situation in which there is "total or considerable breakdown of authority resulting from internal or external conflict and which requires an international response that goes beyond the mandate or capacity of any single agency and/or the ongoing UN country program (IASC)."

ⁱⁱ While both IDPs and refugees are forced to flee their homes due to emergencies or conflict, an important distinction is that IDPs remain in their home countries while refugees cross international borders.

a humanitarian emergency – and because it is often difficult to measure the burden of TB in these settings – control programs are not prioritized; they are typically left to the recovery phase.^{2, 10}

A number of studies have examined the burden of TB in conflict and natural disaster settings, although most have focused on specific countries and emergencies.¹¹⁻²⁴ A recent systematic review examined the TB burden among crisis-affected populations by describing the burden in emergency settings and analyzing surveillance prevalence and notification data². Moreover, Lowicki-Zucca and colleagues recently quantified the proportion of crisis-affected people living with *HIV* globally.²⁵ However, to date, no study has systematically quantified the number and proportion of internally displaced people with *TB* in acute emergency settings. Therefore, the objective of this study was to assess the effect of both natural and man-made emergencies – acute or exacerbated – on the burden (prevalence) of TB in emergency-afflicted countries in three study years (2009, 2011, and 2013) using global and regional estimates and following a similar methodology as Lowicki-Zucca *et al.* Additionally, we discuss the implications of these estimates on global policy, particularly the early establishment and maintenance of TB control programs in humanitarian emergencies.

METHODS

Summary

Countries affected by acute emergencies were identified for years 2009, 2011, and 2013. For each country included in the analysis, we estimated the number of emergency-affected displaced persons. We then applied national TB prevalence rates to these estimates in order to derive the number and proportion of emergency-affected displaced persons with TB disease. Only new

influxes of IDPs and refugees were considered. Estimates were aggregated by WHO region, type of emergency, and country economic classification.

Country Selection

Emergency-affected countries for the years 2009, 2011, and 2013 were identified using the following publically available databases: (1) humanitarian funding appeals published by the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA), (2) global estimate reports on both the natural disaster- and conflict-inducing internal displacement published by the Internal Displacement Monitoring Center (IDMC), and (3) UN High Commissioner for Refugees (UNHCR) statistical yearbooks. The humanitarian appeals include both Consolidated Appeal Processes (CAPs) and flash appeals; countries were included when they were affected by an emergency – whether man-made or caused by a natural disaster.

Countries were included in the analysis only if they met all of the following criteria: (1) they experienced an emergency – either conflict or natural disaster –that was in the acute phase (i.e. the emergency began in the given year) OR the emergency was exacerbated within the year and led to newly displaced persons and (2) the emergency resulted $\geq 50,000$ newly displaced IDPs.

Study Period and Population

Each country included in the analysis experienced an emergency that yielded at least 50,000 new IDPs in 2009, 2011, or 2013. We selected 50,000 IDPs as a cut-off in order to minimize the number of countries included in the analysis. In addition to these newly displaced IDPs, we also obtained estimates for both IDPs and refugees *returning* to the country (i.e. their country of origin) within the last six months of the given year, since these populations might be under similar circumstances as those of newly displaced IDPs.

We extracted from the humanitarian appeals and IDMC and UNHCR reports (1) the cause of emergency (e.g., hurricane, conflict, flooding), (2) whether the emergency was in the acute phase or ongoing, and (3) the estimated number of IDPs displaced by the emergency.

Emergency-Affected Displaced Population Estimates

Both the humanitarian appeals and the UNHCR reports include estimates of the number of IDPs displaced by the emergency; when available, these estimates were captured. However, when this information was not reported in the humanitarian appeal or UNHCR report, we searched other publically available databases, including (1) the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) and (2) the global internally displaced persons (IDP) project database.

Estimates of newly returned IDPs (within last 6 months), and newly returned refugees (within last 6 months) were obtained from UNHCR's statistical yearbooks.

Because it is difficult to estimate the population of IDPs in an emergency, we corroborated each estimate with up to three additional sources (depending on how many estimates were published) using the aforementioned databases and Google searches. For those individual emergencies in a specific country where more than one estimate was obtained, we used the median as the final estimate for all subsequent calculations.

Estimates of Emergency-Affected Displaced Population with Tuberculosis

TB estimates among the emergency-affected population were determined using the TB prevalence in the country (all forms, including HIV co-morbidity) obtained from WHO reports.²⁶⁻²⁸ We multiplied these prevalence rates by the number of each affected population group (IDPs, returned IDPs, and returned refugees). For instance, to estimate the number of

emergency-affected IDPs with TB in 2009, we multiplied the 2009 prevalence rate of TB for that country times the number of IDPs displaced; the same was done for newly returned IDPs and refugees. Finally, a summation of the three groups was calculated to estimate the total estimated number of newly emergency-affected displaced persons with TB. These estimates were then transformed into proportions of each country's TB burden. Country estimates were aggregated into regional (based on WHO-specified regions) and global estimates, and the results were stratified by type of emergency (conflict vs. natural disaster) and country economic status (low-, lower-middle-, upper-middle-, and high-income) based on the World Bank's income classifications.²⁹

Ethics

Institutional review board approval was not required for this study, as it was not human subjects research.

RESULTS

Regions Affected by Emergencies

In 2009, 2011, and 2013, a total of 45 countries were identified as having experienced either an acute emergency or exacerbation of an ongoing emergency producing at least 50,000 new IDPs. The African Region had the most emergency-affected countries (N=18, 40.0%), followed by the Region of the Americas and the Eastern Mediterranean Region, each of which had seven countries (15.6% each) (Tables 1 & 2). All regions had multiple countries that experienced an emergency during at least two of the three study years, except for the European Region, in which only one country (Turkey) experienced only one natural disaster in 2011 (Table 1). For all study years, over half of the countries (N=25, 55.6%) experienced more than one emergency, 11

(24.4%) of which were affected by both natural disasters *and* conflict (Table 1). 2013 had the highest number of both conflicts (N=7) and natural disasters (N=11) (Table 1).

Populations Displaced by Emergencies

The number of emergency-affected displaced persons increased between 2009 and 2013; in both 2009 and 2011, there were approximately 18 million newly emergency-affected displaced persons globally. In 2013, however, there were nearly 30 million (Table 2). The African Region saw a slight decline from 2009 to 2011, although in 2013 the number of displaced persons was over three times the amount in either 2009 or 2011. In the Region of the Americas, there was an increase from about one million displaced to over 2 million, followed by a decrease to under 800,000 in 2013. The South-East Asia Region saw a marked decline in 2011 and 2013, decreasing from about 7.5 million to about 3.5 million in the two subsequent years. The European Region had about a quarter million displaced in 2011, but none in the other years. In the Eastern Mediterranean Region, numbers jumped from between about 3 to 4 million in 2009 and 2011 to over 7.5 million in 2013. Finally, in the Western Pacific Region, the number of displaced increased each year, increasing from about 3 million in 2009 to over 7 million in 2011 to nearly 10.5 million in 2013 (Table 2). Each region – across all three study years – had significantly more *new* IDPs displaced from emergencies than either returned IDPs or returned refugees (Table 2).

Across the three study years, natural disasters accounted for the majority of acute or exacerbated ongoing emergencies, with 25 countries (55.6%) experiencing one or more natural disasters in 2009, 2011, and/or 2013. In comparison, 10 countries (22.2%) experienced only conflict and another 10 experienced *both* natural disasters and conflict (Table 3). Natural disasters also produced the highest numbers of newly displaced (nearly 36 million as compared to about 20

million for conflicts and about 10.5 million for both) (Table 4). The number of newly displaced from natural disasters was similar across all three years – about 11 million in 2009, nearly 14 million in 2011, and nearly 11 million in 2013. Countries experiencing only conflict had significantly more newly displaced persons in 2013 (about 11 million compared to about 6 million in 2009 and about 2.5 million in 2011) (Table 4).

Burden of Emergency-Displaced Persons with TB by Type of Emergency

Natural disasters also produced the highest number of emergency-affected persons with TB as compared to countries experiencing conflict (55,846 vs. 45,050); countries experiencing only conflict had the fewest, with 31,971 emergency-affected persons with TB (Table 4).

For the *proportion* of TB burden in the emergency-affected population, however, the opposite trend was seen; for countries experiencing only conflict, nearly 2% of the TB burden was in the emergency-affected population, compared with about less than half percent in countries experiencing only natural disaster and just over 1.5% in those experiencing both (Table 4). In 2013 the proportion was highest, with 2.18% of the TB burden occurring among the emergency-affected population (compared to 1.78% in 2009 and 0.97% in 2011) (Table 4).

Burden of Emergency-Displaced Persons with TB by Economic Status

For all three years, low-, lower-middle-, and upper-middle-income countries accounted for significantly higher numbers of emergency-displaced persons as compared to high-income countries (cumulative 65,877,212 vs. 221,000) (Table 5). The number of displaced in low-income countries was higher in 2013 (nearly 7 million compared to nearly 3 million in both 2009 and 2011); the same was true for lower-middle income countries, with nearly 18 million displaced in 2013 compared to about 11 million in 2009 and about 6 million in 2011 (Table 6).

The number of emergency-affected persons with TB disease was higher in both low- (56,727) and lower-middle-income countries (77,663) as compared to upper-middle- (13,738) and high-income countries (9) (Table 5). Among upper-middle-income countries, the number of displaced with TB was higher in 2011 (about 8,000) compared to 2009 and 2013 (about 3,000 in each)

The proportion of TB burden in the emergency-affected population, which was proportionate to economic classification, was similar among low- (1.32) and lower-middle- (0.94); upper-middle-income countries had a lower burden (0.32), and high-income countries had the lowest burden (0.03) (Table 6). Among low-income, the proportion was highest in 2013 (1.59% compared to 1.04% in 2009 and about 1.31% in 2011); the same was true for lower-middle-income countries, with emergency-displaced populations accounting for 1.81% of TB in 2013 (compared to 0.63% in 2009 and 0.38% in 2011). Among upper-middle-income countries, the proportion was highest in 2011 (0.43% compared to 0.23% in 2009 and 0.29% in 2013) (Table 6).

DISCUSSION

Results of this study quantify, for the first time, the burden of TB among newly displaced populations affected by acute emergencies. Most countries experienced both conflicts and natural disasters, with the African Region accounting for the most. While natural disasters produced the greatest number of both newly displaced persons and newly displaced persons with TB, the *burden* of TB among the displaced persons was greatest in countries experiencing conflict only and in low-income countries. As such, these results provide quantitative evidence of the particularly high TB burden in conflict settings, especially those in low-resource settings. Our results corroborate those published by Kimbrough *et al.*, who reported elevated notification and prevalence rates among countries experiencing displacement, armed conflict, and natural

disaster.² Additionally, Lowicki *et al.* quantified the proportion of crisis-affected people living with *HIV* globally.²¹

Despite the notable findings and strengths of the study, there are several limitations. First, the estimates do not represent trends through the reference years and cannot be interpreted as such; emergencies are fluid events and are often unpredictable. Second, the humanitarian appeals used for the identification of countries and the estimates of populations affected by emergencies are not sufficiently standardized given the difficulty in collecting such data. Third, for standardization purposes, we made the assumption that TB prevalence was uniformly distributed throughout the population, although this is probably not always the case. Finally, this study did not account for several factors: (1) the co-epidemic of HIV or MDR/XDR TB, (2) malnutrition and overcrowding, (3) the length of IDP status, (4) the likelihood that NGOs may begin to operate sooner in disaster settings as compared to conflict, potentially resulting in more active TB case detection, and (5) the likelihood of notable differences between natural disasters and armed conflict in terms of TB prevalence and the implementation and maintenance of control programs.

These results underscore the importance of implementing TB control programs as soon as possible in the acute phases of an emergency. Established criteria exist, although these programs are oftentimes left to after the acute phase.³¹ If TB is neglected or left for the latter stages of an emergency, it may result in excess TB-associated morbidity and mortality, as demonstrated in Bosnia, Herzegovina,³² Somalia,³³ and Iraq.³⁴ However, successful TB control programs *have* been demonstrated in several countries, including Somalia and Iraq, where there was (1) visible

leadership by one agency, (2) effective partnership and collaboration between parties (i.e. identifying alternative routes to bring drugs to patients), (3) flexible and locally-tailored management (i.e. matching patients to nearest clinics), (4) increased funding (i.e. re-directing domestic spending toward TB), (5) an active social network system (i.e. emergency cell phone units), and (6) active community involvement.³⁴⁻³⁵ The use of “runaway bags,” which contain several weeks’ supply of anti-TB medication, has also proven to be useful in ensuring the continuation of therapy.³⁶ These examples provide evidence suggesting it is possible to implement successful TB control programs in the acute phase of an emergency, and we hope this quantification aids in the prioritization of such programs.

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Conflict of interest

The authors have no conflict of interest to report.

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TABLES AND FIGURES

Table 1. Countries[¶] Affected by Conflicts or Natural Disasters, by WHO Region and Year, 2009, 2011, and 2013

WHO Region	Year					
	2009		2011		2013	
	Conflict	Natural Disaster	Conflict	Natural Disaster	Conflict	Natural Disaster
African Region (n=7)						
Democratic Republic of Congo	+				+	
Ethiopia	+				+	+
Kenya						+
Mozambique						+
Nigeria		+	+		+	+
South Africa				+		
Zimbabwe					+	
Total	2	1	1	1	4	4
Region of the Americas (n=1)						
Brazil		+		+		
Total		1		1		
Eastern Mediterranean Region (n=2)						
Afghanistan				+	+	
Pakistan	+			+	+	+
Total	1			2	2	1
European Region (n=0)						
South-East Asia Region (n=4)						
Bangladesh		+		+		+
India		+		+		+
Indonesia		+				
Thailand			+	+		
Total		3	1	3		2
Western Pacific Region (n=4)						
Cambodia				+		+
China		+		+		+
Philippines		+		+	+	+
Vietnam						+
Total		2		3	1	4

[¶]Includes only top 22 high TB-burden countries and those with $\geq 50,000$ newly Internally Displaced Persons

Table 2. Number and Type of Newly Displaced Persons in Countriesⁱ Affected by Conflicts or Natural Disasters, by WHO Region and Year, 2009, 2011, and 2013

Region	n	2009			Year 2011			2013		
		IDPs ⁱⁱ	Returned IDPs ⁱⁱⁱ or Refugees ⁱⁱⁱ	Total	IDPs ⁱⁱ	Returned IDPs ⁱⁱⁱ or Refugees ⁱⁱⁱ	Total	IDPs ⁱⁱ	Returned IDPs ⁱⁱⁱ or Refugees ⁱⁱⁱ	Total
African	18	2,290,142	123,256	2,413,398	1,114,288	478,798	1,593,086	6,731,500	831,978	7,563,478
Americas	7	1,086,000	60	1,086,060	2,348,354	24	2,348,378	794,959	17	794,976
South-East Asia	6	7,450,805	96,401	7,547,206	3,500,320	146,943	3,647,263	3,452,000	41,604	3,493,604
European	1	0	0	0	252,000	0	252,000	0	0	0
Eastern Mediterranean	7	2,703,602	1,106,400	3,810,002	1,650,735	1,380,194	3,030,929	7,281,353	292,892	7,574,245
Western Pacific	6	2,958,000	0	2,958,000	7,405,399	0	7,405,399	10,268,581	211,607	10,480,188
Total		16,488,549	1,326,117	17,814,666	16,271,096	2,005,959	18,277,055	28,528,393	1,378,098	29,906,491

ⁱ Countries included are those with $\geq 50,000$ New Internally Displaced Persons (IDPs)

ⁱⁱ median number of new IDPs

ⁱⁱⁱ IDPs returning to emergency-affected country-of-origin within first 6 months; refugees returning to emergency-affected country-of-origin within first 6 months

Table 3. Number of Newly Displaced Persons and the Proportion with Tuberculosis in Countriesⁱ Affected by Conflicts or Natural Disasters, by Emergency, 2009, 2011, and 2013

Emergency	# Newly Displaced Persons (IDPs)ⁱⁱ	# with Tuberculosis	(%)
Conflict (n=10)			
Central African Republic	1,043,195	4,360	11.44
Colombia	569,560	194	0.41
Congo, Dem. Rep	2,786,755	12,668	2.16
Cote d'Ivoire	713,808	1,327	3.68
Gaza Strip - OPT	100,500	2	6.67
Libya	1,086,998	652	17.80
Mali	179,531	108	1.18
Syrian Arab Republic	6,796,756	4,014	14.89
Yemen, Rep.	331,024	173	0.73
Zimbabwe	1,100,002	4,449	7.77
Total	14,708,129	27,947	6.67
Natural Disaster (n=25)			
Angola	207,967	644	1.03
Bangladesh	2,342,000	5,259	0.51
Brazil	600,000	287	0.16
Burkina Faso	120,000	476	0.79
Cambodia	358,000	1,481	1.21
Canada	120,000	6	0.34
Chad	272,726	474	1.10
China	11,199,000	8,313	0.28
El Salvador	59,854	19	0.98
Haiti	1,820,000	5,418	9.03
India	8,573,241	15,832	0.73
Indonesia	675,311	1,290	0.28
Japan	1,270,000	246	0.50
Kenya	170,000	456	0.38
Lao PDR	50,000	107	0.77
Mexico	959,000	199	0.27
Mozambique	186,000	1,027	0.72
Namibia	114,072	755	2.61
Nepal	50,001	120	0.19
Niger	201,000	205	1.13
Senegal	264,000	359	2.10
South Africa	52,172	481	0.10
Turkey	252,000	60	0.34
United States	101,000	3	0.03
Vietnam	1,100,000	158	0.12
Total	31,117,344	43,675	1.03
Both (n=10)			
Afghanistan	961,446	2,048	0.99
Ethiopia	484,042	1,177	0.27
Nigeria	792,516	2,682	0.23
Pakistan	4,654,505	15,955	0.91
Philippines	6,866,587	27,879	2.36
Somalia	483,947	1,7001	2.54
South Sudan	1,120,756	3,140	3.61
Sri Lanka	1,497,520	1,152	2.43
Sudan	1,861,420	3,574	4.90
Thailand	1,550,000	1,907	2.33
Total	20,272,739	76,515	2.06

ⁱ Countries included are those with $\geq 50,000$ newly Internally Displaced Persons (IDPs)

ⁱⁱ Includes new IDPs, returned IDPs, and returned refugees

Table 4. TB Burden Among Newly Displaced Persons in Countriesⁱ Affected by Conflicts or Natural Disasters, by Emergency, 2009, 2011, and 2013

Emergency	Number displaced (N)	2009		Year 2011		2013		Annual average		
		Number displaced with TB	TB burden among displaced vs. national prevalence (weighted %)	Number displaced (N)	Number displaced with TB	Number displaced (N)	Number displaced with TB	TB burden among displaced vs. national prevalence (weighted %)	TB burden among displaced vs. national prevalence (weighted %)	
Conflictⁱⁱ	5,931,429	22,611	1.66	2,689,110	3,273	0.50	11,009,713	19,166	4.36	1.83
Natural Disasterⁱⁱⁱ	11,204,263	19,485	0.36	13,903,998	23,663	0.45	10,725,988	12,698	0.60	0.44
Both^{iv}	678,974	448	3.32	1,683,947	2,607	1.95	8,170,790	28,916	1.58	1.61

ⁱ Countries included are those with $\geq 50,000$ newly Internally Displaced Persons (IDPs)

ⁱⁱ 9 countries experienced conflict in 2009, 7 in 2011, and 7 in 2013

ⁱⁱⁱ 12 countries experienced natural disasters in 2009, 19 in 2011, and 15 in 2013

^{iv} 1 country experienced both conflict and natural disasters in 2009, 2 in 2011, and 6 in 2013

^v Includes new IDPs, returned IDPs, and returned refugees

Table 5. Number and Proportion of Newly Displaced Persons with Tuberculosis in Countriesⁱ Affected by Conflicts or Natural Disasters, by Economic Classification, 2009, 2011, and 2013

Economic Classificationⁱⁱ (income)	# Newly Displaced Personsⁱⁱⁱ	# with Tuberculosis	(%)
Low (n=16)			
Afghanistan	961,446	2,048	0.99
Bangladesh	2,342,000	5,259	0.51
Burkina Faso	120,000	476	0.79
Cambodia	358,000	1,481	1.21
Central African Republic	1,043,195	4,360	11.44
Chad	272,726	474	1.10
Congo, Dem. Rep	2,786,755	12,668	2.16
Ethiopia	484,042	1,177	0.27
Haiti	1,820,000	5,418	9.03
Kenya	170,000	456	0.38
Mali	179,531	108	1.18
Mozambique	186,000	1,027	0.72
Nepal	50,001	120	0.19
Niger	201,000	205	1.13
Somalia	483,947	1,7001	2.54
Zimbabwe	1,100,002	4,449	7.77
TOTAL	12,558,645	56,727	1.32
Lower-middle (n=16)			
Côte d'Ivoire	713,808	1,327	3.68
El Salvador	59,854	19	0.98
Gaza Strip, OPT	100,500	2	6.67
India	8,573,241	15,832	0.73
Indonesia	675,311	1,290	0.28
Lao PDR	50,000	107	0.77
Nigeria	792,516	2,682	0.23
Pakistan	4,654,505	15,955	0.91
Philippines	6,866,587	27,879	2.36
Senegal	264,000	359	2.10
South Sudan	1,120,756	3,140	3.61
Sri Lanka	1,497,520	1,152	2.43
Sudan	1,861,420	3,574	4.90
Syrian Arab Republic	6,796,756	4,014	14.89
Vietnam	1,100,000	158	0.12
Yemen, Rep.	331,024	173	0.73
TOTAL	35,457,798	77,663	0.94
Upper-middle (n=11)			
Angola	207,967	644	1.03
Brazil	600,000	287	0.16
China	11,199,000	8,313	0.28
Colombia	569,560	194	0.41
Japan	1,270,000	246	0.50
Libya	1,086,998	652	17.80
Mexico	959,000	199	0.27
Namibia	114,072	755	2.61
South Africa	52,172	481	0.10
Thailand	1,550,000	1,907	2.33
Turkey	252,000	60	0.34
TOTAL	17,860,769	13,738	0.32
High (n=2)			
Canada	120,000	6	0.34
United States	101,000	3	0.03
TOTAL	221,000	9	0.03

ⁱ Countries included are those with $\geq 50,000$ newly Internally Displaced Persons (IDPs)

ⁱⁱ World Bank classification

ⁱⁱⁱ Includes new IDPs, returned IDPs, and returned refugees

Table 6. Number and Proportion of Newly Displaced Persons with Tuberculosis in Countriesⁱ Affected by Conflicts or Natural Disasters, by Economic Classification and Stratified by Year, 2009, 2011, and 2013

Economic Classification (income)	Year									Average TB burden (%)
	2009			2011			2013			
	# ⁱⁱ	# with Tuberculosis (TB)	(%)	# ⁱⁱ	# with TB	(%)	# ⁱⁱ	# with TB	(%)	
Low	2,807,368	11,830	1.04	2,955,887	8,064	1.31	6,795,390	21,583	1.59	1.32
Lower-middle	11,309,207	27,950	0.63	6,067,466	13,636	0.38	17,981,125	36,057	1.81	0.94
Upper-middle	3,698,091	2,764	0.23	9,253,702	7,843	0.43	4,908,976	3,131	0.29	0.32
High	0	0	0	0	0	0	221,000	11,242	0.08	0.03

ⁱ Countries included are those with $\geq 50,000$ newly Internally Displaced Persons (IDPs)

ⁱⁱ Includes new IDPs, newly returned IDPs, and newly returned refugees

CHAPTER IV: Public Health Implications and Recommendations

Public Health Implications

This study represents the first quantification of the burden (prevalence) of tuberculosis (TB) among acute emergency-displaced persons – both internally displaced persons (IDPs) and refugees. The results culminated from this thesis project have considerable public health implications, particularly in the context of global humanitarian emergencies in lower-resource settings.

Today, TB remains one of the most significant public health issues, responsible for the second highest number of deaths from an infectious agent. Humanitarian emergencies also serve as an integral part of global public health work, given the high number of both conflicts and natural disasters occurring each year. As is often the case, these emergencies exacerbate the effect and magnitude of the spread of infectious diseases due to a number of factors: overcrowding, malnutrition, diminished government and public health infrastructure, and displacement.

Persons displaced during the *acute* phase of an emergency are particularly susceptible to the negative health effects commonly associated with displacement. This is because the early stages of an emergency are when the public health infrastructure is abruptly disrupted, resulting in displaced persons not receiving the treatment or care needed. Moreover, because of the

particularly tumultuous nature of the acute phase of an emergency, the spread of infectious diseases like TB is often not blatantly apparent.

These results quantify the burden of TB among displaced populations affected by acute emergencies – both conflict and natural disasters. There were a total of 158,324 people with TB who were also affected by emergencies in 2009, 2011, and 2013. While natural disasters produced the highest numbers of newly displaced persons and emergency-affected persons with TB, the *burden* of TB among the displaced populations was highest (more than four-fold) among countries experiencing acute or exacerbated conflict and in countries with low economic classification. As such, these results provide quantitative evidence of the particularly high TB burden in conflict settings, especially those in low-resource settings.

Moreover, our results corroborate those published in several studies. Kimbrough *et al.* reported elevated notification and prevalence rates among countries experiencing displacement, armed conflict, and natural disaster.² Additionally, Lowicki *et al.* quantified the proportion of crisis-affected people living with *HIV* globally.²¹ These reported elevated rates among emergency-affected populations are due to several key factors – a breakdown in social structures, insufficient income and access to basic needs, sexual violence and abuse, and inadequate health infrastructure and education.³⁰

Recommendations

This article presents, for the first time, global and regional estimates of the prevalence of TB in acute emergency settings. These estimates illustrate the high TB burden among acute emergency-displaced populations and underscore the importance of implementing TB control programs as

soon as possible in the acute phases of an emergency. They also provide rationale for the advocacy of a more comprehensive inclusion of TB-related issues in emergency preparedness and response initiatives. Countries experiencing acute or exacerbated conflict in particular should be prioritized, given the burden of TB among conflict-displaced populations is more than four times as high as that of those displaced by natural disasters.

Newly displaced persons, given the tumultuous nature of humanitarian emergencies, have disrupted TB care and treatment, necessitating the need for quick remedy in order to ameliorate their excess TB-related morbidity and mortality.³¹ There are established criteria for TB control programs in such settings, although these programs are oftentimes left to after the acute phase.³² If TB is neglected or left for the latter stages of an emergency, it may result in excess TB-associated morbidity and mortality, as was demonstrated in Bosnia, Herzegovina,³³ Somalia,³⁴ and Iraq.³⁵

TB control programs have been successful in several emergency-affected regions and have been demonstrated in several countries, including Somalia and Iraq. Factors for success have included visible leadership by one agency, effective partnership and collaboration between parties (i.e. identifying alternative routes to bring drugs to patients), flexible and locally-tailored management (i.e. matching patients to nearest clinics), increased funding (i.e. re-directing domestic spending toward TB), an active social network system (i.e. emergency cell phone units), and active community involvement.³⁵⁻³⁶ Moreover, adherence to prescribed anti-TB treatment is of particular importance in these settings. For instance, “runaway bags,” with several weeks’ supply of anti-TB medication, have been used to ensure the continuation of therapy.³¹

These examples provide evidence suggesting it is possible to implement successful TB control programs in the acute phase of an emergency. We hope that the quantification of the burden of TB among emergency-affected displaced populations provided in this study will aid in the continued development of program guidance and support, and, in particular the prioritization of implementation of control programs in the acute phases of emergencies.

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