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Die Bedeutung von Globaler Gesundheit im Kontext des deutschen Gesundheitswesens

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INHALTSVERZEICHNIS

ABKÜRZUNGEN

AIDS	Acquired Immune Deficiency Syndrome / Akquiriertes Immun Defizienz Syndrom
BMG	Bundesministerium für Gesundheit
HIV	Human Immunodeficiency Virus / Humanes Immundefizienz-Virus
PHC	Primary Health Care / Basisgesundheitsversorgung
PRND	Poverty-Related Neglected Diseases / Armuts-assoziierte vernachlässigte Krankheiten
SDGs	Sustainable Development Goals / Nachhaltige Entwicklungsziele
SDH	Social Determinants of Health / Soziale Determinanten für Gesundheit
UHC	Universal Health Coverage / Universelle Krankheitsversorgung
WHO	World Health Organisation / Weltgesundheitsorganisation

1. EINLEITUNG

Global betrachtet werden in den letzten Jahrzehnten (weiterhin) die liberalen Demokratien des globalen Nordens sowie einige asiatischen Staaten immer mächtiger und reicher. Gleichzeitig ziehen sich diese Staaten aus ihrer Verantwortung gegenüber den Bürgern zurück, in dem sie öffentliche Aufgaben an ihre Staatsbürger übertragen und bestehende staatliche Grenzen aufheben, welche die Mobilität von Kapital, Gütern, Menschen, Ideen und Werte begrenzen. (1)

Und während in diesem Prozess Menschen weltweit technisch, ökonomisch, kulturell, politisch und sozial immer stärker miteinander verbunden und voneinander abhängig werden, geraten die Staaten dabei immer mehr ins Wanken. Sozialer Zusammenhalt und das Vertrauen in staatliche Institutionen schwindet, während sozioökonomische Ungleichheit steigt, und politische Extreme weiten sich aus. (2–4)

Auswirkungen der Globalisierung

In einer globalisierten Welt werden Entscheidungen mit dem Potential weltweiter Auswirkungen unabhängig von internationalen, regionalen oder selbst nationalen Bedürfnissen getroffen. Diese Entwicklung stellt nationale Identität und Territorialität sowie die damit verbundenen staatlichen Systeme in Frage. Der damit verbundene Diskurs drückt sich darin aus, dass wettstreitende gesellschaftliche Prinzipien (wieder) in Frage gestellt werden z.B. in den Diskussionen, ob ein freier Markt oder ein freier Staat, unbegrenzte Freiheit oder staatliche Regulation, Autokratie oder Demokratie benötigt wird (5).

Diese Entwicklungen hat die gesamte Menschheit erstmals in eine Situation gebracht, in der die Spezies Mensch global voneinander abhängig ist und durch bewusste Entscheidung über gemeinsame lebensnotwendige Ressourcen kollektiv bestimmen muss. Allerdings fordert die derzeit (noch) vorherrschende Ideologie der Menschheit, (wirtschaftliches) Wachstum insgesamt zu beschleunigen, ohne rational empirisch zu entscheiden wer davon profitiert zunehmend die regenerative Kapazität der „Grenzen des Systems Erde“ (*planetary boundaries*) heraus (6). In 2020 tragen besonders die Maßnahmen zur Einschränkung der Verbreitung von SARS-CoV-2 dazu bei, dass die

bestehenden Weltwirtschaftssysteme zunehmend erschüttert werden und sich wahrscheinlich die Armut weltweit erhöht (7).

Diese Herausforderungen erzwingen einen Umbau bestehender nationaler und globaler Steuerungssysteme insbesondere in den Bereichen Sicherheit, Wirtschaft, Politik und Soziales, um damit verbundene irreversible Schäden an den Weltökosystemen und an der Funktionalität nationalstaatlicher Regierungen sowie Auswirkungen auf die Gesundheit von Bevölkerungen und Individuen zu vermeiden.

Im Umgang mit diesen Herausforderungen hat sich das Konzept „Globale Gesundheit“ entwickelt. Die Bezeichnung Globale Gesundheit wurde bereits in den 1990er Jahren in der Umweltbewegung benutzt. Der Begriff sollte auf Auswirkungen der globalen Klima- und Umweltzerstörung auf die Gesundheit aller Menschen weltweit aufmerksam machen. (8–10) Die Entstehung des Konzeptes wird darüber hinaus auch damit verbunden, dass HIV/AIDS das Paradigma „internationale Gesundheit“ in Frage gestellt hat (11). Heute wird der Begriff Globale Gesundheit vor allem benutzt im Kontext von Transnationalität und ökonomischer Globalisierung sowie von zunehmenden gesellschaftlichen Herausforderungen und Transformationsprozessen mit globalen Ausmaßen. (12–15)

Erfolgsmodell: Deutsches Gesundheitswesen

Gesundheit wird traditionell als die Grundlage und Voraussetzung für gesellschaftliche Entwicklung verstanden. Die historischen Ursprünge liegen im sozialmedizinischen Verständnis der Auswirkungen von Lebensumständen auf die Gesundheit, vor allem, dass ein Leben in Armut direkt oder indirekt zu erhöhter Morbidität und vorzeitiger Mortalität führen kann. Bereits im Jahr 1809 erklärte Christoph Wilhelm Hufeland, Leibarzt des preußischen Königs, dazu "Aber wenn Krankheit zur Dürftigkeit kommt, dann erst tritt die wahre Hülflosigkeit ein, und es wird heilige Pflicht der Mitmenschen und des Staates, dem Verlassenen beizustehen" um staatliche Institutionen verbindlich auf ihre Verantwortung hinzuweisen (16).

In der zweiten Hälfte des 19ten Jahrhunderts stiegen mit technischem Fortschritt und zunehmender Industrialisierung die individuellen Lebensrisiken. In diesem sozialen Wandel wurden politische Forderungen nach staatlichen Maßnahmen zum Ausgleich

der individuellen Risiken stärker. Aus dieser Erkenntnis und politischem Machtkalkül resultierte die Bismarck'sche Sozialgesetzgebung als ein möglichst umfassendes Konzept sozialer Sicherung, auf deren Basis bis heute das weltweit als Erfolgsmodell angesehene deutsche Gesundheitswesen mit seiner qualitativ hochwertigen medizinischen Versorgung basiert. (17,18) Die dadurch zur Verfügung gestellten Leistungen haben das Ziel, die Lebenslagen Einzelner auszugleichen, die zu Benachteiligungen führen würden. Der Bevölkerung ermöglichte die staatliche Regulierung der Maßnahmen, sich aus dem System Barmherzigkeit gegenüber Armen und Kranken zu emanzipieren. Diese geschichtliche Entwicklung stellt die Grundlage der klassischen Sozialmedizin dar, die seit der Einführung der Sozialversicherungen durch Bismarck bis heute eng mit der Versicherungsmedizin verknüpft ist (19).

Soziale, ökonomische und politische Determinanten haben einen großen Einfluss auf Gesundheit und Krankheit (20). Um Gesundheit zu fördern und Krankheit zu bekämpfen, sind daher neben medizinischen soziale und politische Maßnahmen notwendig. Die theoretische Auseinandersetzung und Verortung einer modernen Sozialmedizin spiegelt sich in den letzten Jahrzehnten, insbesondere im Kontext der wissenschaftlich-konzeptionellen Debatten zu Tropenmedizin, Internationaler Gesundheit, Öffentlicher Gesundheit und Globaler Gesundheit wieder (14,15,21–24).

Während global einerseits die individuelle Übernahme von gesundheitlichen Risiken durch die Ausweitung von beispielsweise privaten Krankenversicherungen oder öffentlich-privaten Partnerschaften in der Entwicklungshilfe gefördert wurden, wurde andererseits weltweit staatliche Gesundheitsversorgung abgebaut und unterfinanziert. (25–28) Gleichzeitig wurde die Debatte um Gesundheit zunehmend über nationalstaatliche Grenzen hinweg aus einer globalen Perspektive geführt. (21) In dieser Debatte wird heute wieder das Leitmotiv Solidarität neu aufgegriffen, das der klassischen Sozialmedizin zugrunde liegt. Es wird durch zivilgesellschaftlichen Lobbyismus als kontemporäres politisches Mittel genutzt, um im Sinne einer modernen Sozialmedizin im nationalen und globalen Kontext zu fordern, Gesundheitsvorsorge und -fürsorge von marktwirtschaftlichen Mechanismen zu entkoppeln (24).

Die Notwendigkeit einer Veränderung gesellschaftlicher Verhältnisse zur Verbesserung der Gesundheit von Bevölkerungen wird so wieder zum Anliegen einer sozialen Medizin im Sinne des Alfred Grotjahn, dem ersten Professor für Sozialhygiene

an der Charité. Sie entspricht der von ihm postulierten normativen Sozialhygiene, die der Verbesserung der Gesundheit von Menschen unterschiedlicher sozialer Schichten dienen soll und der er die deskriptive Sozialhygiene gegenüberstellt, die die Auswirkungen sozialökonomischer Faktoren auf die Gesundheit der Bevölkerung erforscht. (29) Die beiden Perspektiven finden sich bis heute in Diskussionen zu Bevölkerungsgesundheit auf nationaler, internationaler und globaler Ebene wieder, auf der einen Seite die Betrachtung der sozialen Faktoren für die individuelle Krankheitsentstehung und auf der anderen Seite das staatliche Bemühen um Krankheitsvorsorge und Gesundheitsfürsorge. (13,15) Auch wenn in Diskussionen auf den unterschiedlichen Ebenen Gesundheit als gleichwertig wichtig gesehen wird, so wird Globale Gesundheit als inklusiver umfassender und werte-basiert mit altruistischer Motivation im Sinne des Konzeptes „Gesundheit für Alle“ (*health-for-all*) verstanden, die Sozialmedizin bietet dabei weiterhin eine verbindende Grundlage, die die Auseinandersetzung mit Krankheitsverteilungen in Bevölkerungen und daraus resultierende bevölkerungsbezogene Maßnahmen integriert. (30,31)

Die hier hergeleiteten verschiedenen Begriffe werden für die Zwecke der vorliegenden Arbeit wie folgt definiert:

Die klassische Sozialmedizin setzt sich vor allem mit Aspekten der Sozialversicherungen auseinander. Dem wird die moderne Sozialmedizin gegenübergestellt, die nach Grotjahn zwei Bereiche umfasst (29):

- Einen deskriptiven Bereich, der die sozio-ökonomischen Auswirkungen auf Gesundheit erforscht heute beispielsweise mit den Methoden der (Sozial-)Epidemiologie, Gesundheitsökonomie oder Versorgungsforschung.
- Und einen normativen Bereich, der sich um die Verbesserung der Gesundheit bemüht, beispielsweise mit karitativen oder ordnungspolitischen Maßnahmen.

Seit den 1980er Jahren wird in Deutschland für die Bemühungen zur Verbesserung der Gesundheit, insbesondere auf der Bevölkerungsebene, häufig der Englische Begriff *Public Health* verwendet.

Der Begriff internationale Gesundheit wird für Bemühungen zur Verbesserung der Gesundheit über nationalstaatliche Grenzen hinaus verwendet. Dieser wird

zunehmend durch den Begriff Globale Gesundheit abgelöst, der über das Bemühen zur Verbesserung der Gesundheit hinaus das Verständnis eines Rechtes auf bestmögliche Gesundheit aller Menschen an allen Orten impliziert.

Im bestehenden gesellschaftlichen Konsens der Bundesrepublik Deutschland stellt die selbstverwaltete gesetzliche Krankenversicherung heute den prominenten elementar wichtigen Teil der sozialstaatlichen Ordnung dar. Diese Krankenversicherung prägt das für alle zugängliche Gesundheitswesen in Deutschland. Für die Bevölkerung steht damit seit Jahrzehnten ein Gesundheitswesen mit präventiven, kurativen, rehabilitativen und palliativen Leistungen von höchster Qualität zur Verfügung, ohne seine Nutzer in finanzielle Schwierigkeiten zu bringen. Von Seiten der Weltgesundheitsorganisation (*World Health Organisation, WHO*) ist es notwendig, dass ein Gesundheitswesen eine allgemein zugängliche Gesundheitsversorgung (*Universal Health Coverage, UHC*) bietet. Das deutsche Gesundheitswesen erfüllt diese essentielle Grundvoraussetzung. (32) Die WHO hatte bereits 1948 in ihrer Satzung Gesundheit als ein fundamentales Menschenrecht verankert und damit eine Basis für UHC geschaffen (33). Die Implementierung von UHC ist derzeit ein prioritäres Ziel der WHO (34).

Das Grundgesetz der Bundesrepublik Deutschland legt die sozialen Aufgaben des Staates fest und führt diese in den Sozialgesetzbüchern aus (35). Es basiert auf den Werten Freiheit, Gerechtigkeit und Solidarität und stellt eine grundlegende Verknüpfung zwischen wirtschaftlichen, sozialen, bürgerlichen und politischen Grundrechten der Staatsbürger her. Die staatlichen Einrichtungen stellen auf der freiheitlichen Grundordnung die Verbindungen zwischen Politik, Wirtschaft und Gesellschaft her und führen planende, fördernde und erhaltende staatliche Maßnahmen durch. Damit hat in Deutschland derzeit niemand Grund anzunehmen, dass die eigene Gesundheit das eigene Leben oder die eigene Würde unter der Kontrolle anderer steht.

Jenseits von Deutschland und anderen westlichen Nationalstaaten mit liberalen sozialen Demokratien besteht die Möglichkeit, dass sozioökonomisch bevorteilte Menschen eine inakzeptable Kontrolle über das Leben anderer erlangen, was die Fairness politischer Institutionen, die Gerechtigkeit des Wirtschaftssystems und die Umsetzung allgemeingültiger Menschenrechte untergräbt (36).

Die Herausforderungen eines Gesundheitswesens

Der medizinische Fortschritt wächst stetig, auch da die Bevölkerung zunehmend nach Gesundheitsleistungen und gesundheitsbezogenen Produkten nachfragt und diese erwartet. Das Gesundheitswesen ist daher nicht nur gesellschaftlich bedeutsam, sondern in vielen Ländern des globalen Nordens ist der Gesundheitssektor heute bereits der umsatzstärkste Wirtschaftszweig. (37). So brauchen mehr und mehr Diagnosen, Medikamente, Technik und medizinisches Personal mehr finanzielle Ressourcen, während gleichzeitig der Gesundheitssektor zunehmend wirtschaftliches Gewicht und politische Aufmerksamkeit erhält. (38) Bereits 2001 hat die WHO „Commission on Macroeconomics and Health“ diese wichtigen Zusammenhänge und die damit verbundenen Herausforderungen für postindustrielle Gesellschaften beschrieben (39).

Die wissenschaftliche Medizin in Deutschland hat diese Beziehung zwischen der Gesundheit des Individuums, den gesellschaftlichen Rahmenbedingungen und der Wirtschaft lange vernachlässigt. Insbesondere in der universitären Forschung an medizinischen Fakultäten wurden Konzeption und Umsetzung von effektiven und effizienten Versorgungssystemen für große Bevölkerungsgruppen, welche die Qualität, den Patientennutzen und die Wirtschaftlichkeit gleichermaßen optimieren, wenig akademische Aufmerksamkeit geschenkt. (40)

Die Vernachlässigung der klassischen und modernen Sozialmedizin stellt heute eine große Herausforderung für universitäre Einrichtungen dar, insbesondere vor dem Hintergrund, dass zusätzliche Aspekte der Globalisierung, die Gesundheit von Individuen und Bevölkerungen sowie das Gesundheitswesen beeinflussen.

Die Herausforderung der Globalen Gesundheit

Die Herausforderungen durch die Globalisierung werden im Kontext der Diskussionen zu Globaler Gesundheit thematisiert. Dabei kristallisieren sich zwei essentielle Perspektiven auf das Gesundheitswesen heraus, bei denen globale Fragen eine Rolle spielen: [1.] eine individualmedizinische Perspektive, die betrachtet, wie beispielsweise der Zugang zu lebenswichtigen Medikamenten und Impfungen oder der Schutz vor katastrophalen Ausgaben für Gesundheitsleistungen ermöglicht werden kann und [2.] eine bevölkerungsmedizinische Perspektive wie beispielsweise Schutz

vor globalen Pandemien oder vor Auswirkungen der Klimazerstörung sichergestellt werden kann (2). Dabei sollten sozialmedizinische Bezüge zu den Determinanten für Gesundheit, die unterschiedlichen Bedürfnisse von Gesunden und Kranken sowie sich ändernde Gesundheits- und Krankheitsmuster berücksichtigt werden. (20) Daneben wird in der Diskussion zu Globaler Gesundheit zunehmend eine egalitäre Transnationalität impliziert, die die Gesundheit von allen Menschen weltweit als gleich wichtig definiert und jenseits der Bedürfnisse einzelner Nationalstaaten verortet (22). Zusätzlich wird die etablierte theoretische Sozialmedizin um die Auswirkungen menschlichen Handelns auf die planetare Umwelt (planetary health) erweitert (41).

Bemühungen der Bundesregierung für die Globale Gesundheit

Die deutsche Bundesregierung hat für sich das Thema Globale Gesundheit zu einer strategischen Priorität ernannt und übernimmt in der internationalen politischen Diskussion dazu zunehmend Verantwortung (42). Dabei vertritt die Bundesregierung den Standpunkt, das Menschenrechte weltweit gleichermaßen gelten und intrinsisch mit wirtschaftlichen, sozialen und kulturellen Rechte verbunden sind. (43,44)

Dazu wurden von der Bundesregierung entsprechend ein Konzept und eine Strategie ressortübergreifen erarbeitet, welche die Rolle der Bundesregierung in der globalen Gesundheitspolitik transparent und nachvollziehbar darstellen. (43,44) Sowohl Wirtschaft als auch Wissenschaft in Deutschland sollen dabei politisch und finanziell unterstützt werden, um zu wichtigen Themen aktiver und sogar weltweit führend zu werden. Das 2013 vom Bundesministerium für Gesundheit (BMG) erstellte Konzeptpapier enthält daher Leitgedanken, die den Beitrag Deutschland auf der Basis eines wertebasierten Ansatzes darstellen und die Schwerpunkte des Engagements prägen. (43,45) Die in dem Konzept formuliert drei Leitgedanken sind [1] „Schutz und Verbesserung der Gesundheit der Bevölkerung in Deutschland durch globales Handeln“ (43), [2] „Wahrnehmung globaler Verantwortung durch die Bereitstellung deutscher Erfahrungen, Expertise und Mittel“ (43) und [3] „Stärkung internationaler Institutionen der Globalen Gesundheit“ (43). Schwerpunkte sind dabei „Grenzüberschreitende Gesundheitsgefahren wirksam bekämpfen“ (43), die „Stärkung von Gesundheitssystemen“ (43) weltweit „Intersektoraler Kooperationen ausbauen“ (43), sowie die „Gesundheitsforschung und Gesundheitswirtschaft“ (43)

und die „Globalen Gesundheitsarchitektur“ (43), dabei vorrangig die WHO zu stärken (43).

Bereits in dem Konzept der Bundesregierung von 2013 wurde die wirksame Bekämpfung von armuts-assoziierten und vernachlässigten Krankheiten (*poverty-related neglected diseases, PRNDs*) durch Gesundheitsforschung in Deutschland dargestellt. (43) Auch in der 2020 vom BMG federführend erstellten Strategie bekennt sich die Bundesregierung wieder dazu, ihr internationales Engagement sowie die Forschung und Innovation zu verstärken, insbesondere zu Antibiotika und Impfstoffen und gezielt die PRND zu bekämpfen. (44)

Zielsetzung

Durch die zunehmende Aufmerksamkeit für das Thema Globale Gesundheit proklamieren einige bereits beispielsweise das Ende von HIV/AIDS, eine Kompetenz zur Verhinderung weltweiter Pandemien oder auch eine allgemeine sozial ausgerichtete Gesundheitsversorgung. (46–48) Aber es ist heute insbesondere mit den bisherigen Erfahrungen durch die COVID-19 Pandemie offensichtlich, dass auch zukünftig weitere und möglicherweise noch komplexere Herausforderungen auf Gesundheitswesen und die darin und damit beschäftigten Menschen zukommen. Gleichzeitig wird von diesen erwartet, dass für gesunde und kranken Menschen weiterhin eine qualitativ hochwertige Vor- und Fürsorge durch alle Bereiche des Gesundheitswesens sichergestellt wird.

Daher ist es in einer globalisierten Welt wichtig, Individuen, Institutionen und Systeme bereits heute auf die Herausforderungen von Morgen vorzubereiten. Es gilt zu klären, was dieses für die Steuerung von Gesundheitswesen beziehungsweise Verantwortlichkeiten und Kompetenzen für Mitarbeitende im Gesundheitswesen weltweit und auch in Deutschland mit sich bringt.(2)

Ausgehend von diesen Beobachtungen soll in dieser Arbeit dargestellt werden, wie aus der Perspektive einer modernen Sozialmedizin die Globale Gesundheit heute zu verstehen ist und welche Verantwortungen sich daraus für die medizinische Praxis, die Forschung und ebenso die Lehre in Deutschland ergeben.

2. ORIGINALIA

Globalen Kooperationen in der Forschung, am Beispiel Ebola-Viruserkrankung

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Ausbrüche von Infektionserkrankungen mit dem Potential einer Epi- oder sogar Pandemie erfordern globale Zusammenarbeit auf verschiedenen Ebenen, nicht zuletzt in der Forschung. Mit Hilfe sozialer Netzwerkanalysen wissenschaftlicher Fachartikel lassen sich die Kooperationsbeziehungen von Wissenschaftlern/innen verschiedener Institutionen darstellen und analysieren.

Da die Ausbrüche der viralen Ebola-Erkrankung eine wesentliche Herausforderung für die Globale Gesundheit darstellen und umfangreiche Forschungsaktivitäten in Gang setzten, erlaubt die Analyse der dazu publizierten medizinischen Fachliteratur eine Charakterisierung der entsprechenden Forschungslandschaft und ihrer Entwicklung. Aus der Thomsons Reuters' Web of Science Core Collection ließen sich 4.567 zwischen den Jahren 1976 und 2015 publizierte Fachartikel über Ebola extrahieren. Die Analyse der bibliometrischen Daten aller Artikel zeigte über 9.900 Verbindungen zwischen 1.644 Einrichtungen, zu denen sich die Autoren/innen der Fachartikel als zugehörig ausgegeben haben.

Darüber hinaus ließen sich für verschiedene Zeitabschnitte unterschiedliche Netzwerke ermitteln und analysieren. Insbesondere fiel eine deutliche Konzentration der Forschungsexpertise im globalen Norden auf. Während Ebola bisher ausschließlich in Afrika auftrat, befanden sich die meisten Einrichtungen, denen die Autoren/innen angehörten, in Nordamerika und Europa. Bestimmte Netzwerkparameter zeigten eine starke Vernetzung einiger weniger Einrichtungen in

einflussreicher Netzwerkposition, wobei es sich dabei hauptsächlich um öffentlich finanzierte Organisationen und Regierungseinrichtungen handelte.

Trotz der massiven Zunahme an einschlägiger medizinischer Fachliteratur während des Ebola-Ausbruchs 2014/15 in West-Afrika war das gesamte Netzwerk der Einrichtungen, deren Wissenschaftler/innen zu Ebola publizierten, um einige wenige Einrichtungen organisiert, die für eine große Zahl von Publikationen verantwortlich zeichnet.

Da sich Forschungslandschaften vor allem organisch entwickeln, kann deren regelmäßige Analyse dazu beitragen, die notwendige Forschung besser und zielgerichteter zu steuern, beispielsweise durch die WHO. Dies kann sowohl zur evidenzbasierten Priorisierung erforderlicher Behandlungen als auch zur Stärkung der wissenschaftlichen Zusammenarbeit zwischen Forschungseinrichtungen im Globalen Norden mit Forschungseinrichtungen in von Ebola betroffenen Ländern beitragen.

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RESEARCH ARTICLE

Analysing published global Ebola Virus Disease research using social network analysis

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Abstract

Introduction

The 2014/2015 West African Ebola Virus Disease (EVD) outbreak attracted global attention. Numerous opinions claimed that the global response was impaired, in part because, the EVD research was neglected, although quantitative or qualitative studies did not exist. Our objective was to analyse how the EVD research landscape evolved by exploring the existing research network and its communities before and during the outbreak in West Africa.

Methods/ Principal findings

Social network analysis (SNA) was used to analyse collaborations between institutions named by co-authors as affiliations in publications on EVD. Bibliometric data of publications on EVD between 1976 and 2015 was collected from Thomson Reuters' Web of Science Core Collection (WoS). Freely available software was used for network analysis at a global-level and for 10-year periods. The networks are presented as undirected-weighted graphs. Rankings by degree and betweenness were calculated to identify central and powerful network positions; modularity function was used to identify research communities. Overall 4,587 publications were identified, of which 2,528 were original research articles. Those yielded 1,644 authors' affiliated institutions and 9,907 connections for co-authorship network construction. The majority of institutions were from the USA, Canada and Europe. Collaborations with research partners on the African continent did exist, but less frequently. Around six highly connected organisations in the network were identified with powerful and broker positions. Network characteristics varied widely among the 10-year periods and evolved from 30 to 1,489 institutions and 60 to 9,176 connections respectively. Most influential actors are from public or governmental institutions whereas private sector actors, in particular the pharmaceutical industry, are largely absent.

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Conclusion/ Significance

Research output on EVD has increased over time and surged during the 2014/2015 outbreak. The overall EVD research network is organised around a few key actors, signalling a concentration of expertise but leaving room for increased cooperation with other institutions especially from affected countries. Finding innovative ways to maintain support for these pivotal actors while steering the global EVD research network towards an agenda driven by agreed, prioritized needs and finding ways to better integrate currently peripheral and newer expertise may accelerate the translation of research into the development of necessary live saving products for EVD ahead of the next outbreak.

Author summary

Ebola Virus Disease (EVD) research publications were used to analyse and visualise collaborations between institutions jointly publishing research results, using freely available social network analysis tools. Constructed co-authorship networks between author affiliated institutions showed EVD research publications increased and networks evolved over time. The global network is organised around a few co-authoring, mostly publicly financed key actors, highly connected with powerful and broker positions. The results present an extensive narrative how modern empirical scientific methods for data processing and translation can supplement evidence-based arguments for public discussion on the status and focus of global EVD research. Based on the network characteristics or concentration of expertise, we recommend a globally agreed and prioritized EVD research agenda may facilitate the translation of this research into new EVD tools. Also, to analyse research networks regularly to enable public discussion on the direction in which research could be organized and optimised. We would like to encourage others to utilize our methods with open access tools to enhance new methods to the field of NTD R&D.

Introduction

The 2014/2015 West African Ebola Virus Disease (EVD) outbreak with more than 28,000 cases and 11,000 deaths, was a public health emergency of international concern [1,2]. Although EVD was discovered in the former Zaire (now: Democratic Republic of Congo) more than 40 years ago, the absence of treatment generated global alarm and raised questions on the state of EVD research. Studies analysing EVD transmission and clinical trials testing EVD treatments or vaccines have been difficult due to the small number of infected cases in previous outbreaks [3,4]. Moreover, the pharmaceutical industry has been criticized for neglecting EVD research because it is not profitable enough as EVD occurred rarely and mostly in impoverished African communities [3,5–7]. EVD outbreaks have attracted general public attention since the mid-90s, benefitting science funding, leading to increased publications, but EVD research funding is mostly spent outside of affected African countries and research capacity building there was neglected [8].

The World Health Organization (WHO) called for greater transparency and better sharing of results from clinical trials as being a necessary contribution to facilitate research and development (R&D) for the benefit of science and patients [9] and published a research priority

agenda [10]. The necessity for increased transparency also applies to any existing EVD research and expertise to improve the value and efficiency of research efforts.

In order to enhance the understanding of on-going EVD research activities and its communities, social network analysis (SNA) of bibliometric data of EVD related scientific publications can be used. Since co-authorships are the most visible and accessible indicator for collaborations, co-authorship-based SNA studies can be used to measure the presence of research collaborations and their evolution over time [11–13]. SNA metrics can reveal network patterns and identify its most central and influential actors [14–16].

The volume of publications, in combination with results from a co-authorship network analysis, can serve as a proxy indicator for R&D. Besides mapping the research landscape [17], especially co-authorship network analysis can provide insight into the degree of research governance and be relevant for strategic research planning [18,19]. Moreover, information from collaboration networks can be used to identify potential collaborations in order to improve research communication and therefore maybe also influence research outcomes [12,20].

The aim of this study is to identify EVD research activities and to analyse the structure of the evolving EVD research community network over time to map existing research collaborations and influential actors based on centrality network metrics.

Methods

Based on bibliometric data we analysed the development of EVD research in two steps. Firstly, we measured the annual EVD research publications amongst all published materials. Secondly, we conducted a co-authorship network analysis at institutional level based on original research publications between 1976 and 2015. Additionally, network analyses were conducted for 10-years' time periods in order to assess temporal network dynamics.

Data

EVD research publications. Bibliometric data was collected on 17 January 2016 from Thomson Reuters' Web of Science Core Collection (WoS) using the research query "*Ebola**". Earlier piloted information retrieval strategies included different terms, synonyms or abbreviations (e.g., EBV, EBOV or SUDV) did not reveal additional search results.

For the analysis of research publications we included publications of all document types available in the data source published between 1976 and up to 2015. For the network analysis data was restricted to original research articles from non-anonymous authors only (i.e. by excluding reviews, letters, editorial material, news items, meeting abstracts, notes, corrections, reprints, biographical items and book reviews).

In order to achieve a data demarcation, the initial data set was stepwise filtered by years from 1976 until 2015. Anonymous authors were deleted and document types restricted to original research articles (Fig 1).

EVD cases. For relating the EVD publications to occurrences of EVD outbreaks we collected WHO data on reported EVD cases from the online statistics portal Statista [21]. EVD case data for 2001 and 2002 (124 cases) was only available in aggregated form, therefore data for both years was divided equally (62 cases/year). For 2014 and 2015 EVD case figures were extracted from the WHO situation reports and manually calculated [1].

Data processing

Bibliometrics of 2,528 articles resulting for our WoS search were exported as tab-delimited data and imported into MS Excel as one bibliometric data set (Fig 2). In the raw data set each entry referred to one publication. We included data on title, authors, address of authors'

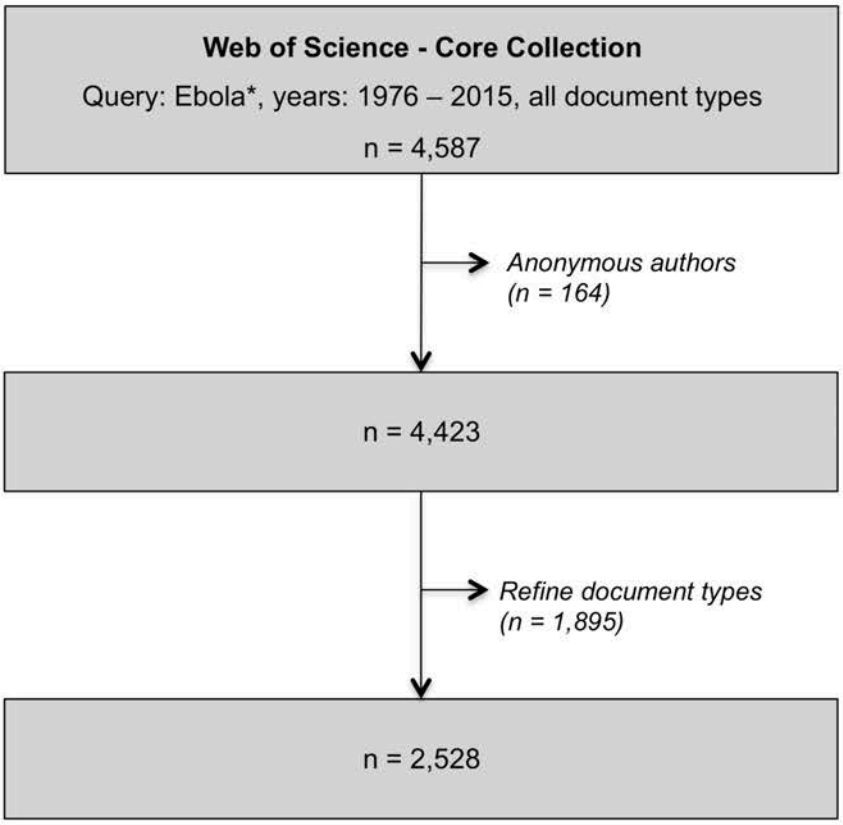

Fig 1. Flow chart, Web of Science Core Collection search results filtered stepwise (by years, author and document type).

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affiliated institution, publication year, source, language, document type, cited references, funding agency, publisher and subject category in further analysis. Other columns were deleted from the data set. Information on addresses of author's affiliated institution, e.g. institution name, sub-departments and institution address including city and country, were split into separate columns.

Data cleaning

Data processing and further cleaning was performed using the software AppleScript [22] and OpenRefine [23]. Name disambiguation, e.g. Centers for Disease Control and Prevention was abbreviated as CDC, Ctr Dis Contr and Centers Dis Cont, orders within names, e.g. Univ Washington and Washington Univ or name spellings, e.g., Univ Georgia, UNIV GEORGIA were identified and harmonised using OpenRefine algorithms or manually. Missing data, e.g. missing country information of an affiliated institution, were substituted by manual web search.

If an institution name appeared with addresses in different locations in the data set, e.g. WHO with location Switzerland and location Copenhagen e.g. due to different regional offices, different locations were considered for construction of the network to account for

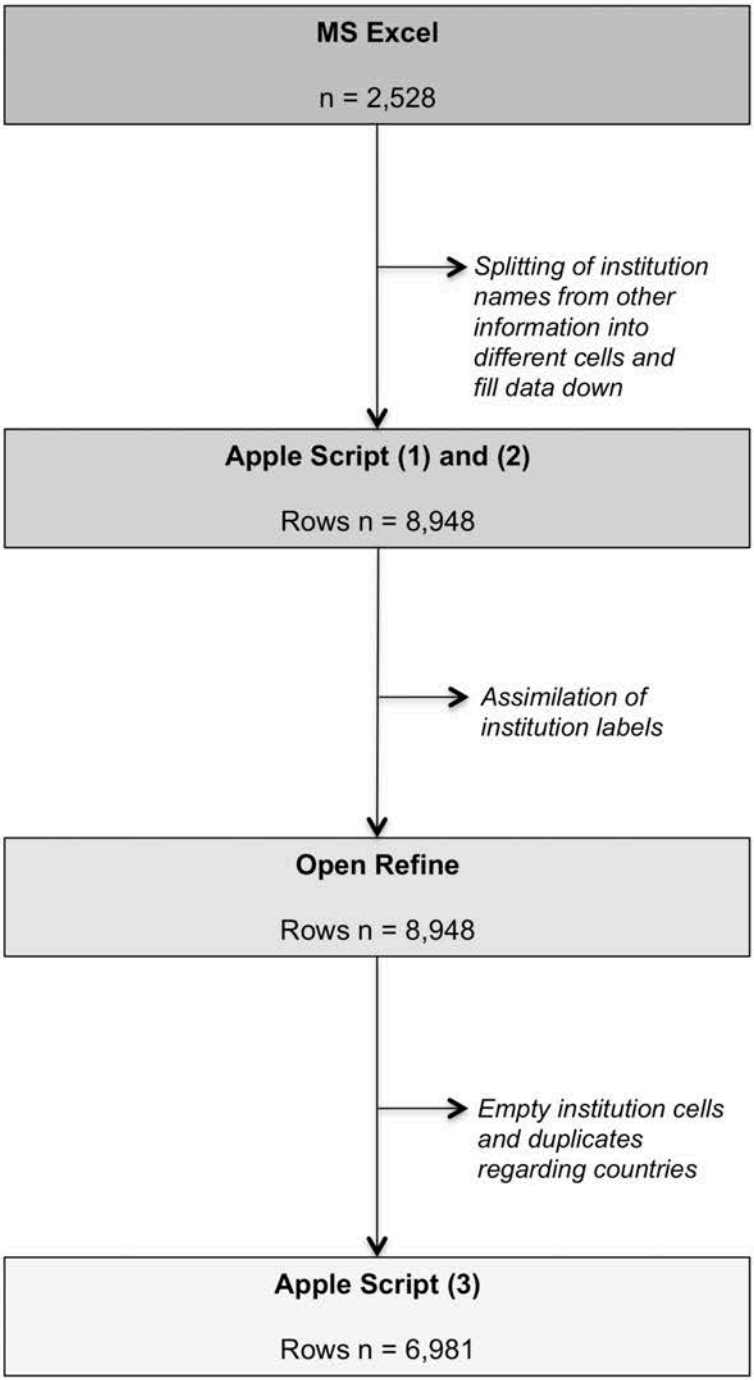

Fig 2. Flow chart, stepwise data processing using MS Excel, AppleScript and OpenRefine, by number of spreadsheet rows (one row per authors' affiliated institutions per publication).

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institutions international representations. Institutions duplicates originating from publications with multiple co-authors affiliated with the same institutions were eliminated to ensure a single weighting of institutions.

Translating the data into a network

The free online application Table2net was used to extract network information from the refined data set to construct a Gephi readable file [24]. Network nodes (i.e. actors) are institutions named as authors' affiliations in original research publications. Network edges are titles of joint publications from authors' affiliated institutions.

Measuring and visualisation instrument

The free software Gephi was used to calculate network metrics and visualise the networks [25].

Network analysis provides various tools and metrics in order to assess different notions of importance of individual nodes and node groups. As the simplest metric of centrality we calculated each node's ***degree***, as the sum of direct links to other nodes. Nodes with more direct connections are considered more central. The **average node degree** captures the number of actors that each actor is connected with on average. The **average weighted node degree** also takes the weight of a connection between a pair of nodes into account [26,27].

Betweenness centrality measures the frequency with which a particular node lays on the shortest paths between all other node pairs. Therefore, nodes with a high betweenness are considered to have a broker position as they connect many other nodes and thus have a large influence on the transfer of items through the network, under the assumption that item transfer follows the shortest paths [26,28]. We used a betweenness calculation algorithm for weighted graphs as developed by Opsahl [29].

Besides positional properties of the nodes within the network, metrics are capturing topological aspects of the network as a whole. This information can provide an insight on the evolution at network level. ***Density*** measures were calculated to assess the connectivity of the network. The density of a network is defined as the total number of existing edges divided by the total number of possible connections. If edges exist between all nodes (density = 1) a network is considered completely dense [26,28]. Since density captures the probable feasible number of connections in a network, it is an indicator for possible community building [30] or innovation flow within a network [15].

Communities within the network were detected using Gephi's ***modularity algorithm***. Modularity measures the degree of separation of a network into modules or clusters (communities). While a modularity value of 1 indicates that the actors separate perfectly into self-contained clusters, a value of -.5 suggest the opposite, a homogeneously connected network [27,31]. Networks with a high modularity score employ dense connections between nodes within the modules but sparse connections between nodes from different modules.

For visual presentation of network metric calculations we used Gephi's Force Atlas II algorithm in log-linear mode optimized towards hub dissuasion [32].

Results

Publications on EVD

Systematic search in WoS for publications containing "Ebola*" yielded a total of 4,587 publications between 1976 and 2015, including original articles (2,531), editorial material (659), news items (437), reviews (415), letters (325), meeting abstracts (157), corrections (36), notes (14), reprints (7), biographical items (4) and book reviews (2). Amongst the 2,531 original articles

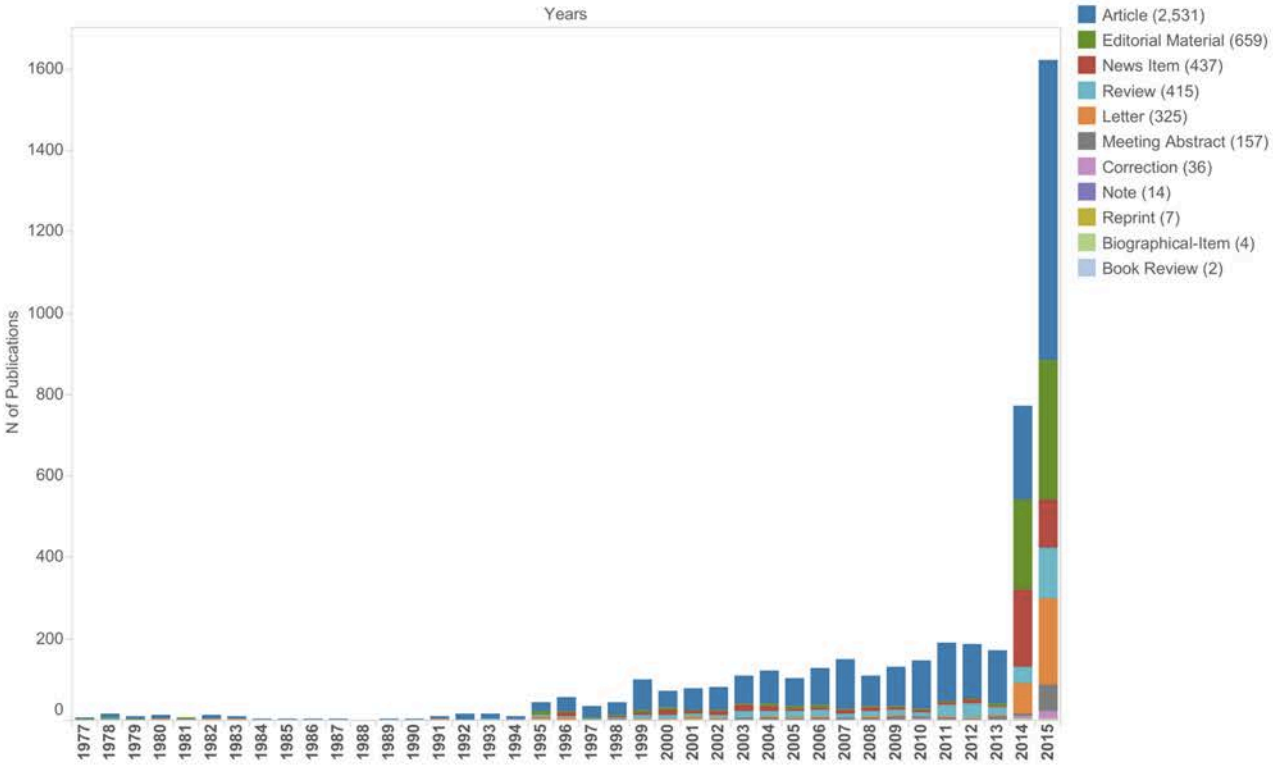

Fig 3. Articles of all authors from 1976–2015 (n = 4,587).

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were 75 article proceedings and five article book chapters. Three of those publications appeared with anonymous authors and were therefore deleted for social network analysis (Figs 1 & 2).

The first EVD research article was published in 1977, shortly after the first noted EVD outbreak in 1976. Only few EVD publications were visible until the early nineties, whereas from 1994 onwards the number of yearly EVD publications increased continuously (Fig 3). Since 1994 a higher frequency of EVD outbreaks were recorded and more EVD cases were being detected in almost every year. Several localised EVD outbreaks in Africa have occurred with up to several hundred cases. The initial EVD outbreak in 1976, with a relatively high number of reported cases (>600), was followed by only a small number of publications on EVD research. No EVD outbreaks were reported between 1979 and 1994 and hardly any publications were published on the topic. The number of publications increased gradually and continuously after the second outbreak in 1994, although compared to the 1976 outbreak only about one-tenth of cases were reported (Fig 4).

A substantial increase in EVD research publications occurred during the 2014/2015 West African outbreak. An almost 10-fold increase from 2013 (171), 2014 (772) to 2015 (1,621) was visible for almost all document types, but it was most pronounced for editorials (5, 220, 343), letters (1, 75, 213), news items (4, 190, 118) and meeting abstracts (9, 5, 66) respectively. An increase in reprints, notes, biographical items and book reviews was not detected.

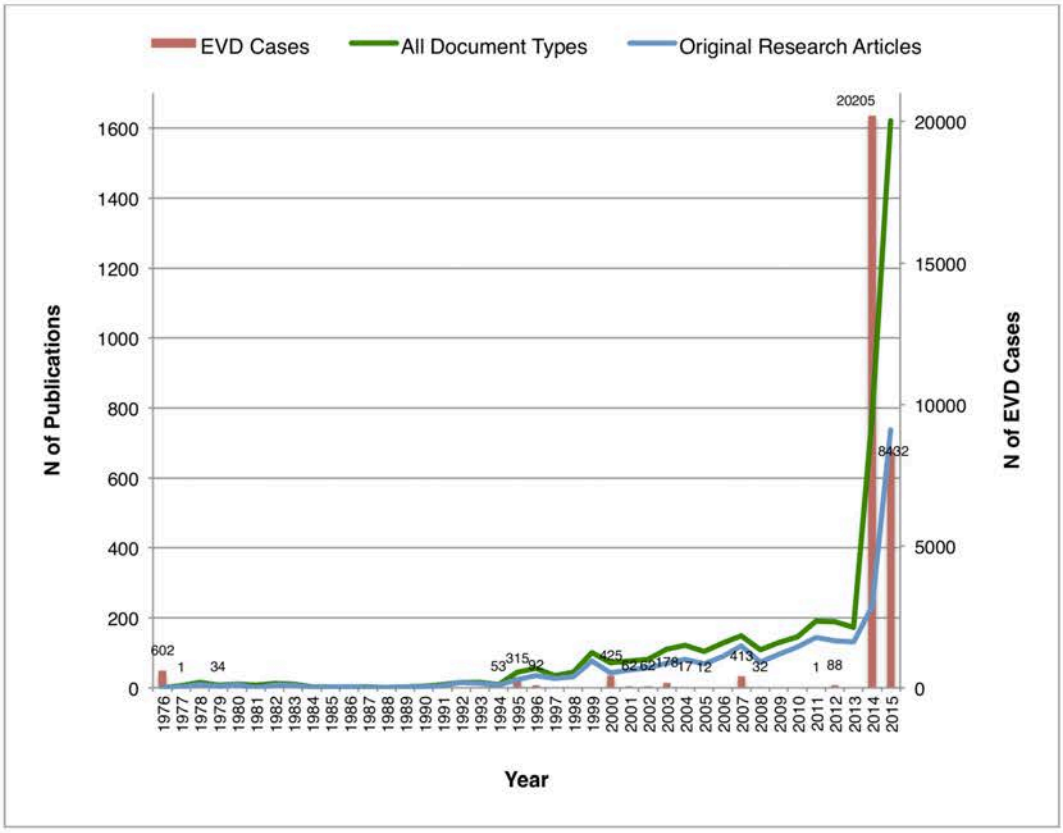

Fig 4. Annual EVD cases (n = 31,024), and number of publications on EVD from 1976 to 2015 [note the different ordinates on y-axes].

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Global EVD research network

Bibliometrics of 2,528 original research articles were used for social network analysis. Based on their co-authors' affiliated institutions a global network including institutions from 101 different countries with 704 connections was constructed (Figs 5 & 6).

Research institutions in the United States (US) are among the most highly connected institutions in EVD research (degree (d) = 80). They are mostly connected to institutions in Canada (d = 40) with an edge weight (ew) of 130 and Europe, especially Germany (d = 53, ew = 110), the United Kingdom (UK) (d = 60, ew = 90) and France (d = 57, ew = 51), but also to Japan (d = 32, ew = 99). Connections between US institutions and institutions in EVD affected African countries are less frequent (e.g. Guinea-USA ew = 14, Sierra Leone-USA ew = 32, Liberia-USA ew = 30). However, institutions in Sierra Leone and Guinea (both d = 32) and other African countries, especially Nigeria, Uganda and Ghana, are embedded in the global research network with connections to UK, Germany, France and Switzerland. The overall density of the global country-level EVD research network measures 0.15, with an average degree of 14.65 and an average weighted degree of 61.01.

Amongst all collaborations on country-level, nine research communities were identified using modularity-based community detection and visualised by different colours (Fig 6). The

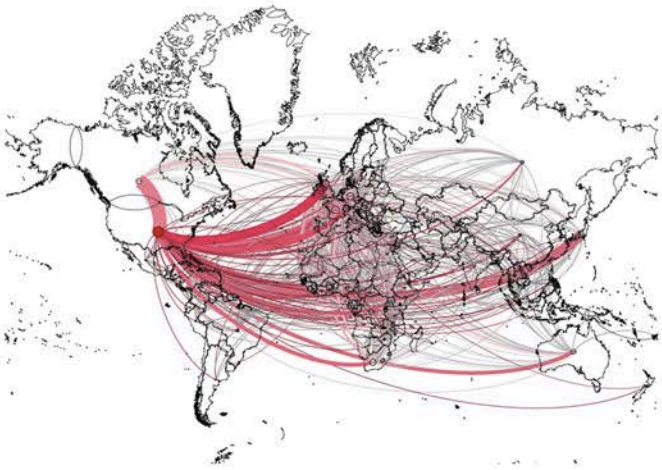

Fig 5. Global EVD research network, countries linked by cumulative co-authorships from 1976–2015, Layout: Geolayout.

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largest community (red) is centred around the US with strong collaborations to Canada, Germany and the UK, representing 59.41% of the co-authorships collaborations (weighted edges). Another large community is a (mostly francophone) European–African community (blue) representing 31.68% of all co-authorships connections.

EVD research network on institution level

Among all published original research articles between 1976 and 2015 a total of 1,644 co-author's affiliated institutions were named, which yielded 9,907 co-authorship connections in the overall research network (Fig 7). The main actors according to degree are the US government (CDC USA, d = 353; NIH, d = 315; USAMRIID, d = 283) and WHO (d = 256). Other prominent actors are from the US and European countries. Most central institutions are publicly funded (e.g. CDC USA, USAMRIID), government research institutions (e.g. BNI, ISERM), (mostly public) universities (e.g. Uni London, Univ Marburg) or international institutions (e.g. WHO) or non-governmental institutions (NGOs) (e.g. MSF).

Modularity analysis reveals 166 communities within the network (Fig 7), whereas the largest community (blue) represents 17.33% of the total network nodes and the second largest (green) represents 14.44% of the network nodes. Numerous smaller and less connected communities exist in the periphery, with some being entirely disconnected from the main network.

Network development over time

The temporal development of the research network is visualised over four 10-year time periods (Figs 8, 9, 10 & 11).

In the first decade 1976–1985, (Fig 8) the network consists of only a few actors, with one large central cluster surrounded by four smaller clusters. The German Bernhard-Nocht Institute (BNI) has the highest centrality degree (d = 11), closely followed by the Institut Pasteur, PHLS Center for Microbiology and Research (Salisbury, UK) and USAMRIID. The CDC USA is a central institution (d = 7) of a smaller cluster, publishing with African partners (Kenyan Ministry of Health) others. Smaller research groups in Kenya (Kemri Wellcome Trust,

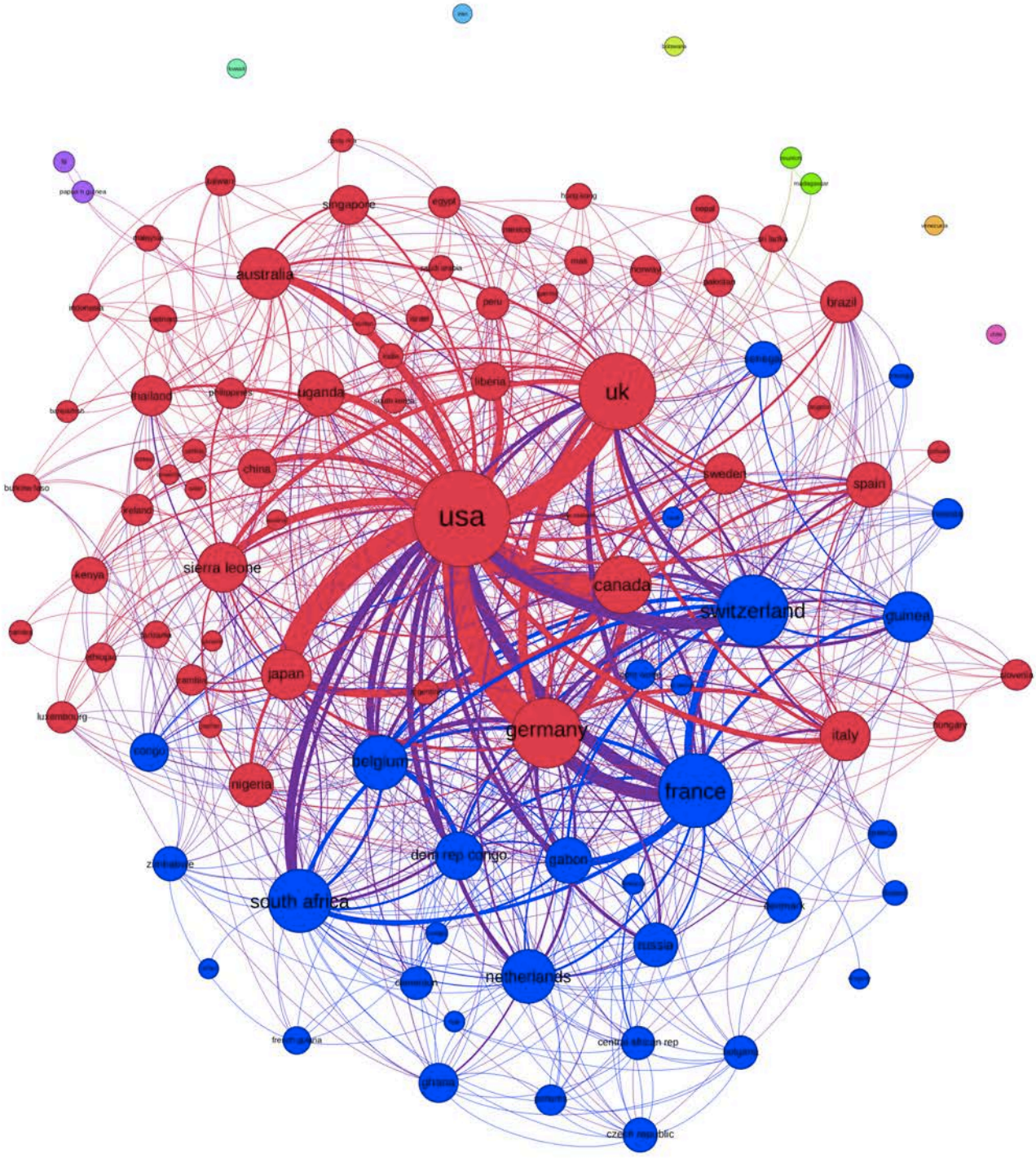

Fig 6. Global EVD research network, countries linked by cumulative co-authorship from 1976–2015, Layout: Force Atlas 2.

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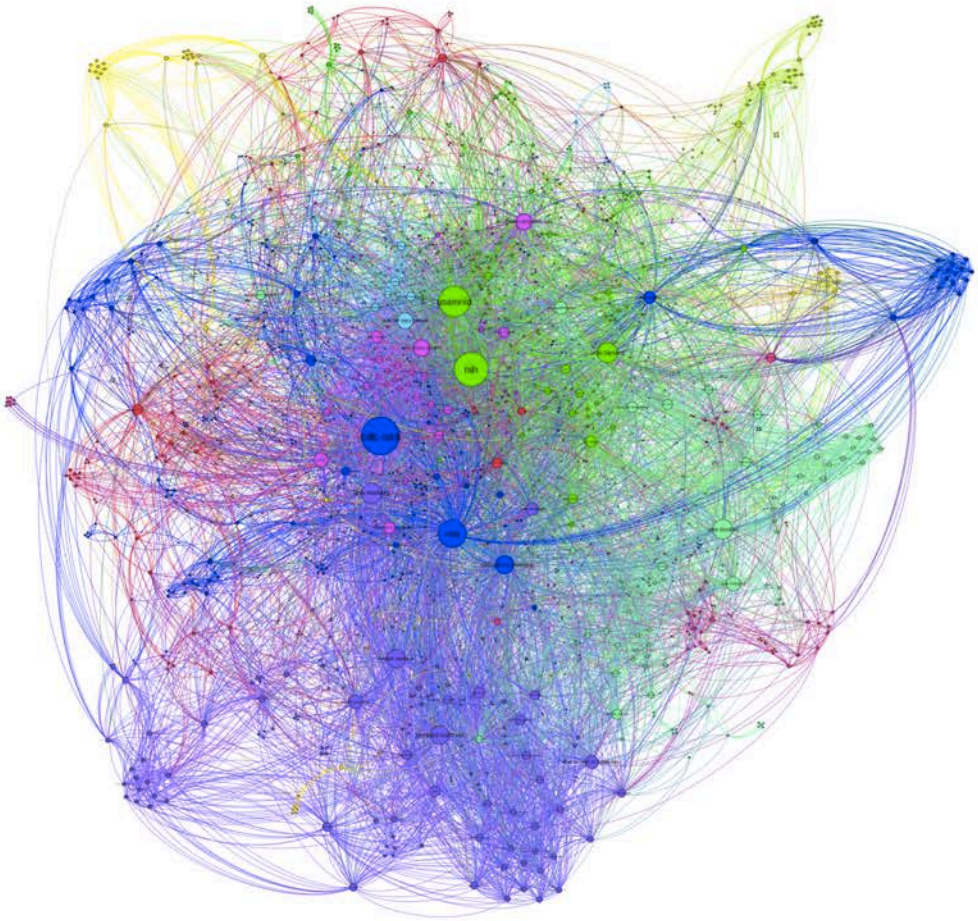

Fig 7. Cumulative EVD research network on institution level. Nodes sized by degree centrality. Research communities are colour-coded. Layout: Force Atlas 2.

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Institute of Primate Research, Kenya Trypanosomiasis Research Institute), UK and US published together, but had no connections with others.

In the second decade 1986–1995, (Fig 9) two larger, but separate, research communities evolved. One francophone French-Swiss-African community with a homogenous structure in which the Institut Pasteur published mainly with the University of Basel, Institut de recherche pour le développement (IRD), Ecole national veterinaire Lyon and the Hospital Bichat Claude Bernard Paris. The other community consists mostly of American and German institutions, with three main actors (USAMRIID, CDC USA and the University of Marburg), where the USAMRIID and CDC USA connect this community. During this period the WHO had its first appearance as a disconnected actor. All institutions in the network of the second decade are public entities.

With the occurrence of new EVD outbreaks in 1994/1995 the EVD research network grew in the third decade 1996–2005, (Fig 10) into a star-like structure with surrounding chains. During this decade the CDC USA evolved as the most central actor (d = 87). The University of Marburg (d = 54), USAMRIID (d = 52), WHO (d = 46) and NIH (d = 36) remain central but less prominent actors.

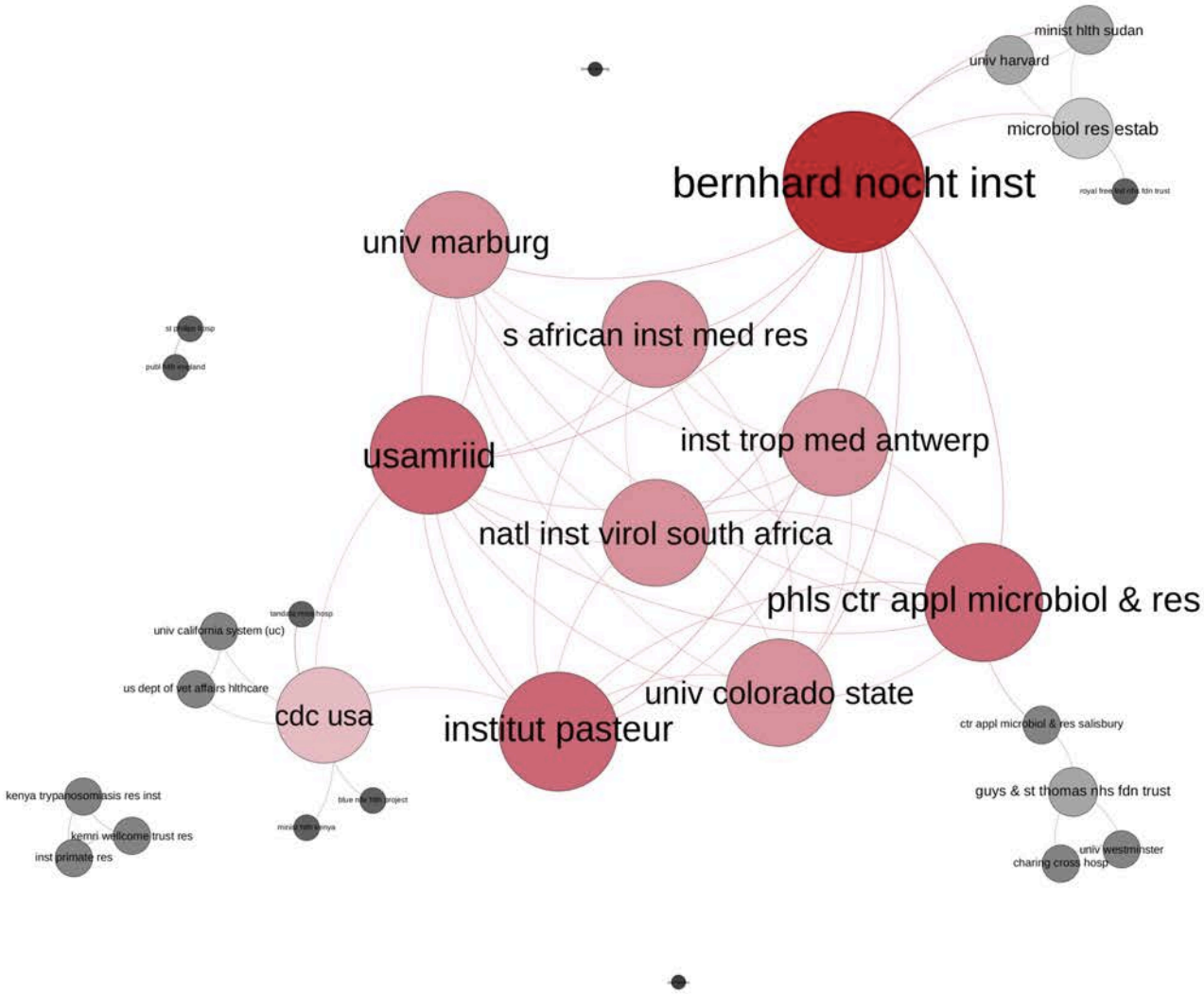

Fig 8. EVD research network. Publications from 1976–1985 by degree centrality (colour and size of nodes), Layout: Force Atlas 2.

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The network of the fourth decade 2006–2015, (Fig 11) is skewed by publications in 2014/2015. During this time only few public research institutions and university actors dominate the research collaborations but numerous new actors appeared. Prominent cooperation exist between CDC USA and WHO and CDC, NIH and USAMRIID. While the transnational WHO was well embedded in the network over these last two decades, all main network actors are public institutions, mostly from the US and European countries.

Network metrics over time

While the global EVD research network remains relatively consistent in the first two decades, the third and in particular the forth decade shows substantial overall increase in the number of institutions and the links between them (Table 1). Simultaneously the average node degree

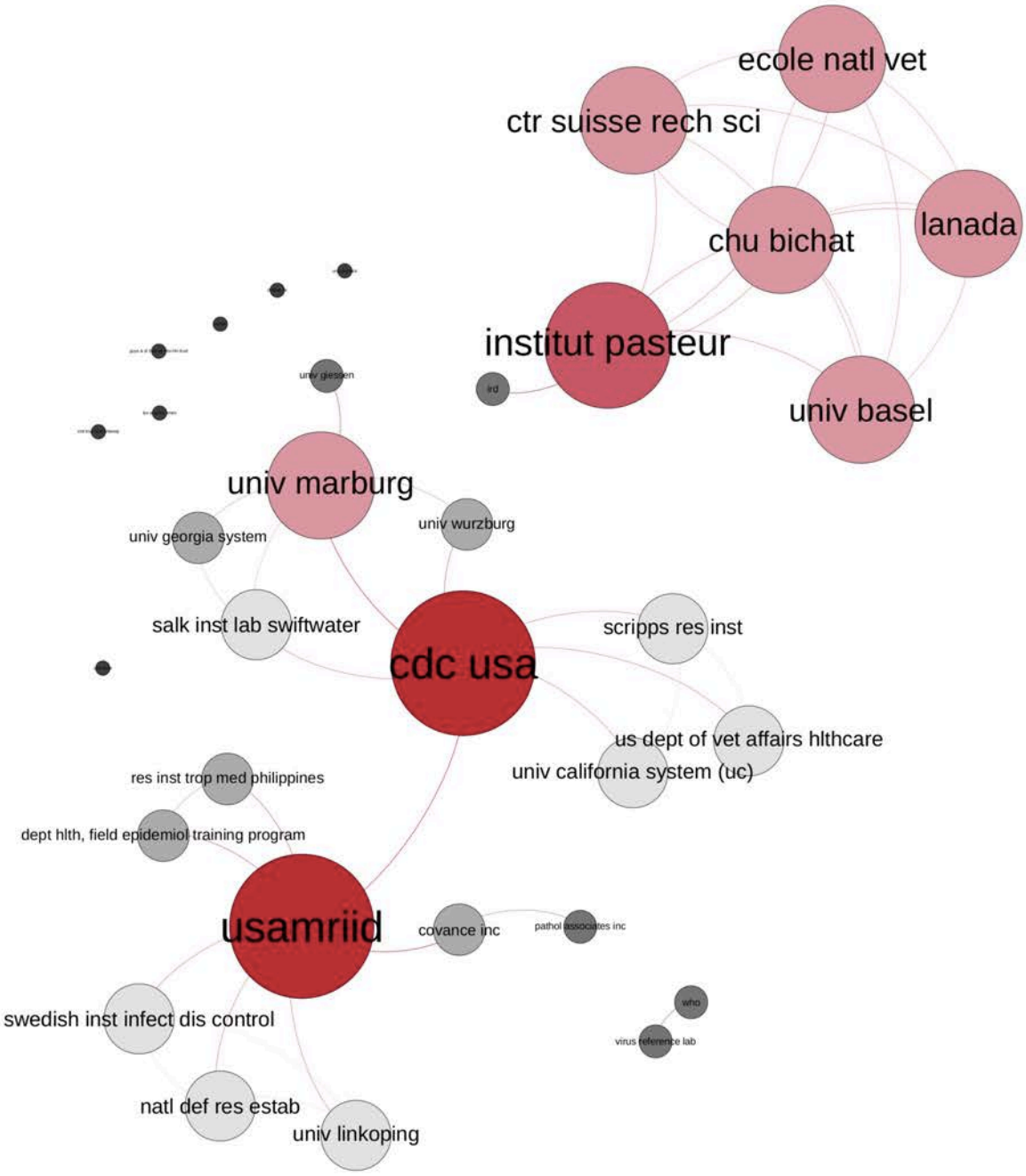

Fig 9. EVD research network. Publications from 1986–1995 by degree centrality (colour and size of nodes), Layout: Force Atlas 2.

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and weighted node degree increased over time, which indicates a growing number of collaborations and research activity per institution.

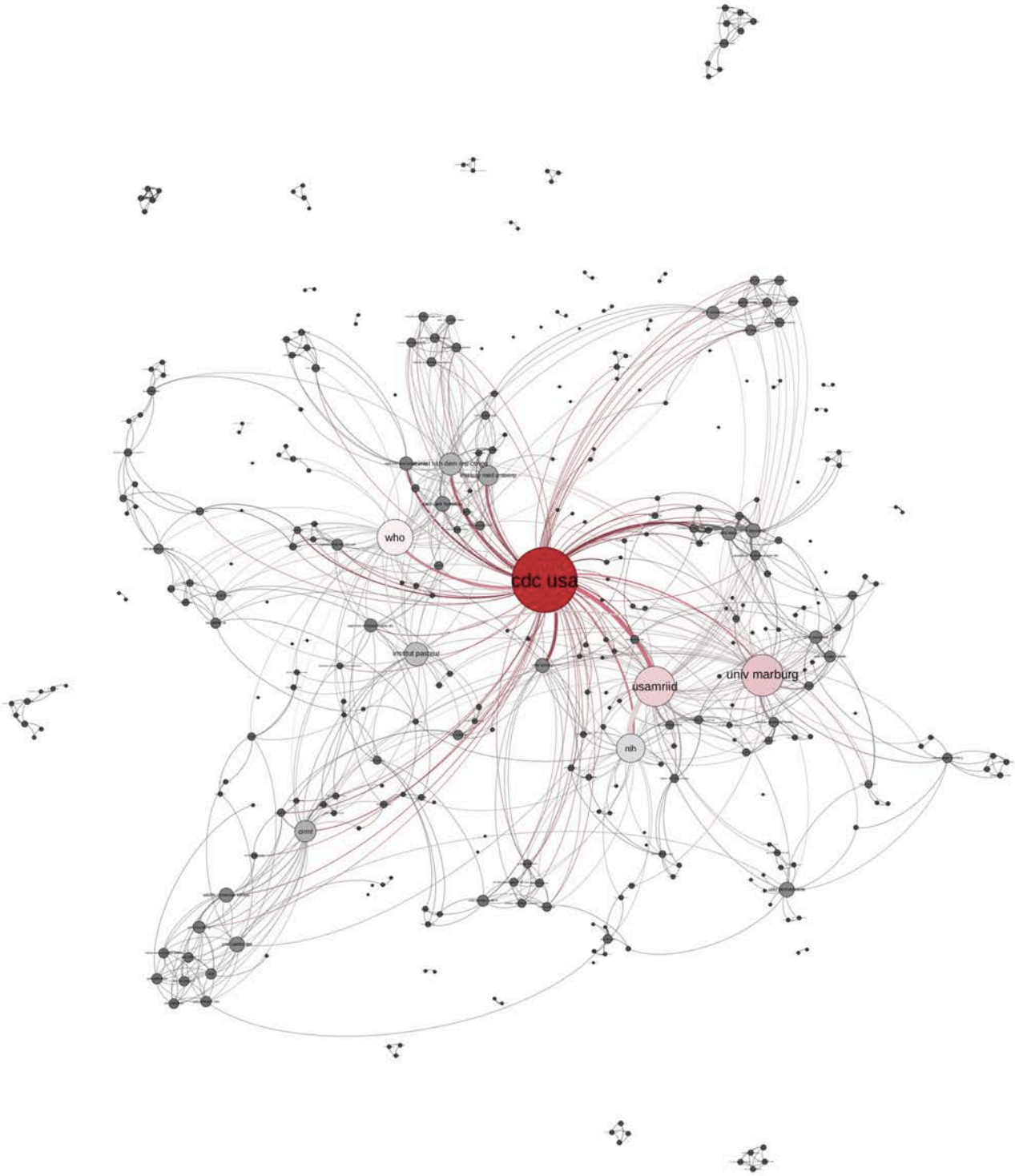

Fig 10. EVD research network. Publications from 1996–2005 by degree centrality (colour and size of nodes), Layout Force: Atlas 2.

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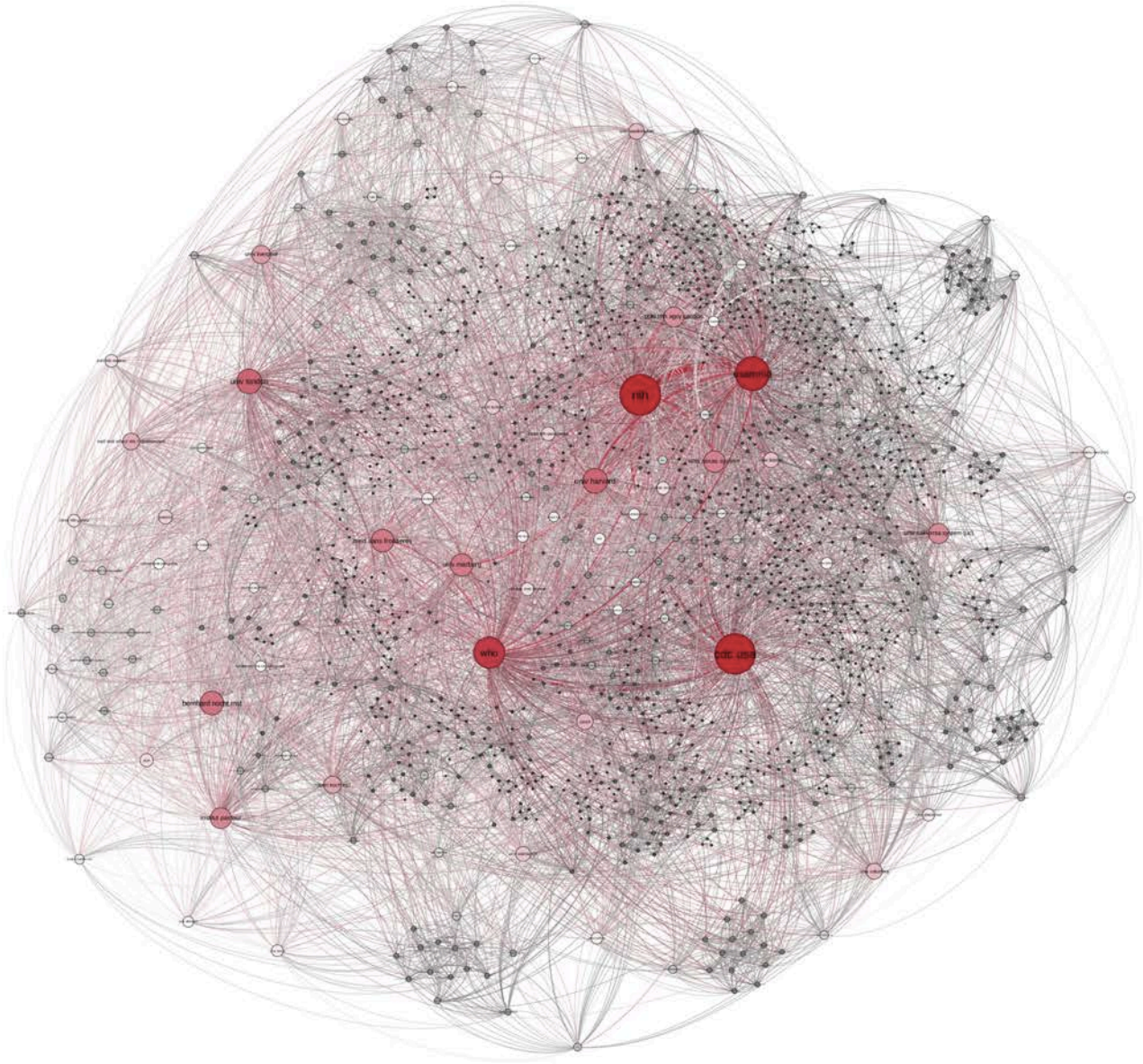

Fig 11. EVD research network. Publications from 2006–2015 by degree centrality (colour and size of nodes), Layout Force: Atlas 2.

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The decreasing density of the network over all decades indicates a decreasing number of realised edges between nodes relative to the total number of possible edges. The increasing average node degree implies a growing number of research connections per institution. The number of communities increased in line with number of nodes. The high modularity values show that the solutions of the community detection algorithm reflect the substructures of the graph well, i.e. the increase in communities is unlikely to represent a sheer increase in volume, but rather seems to capture an evolution of the field of EVD into several smaller communities.

PLOS | NEGLECTED TROPICAL DISEASES

Table 1. SNA parameters and metrics of the global EVD research network, for overall network and stratified by 10-year periods.

	Overall	10-year periods			
	(1976–2015)	(1976–1985)	(1986–1995)	(1996–2005)	(2006–2015)
Publications	2528	45	74	536	1873
Nodes *	1,644	30	33	357	1,489
Edges**	9,907	60	43	882	9,176
Node degree (avg.)	12.05	4	2.61	4.94	12.31
Node degree (weighted avg.)	17.89	4.07	2.85	6.89	17.95
Network diameter	8	6	5	7	8
Path length (avg.)	3.02	2.74	2.31	2.99	2.99
Shortest paths	2,032,226	514	316	60,530	1,634,748
Density ***	0.007	0.138	0.081	0.014	0.008
Modularity ****	0.46	0.46	0.65	0.61	0.44
Communities	166	8	11	69	154

*Authors' affiliated institutions

**Co-authorship of authors' affiliated institutions by joint publication

***1 means completely dense

****with resolution 1.0

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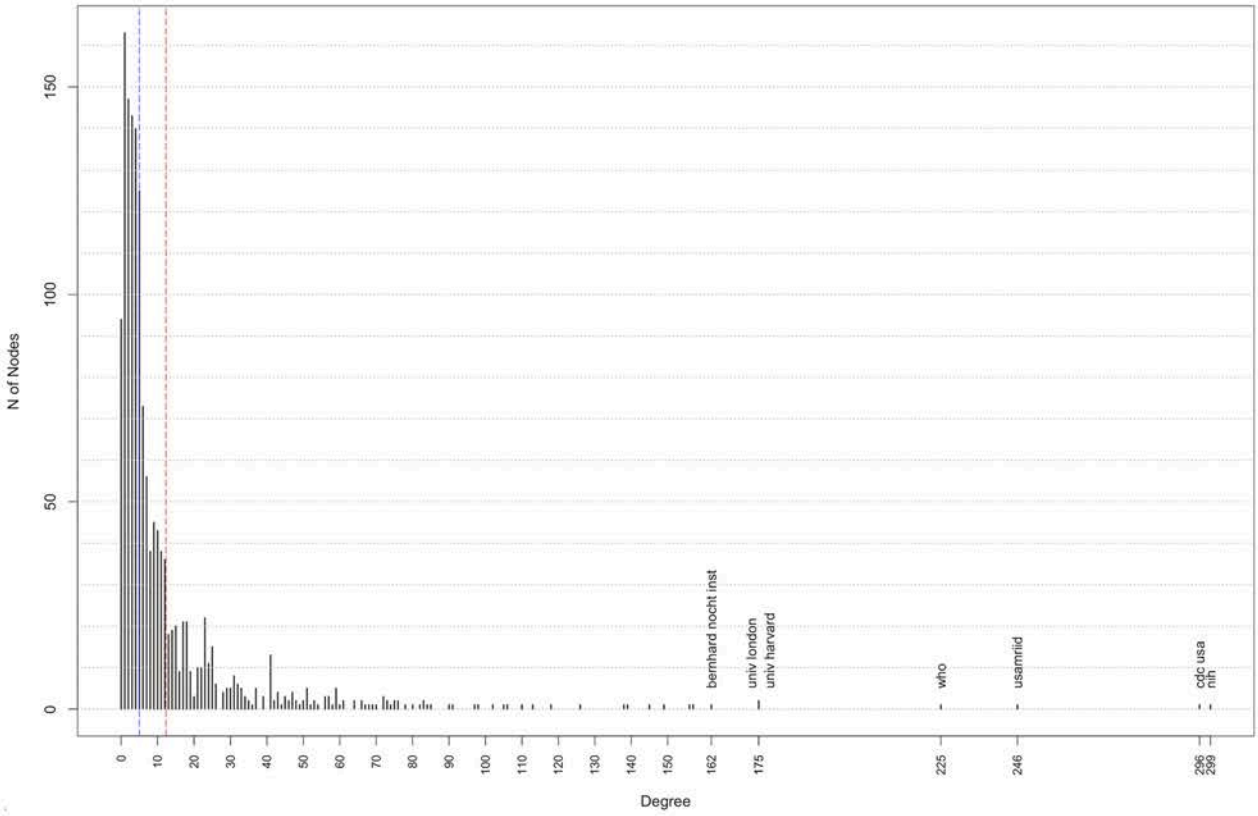

Fig 12. Degree centrality distribution, network from 2006–2015 [median (blue line), mean (red line)].

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Table 2. Top 10 ranking of institutions by degree and betweenness centrality.

Ranking	Top 10 institutions (by degree centrality)	Top 10 institutions (by betweenness centrality)
1.	CDC USA (353)	CDC USA (173,132.04)
2.	NIH (315)	NIH (130,496.07)
3.	USAMRIID (283)	USAMRIID (121,169.95)
4.	WHO (256)	WHO (82,398.38)
5.	Univ Marburg (182)	Univ Marburg (47,811.38)
6.	Univ Harvard (181)	Univ Harvard (43,055.20)
7.	Univ London (176)	Univ California System (41,661.66)
8.	Bernhard Nocht Inst (168)	Bernhard Nocht Inst (39,446.48)
9.	Institute Pasteur (164)	Univ London (38,083.88)
10.	Médecins Sans Frontières (164)	Univ Texas System (36,863.03)

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Degree centrality distribution

A degree distribution analysis of the EVD research network in the fourth decade shows a skewed node-degree distribution (Fig 12). While almost 100 nodes appear with a degree of zero (d = 0), indicating no collaboration at all, only few institutions have a very high degree above 160 (mean 12.24; median 5). Most institutions had a degree of less than five ($d \leq 5$) as they were named as affiliations by authors of few publications by authors that published with only few co-authors. The few very well connected institutions, such as NIH and CDC USA, are the key actors in this period. In fact the CDC USA has maintained a very central position in the network over all time periods. The private NGO Médecins Sans Frontières (MSF) has only recently emerged within the network and is centrally embedded with a high degree (d = 157).

Main actors in the global EVD research network. Calculating degree and betweenness centrality for all network nodes allowed ranking and identifying the most central network actors (Table 2). Exclusively publicly funded institutions are among the top 10 ranked institutions (degree and betweenness centrality), while US research institutions are central institutions in the network. The CDC USA is the institution with most collaborations (highest degree) and linking most institutions (highest betweenness centrality), closely followed by USAMRIID, the NIH and the World Health Organization (WHO).

No institution from an African country ranks for degree or betweenness centrality amongst the top 10 institutions (based in the US and Europe), whereas MSF ranks for degree among the top 10 entities.

Discussion

Description of the network

Since the first reported EVD outbreak in 1976 until today the total number of publications on EVD in WoS has exceeded more than 4500 publications, of which 2528 were original research articles. Like in scientometric analyses we used joint publishing as a proxy indicator of scientific collaboration [17] and thus knowledge exchange for our SNA of the co-authorship network [11,13,30]. Indeed for the EVD overall network we identified research contributions from 1,644 research institutions in 101 countries; most actors are indeed coming from the US [17]. Since 1994 EVD research publications have increased continuously, steadily and independently of the major West African outbreak. This growth in publications is mirrored by a growth in the number of institutions (from 30 to 1,489) and edges (from 60 to 9,176) and therefore on-going network growth accompanied by a decreasing network density. The overall

network is an extensive aggregation of 166 different communities with a clearly dominant anglophone and francophone community. This same dominance is seen when analysing the most central actors by degree and betweenness centrality both confirming the dominance of 10 institutions in powerful, control or broker positions in the network [11,33,34].

Analysis of the network

The pattern of a growing EVD network in size but with a reducing density is characterised by some outliers (106 institutions not connected), frequently less connected contributions from developing countries and the private sector, but with a strong and stable core of dominant or 'central' institutions. These characteristics of the network are supported by many of the analyses we performed. For example the relatively and increasingly poorly connected nature of the network (network density), the heavily skewed node degree distribution with the median node degree remaining rather constant, the relatively compact nature of the network (path lengths) and the strong centralisation showing a dominance of a few very strongly connected actors and many poorly connected actors.

Although we acknowledge that our analysis is weakened by the absence of a comparator network (a common challenge in emerging research fields), we also believe that our analysis bring some added value. For example SNA metrics for the overall network shows a density of 0.007 and calculating network density for each decade individually showed progressively decreasing density from 0.138 in the first decade to 0.008 in the last decade. While this is largely influenced by both the size (the more actors a network includes, the more difficult it is for all actors to be connected) and also the correspondingly rapid growth in the network (connections take time to build), we still believe that these figures should raise questions about whether the network–and therefore research outputs–could benefit from greater connectivity and linkages and in doing so greater optimise knowledge transfer and the spread of innovation [15]. The node degree distribution (for the last decade from 2006–2015) further confirms both the observed increase in the average node degree is attributable to only a few central actors whereas the overall network was not well connected in this period. Thus, the network growth during the 2014/2015 epidemic diluted connectivity, at a time when collaboration was arguably most needed.

These observations are built on when we look further at the node degree distribution for 2006–2015 . This confirms that while most actors only had few connections during this time, some actors are extremely connected. This distribution form has been described as "power law" or "scale free distribution" and is typically observed amongst poorly connected networks [35,36]. This 'concentrated core' is corroborated by the high number of the average weighted node degree (17.89), in contrast to the average node degree (12.05), which is also an indicator that some actors in the EVD network are connected more strongly to each other than others due to repeated publishing [27]. It shows that these actors have on-going collaborations, share research results intensely by jointly publishing—but focus sharing amongst their co-authors. This latter finding is something confirmed by our SNA results, which show strong centralisation amongst six institutions (CDC USA, NIH, USAMRIID, WHO, the University of Marburg and the University of Harvard), suggesting that knowledge is mostly exchanged within the network between and/or through these actors. Centrality is a measure of power in SNA [37], this is especially the case for our central actors whose knowledge broker status is confirmed with regard to EVD research due to their high degree and betweenness centralities.

Additionally, observation of the path lengths reveal further insight into the efficiency of information exchange, with the shorter the average path length of a network diameter, the more efficient is information exchanged within the network structure [26,35]. We found that

the average paths lengths (3.02) of the overall network is lower than the average node degree (12.05), indicating both that some institutions have a lot of direct neighbours and that on average nodes can reach other nodes by crossing only two other nodes. The network diameter (8.0) suggests that sub-graphs within the network do not span more than across a chain of eight nodes. Taking both aspects into account this implies that the overall structure of the network is characterized by isolated and weakly connected components, i.e. localized small networks that have only few relations amongst each other.

Network actors

Although our study cannot, unfortunately, reveal anything about the 'type' of research conducted, observations on the type of research institution maybe serve as a proxy for this insight. Two notable observations here were both the relative underrepresentation and disconnectedness in the overall network of both research institutions from affected countries and the private sector. Among the unconnected nodes appear some private industry actors (e.g., Novartis Vaccines, Biohelix Corp, Baxter Bioscience and Oravax Inc.), in addition to African universities such as the University of Benin and the University of Mbarara. While there may be many good reasons that explain the disconnectedness, for example proprietary restrictions to collaboration (in the case of industry), new entrants to the field or for resource-related barriers to International collaboration. This observation remains significant for a number of reasons, presumably both of these actor types posses' unique and distinct knowledge and capabilities that could diversify and strengthen the expertise within the network if better and more broadly integrated, this is likely even more the case during a public health emergency of international concern. Also, this ability to identify disconnected but valuable nodes, demonstrates a great added value of tools such as SNA. Finally the recent entry into the network of non-traditional research actors such as MSF should be welcomed, especially as endemic country capacity is being developed and integrated into international networks, due to their unique position as being close to patients in the field yet able to advocate–distant funders–on the need for a well-supported, needs-driven research agenda [5,38].

Network–implications for policy

We believe the structure, nature and evolution of the international EVD research network described in this paper presents some learnings for policy. Looking positively, the network itself has maintained a similar structure–a relatively compact network with a few consistent actors at its core–over the four decades studied, implying it is a stable constellation. This institutional memory provides a solid foundation for knowledge maintenance over time, indeed without central actors networks might be disrupted and knowledge exchange hampered [30]. The growth in the network over time through the entry of new actors, particularly since 2014/2015, is positive as it likely indicates the arrival of new ideas and approaches. However although collaboration has increased over time, our analysis found that the network remains relatively poorly connected. Hence there may be an additional role for the 'central actors' to expand their role beyond a hub for dissemination and exchange into a facilitator for integrating the newer actors and expertise into the network. Additional opportunities presented by the network analysis include: a reflection on the, perhaps, over-reliance or vulnerability to the network of all of the 'central actors' being public government or university institutions. The importance of predictable, sustainable, funding flows to their continued role as network 'brokers' feels more exposed in these current financially and politically turbulent times. While the dominance of these institutions is not surprising, we assume that they have the infrastructure, capability and public-financing, it may represent a weakness in two respects: firstly, with

respect to its insufficiently diverse expertise mix, particularly with respect to the translation of this research into the development of tangible, context-relevant tools and capacity building in affected countries [8,39]; secondly, with respect to the risk of over-centralising expertise, resulting in the stifling or suppression of innovation and growth and development of new ideas.

Finally, in small research areas for diseases predominantly impacting the lives of those in low-income countries such as EVD, the inherent market failures indicate that this reliance of public-financing will likely continue [Wölfel in: 3,5–7]. Given this, we believe, that a valuable insight from our study is to observe ways in which the network efficiency could be enhanced to extract greater patient-impact from the public financing inputs. For example: focused efforts on integrating new collaborators into the network, provision of tools to enhance the productivity and improved transparency and sharing of research data [9,40] the identification of expertise gaps and targeted filling of these gaps and lastly, but perhaps most importantly, National alignment, focus and financing coordination (strategic research planning) around the globally agreed prioritised research agenda [41]. Although many of these calls have already been made by many actors, particularly since the 2014/2015 EVD outbreak we believe this study represents an important empirical tool to support these calls and inform National and global policy development as the global community works to avert the next EVD outbreak.

Limitations

The use of bibliometric data has intrinsic limitations and restrictions related to any analysis of secondary data and where data ceases to provide information, in particular in relation to content or results of published research.

Two major limitations to our study were identified and previously highlighted. The first being the absence of other publications with which to contextualise and compare our results. This absence of relativity in our conclusions limits the comparative value of our findings although the absolute data remain valid. Although SNA is increasingly being used as a tool to analyses research areas it remains a relatively new field so we are optimistic that this is a time-limited constraint.

Secondly, we acknowledge that our study would be greatly enriched by an ability to analyse the data by 'type' of research not only type of publication i.e. basic, applied, clinical, implementation research, translation, health systems etc. However, at present, this is not a search field within WoS, so we were unable to attain the source data. Should key, public, medical, search engines enable this in the future, SNA such as ours would be an even more powerful tool to provide insight into research focus and productivity. This analysis we believe would have great value–supplementing existing financing and development pipeline analyses [42,43]—in providing a more granular understanding of product development gaps and the persistent absence of tools for the prevention, diagnosis and treatment of EVD [6,44]. Our analysis of decreasing network density over time could have been further triangulated with the use of an additional metric such as the percentage of the giant component or the clustering coefficient. Other limitations include reporting delays and the possibility that some publications were not included in the WoS database, however sample testing of other databases, including PubMed.gov, did not reveal other publications on EVD.

Although the impact of missing publications was likely small future studies could aggregate studies from diverse databases and in particular try to assess contribution of private industries R&D. Despite manual and automated attempts to resolve challenges with institution name cleaning and disambiguation it cannot be excluded that some actors and/or relationships were not captured or were captured incorrectly. Although unlikely, errors of the software used

cannot be completely excluded and different algorithms might lead to different presentations of results. Therefore network visualisations should be critically assessed in context to minimise misinterpretations. We further note that GeoLayout visualisation can be misleading since it locates the African continent in the map centre and visualised edges may overlap nodes. For this reason a country distribution was processed additionally with Force Atlas 2. The use of only free available software and easy accessible bibliometric data from WoS both facilitate the easy reproducibility of our study.

Conclusions

We conducted the first systematic landscaping of published EVD global research bibliometrics using SNA tools for analysis and visualisation.

Since 1976 Ebola outbreak EVD research, numbers of authors and affiliated institutions and links between them are constantly increasing, mostly independent from outbreaks and in-particular in the past two decades.

The overall EVD research network is organised around a few co-authoring key actors, mostly publicly financed. Low network density indicates room for increased cooperation between institutions, in-particular links to less connected and more peripheral institutions could foster knowledge exchange and innovation. Key network actors, such as the CDC USA, maintained network coherence over time–and probably kept EVD research on-going. Limited scientific collaboration of research organisations from LMIC and the private industry, and how they utilise their expertise and knowledge, is neglected.

However, the absence of effective treatments for EVD questions the existing EVD research network efficacy and efficiency and suggests the need for both direction and structure to optimize the network to focus on research relevant for treatments. Since most institutions in the global network are publicly funded, guidance to direct and re-orientate research might be facilitated by funders (through calls targeting knowledge and translation gaps) and be offered by supranational policy setting entities such as WHO and its Global Observatory on Health Research and Development.

Further in-depth quantitative and qualitative analysis, e.g. text mining of publications abstracts, analysis of EVD research study methods and separate R&D product pipeline analysis, is recommended to ensure empirically based strategic research guidance and relevant to EVD product development.

In any case, SNA of co-authorship networks is an innovative tool to evaluate research collaborations between individuals, organizations and countries, contributes to the understanding of the evolution of research networks and should be used for strategic research planning and a regular monitoring.

Author Contributions

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Validation: Christiane Hagel, Felix Weidemann, Peter Tinnemann.

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Writing – review & editing: Christiane Hagel, Felix Weidemann, Stephan Gauch, Suzanne Edwards, Peter Tinnemann.

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Armuts-assoziierte und vernachlässigte Erkrankungen

von Philipsborn P, Steinbeis F, Bender ME, Regmi S, **Tinnemann P.** Poverty-related and neglected diseases - an economic and epidemiological analysis of poverty relatedness and neglect in research and development. Glob Health Action. 2015 Jan 22; 8:25818. doi: 10.3402/gha.v8.25818

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Die Zusammenhänge zwischen der sozioökonomischen Entwicklung von Bevölkerungen und deren Erkrankungen werden seit Jahrzehnten sozialmedizinisch beschrieben und untersucht. Seit den 1990er Jahren wird diskutiert, das Ländern mit niedrigem- und mittlerem Einkommen von der sogenannten doppelten Krankheitslast betroffen sind d.h. durch Infektionskrankheiten sowie nicht-übertragbare Erkrankungen. Im Vergleich zu Krankheiten, die vor allem Menschen in Ländern mit hohem Einkommen betreffen, werden armuts-assoziierte Erkrankungen in Ländern mit niedrigem- und mittlerem Einkommen in Forschung und Entwicklung systematisch vernachlässigt.

Um diese Vernachlässigung besser zu verstehen, wurden für einige ausgewählte sogenannte armuts-assoziierte und vernachlässigte Krankheiten und Krankheitsrisiken quantifiziert und in Bezug zu den unterschiedlichen Stufen der sozioökonomischen Entwicklung von einzelnen Ländern gebracht.

In der Analyse wurde gezeigt, dass sich in den letzten Jahrzehnten das Verhältnis der Krankheitslast pro Kopf in Ländern mit niedrigem und mittlerem Einkommen gegenüber dem in Ländern mit hohem Einkommen in den letzten Jahrzehnten insgesamt verringert hat. Allerdings sind die mit bestimmten Krankheiten assoziierten Risikofaktoren wie beispielsweise die Wasserversorgung und Hygiene oder die Unterernährung von Müttern und Kindern in Ländern mit niedrigem Einkommen weiterhin inakzeptabel hoch. Auch wurde gezeigt, dass Infektionskrankheiten weiterhin einen großen Anteil der Krankheitslast verursachen, während sie in der

Forschung und Entwicklung immer noch vernachlässigt werden. Zudem sind mehr Erkrankungen mit Armut in Verbindung zu sehen, als die bisherige Definition der armuts-assoziierten und vernachlässigten Erkrankungen der WHO umfasst.

Um die Krankheitslasten in Bevölkerungen zu verringern, ist daher eine systematische Priorisierung und Steuerung von der Forschung und Entwicklung zu Infektionskrankheiten wichtig.

Global Health Action

COACTION PUBLISHING

ORIGINAL ARTICLE

Poverty-related and neglected diseases – an economic and epidemiological analysis of poverty relatedness and neglect in research and development

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Background: Economic growth in low- and middle-income countries (LMIC) has raised interest in how disease burden patterns are related to economic development. Meanwhile, poverty-related diseases are considered to be neglected in terms of research and development (R&D).
Objectives: Developing intuitive and meaningful metrics to measure how different diseases are related to poverty and neglected in the current R&D system.
Design: We measured how diseases are related to economic development with the income relation factor (IRF), defined by the ratio of disability-adjusted life-years (DALYs) per 100,000 inhabitants in LMIC versus that in high-income countries. We calculated the IRF for 291 diseases and injuries and 67 risk factors included in the Global Burden of Disease Study 2010. We measured neglect in R&D with the neglect factor (NF), defined by the ratio of disease burden in DALYs (as percentage of the total global disease burden) and R&D expenditure (as percentage of total global health-related R&D expenditure) for 26 diseases.
Results: The disease burden varies considerably with the level of economic development, shown by the IRF (median: 1.38; interquartile range (IQR): 0.79–6.3). Comparison of IRFs from 1990 to 2010 highlights general patterns of the global epidemiological transition. The 26 poverty-related diseases included in our analysis of neglect in R&D are responsible for 13.8% of the global disease burden, but receive only 1.34% of global health-related R&D expenditure. Within this group, the NF varies considerably (median: 19; IQR: 6–52).
Conclusions: The IRF is an intuitive and meaningful metric to highlight shifts in global disease burden patterns. A large shortfall exists in global R&D spending for poverty-related and neglected diseases, with strong variations between diseases.

Keywords: *poverty-related and neglected diseases; neglected tropical diseases; research and development; disease burden; double burden; global burden of disease; research and development expenditure*

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Over the past 20 years, rapid economic change in low and middle income countries has raised interest in how disease burden patterns are related to economic development. It is commonly held that in the course of the global epidemiological transition, a growing number LMIC face a double burden of both poverty-related, communicable diseases and affluence-related, non-communicable diseases at the same time (1, 2).

Meanwhile, poverty-related diseases are still considered to be neglected in research and development (R&D). While affluence-related diseases may attract considerable commercial R&D funding, many poverty-related diseases are considered neglected in the current R&D system (3–10). Differing assessments of the extent and relevance of this so-called R&D gap influence the broader debate on global health R&D policy (5, 11, 12). Concerns about

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these issues have led to negotiations on a possible Global Health R&D Convention, as proposed by the Consultative Expert Working Group on Research and Development (CEWG) commissioned by the World Health Organization (WHO), subsequent debates on a Global Health R&D Observatory, and ongoing WHO-sponsored R&D demonstration projects (5, 6, 13–17).

Based on a definition of Type I, II, and III diseases discussed in a background document prepared by the WHO Secretariat (18) and by Røttingen et al. (13), we propose an income relation factor (IRF) as a quantitative, intuitive, and meaningful metric for the degree to which diseases, disease groups, and risk factors are related to the level of economic development. Based on the IRF and work done by the WHO Secretariat (18) and Røttingen et al. (13), who used disease burden data for 2004, we propose quantitative definitions for poverty- and affluence-related diseases based on data from the Global Burden of Disease Study 2010 (GBD 2010). Moreover, we assess the size and the characteristics of the gap in R&D for a subset of poverty-related diseases by comparing global R&D expenditure and disease burden.

Methods

We conduct our analysis in two steps. First, we analyze 291 diseases, injuries and cause groups, and 67 risk factors and risk factor clusters included in the GBD 2010 (19, 20) with regard to their relatedness to the level of economic development. Second, we analyze the R&D gap for 26 diseases and disease groups commonly defined as poverty related and neglected and for which sufficiently specific R&D expenditure data were available, by comparing disease burden and R&D expenditure. An overview of our methodology is given in Fig. 1.

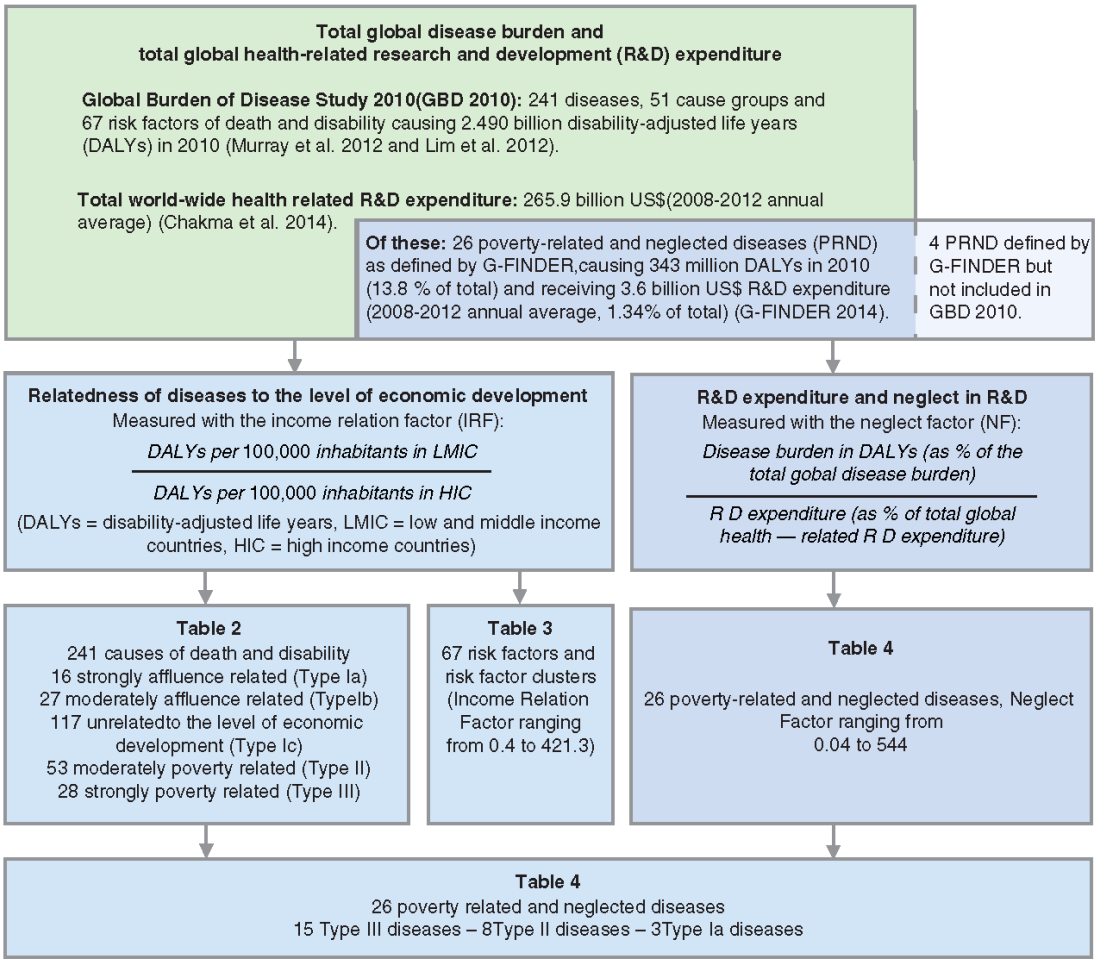

Fig. 1. Data sources and analytical steps of our analysis of income relatedness and neglect in terms of research & development (R&D).

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Relatedness of diseases to the level of economic development

In 2001, the WHO Commission on Macroeconomics and Health proposed a scheme for classifying diseases according to their relatedness to the level of economic development which distinguishes three disease types (disease Types I, II, and III, see Table 1) (18, 21). The WHO Secretariat (18), as well as Røttingen et al. (13), propose the following ratio to operationalize this classification scheme, based on DALY figures (disability-adjusted life years, a composite figure that captures both premature mortality and the prevalence and severity of ill-health) for different world regions:

$$\frac{\text{DALYs per 100,000 inhabitants in low- and middle-income countries}}{\text{DALYs per 100,000 inhabitants in high-income countries}}$$

We use the term income relation factor (IRF) for this ratio. We define Type III diseases ($IRF \geq 35$) as strongly poverty related, and Type II diseases ($3 \geq IRF < 35$) as moderately poverty related. To accommodate all conditions, and not just those related to poverty, we expand the existing classification by subdividing the group of Type I diseases ($0 \geq IRF < 3$) into three groups: conditions unrelated to economic development (Type Ic, $0.66 \geq IRF < 3$), moderately affluence-related conditions (Type Ib, $0.33 \geq IRF < 0.66$), and strongly affluence-related conditions (Type Ia, $IRF < 0.33$). We then calculate the IRF for all diseases, injuries and cause groups included in the GBD 2010 and categorize them according to the above definitions. An overview of the different disease categories and their definitions is given in Table 1. Based on DALYs attributable to the independent effects of risk factors and risk factor clusters as estimated by the GBD 2010, we calculate the IRF for the 67 risk factors and risk factor clusters included in the GBD 2010 (20).

R&D expenditure and neglect in R&D

In the term neglected diseases, the word neglect refers to the notion that for the diseases in question, the proportion of current R&D efforts is considered to fall short of the proportion which would be equitable and efficient under the given conditions. In our operationalization of neglect, we use R&D expenditure as a yardstick for current R&D efforts, as it reflects both the commercial interest of industry and the political commitment of governments and philanthropy. We use the contribution of diseases to the global disease burden measured in DALYs as an incomplete and controversial proxy for the proportion of R&D efforts which should ideally be directed toward specific diseases. To quantify the magnitude of the imbalance between R&D efforts and assumed R&D needs for specific diseases – that is, the size of the R&D Gap – we calculate the R&D expenditure in US$ per DALY for individual diseases and disease groups. This metric has been used in previous studies on neglect in R&D (6, 13, 22, 23). In addition, we propose the neglect factor (NF) as a new summary measure, with the following definition:

$$\text{Neglect Factor} = \frac{\text{Disease burden in DALYs (in \% of the total global disease burden)}}{\text{R\&D expenditure (in \% of total global health-related R\&D expenditure)}}$$

Table 1. The WHO classification of diseases according to their relatedness to the level of economic development and our proposed substratification and nomenclature

	Verbal definition of the WHO Commission on Macroeconomics and Health in 2001	Operationalization proposed by the WHO Secretariat (18) and Røttingen et al. (13)	Our proposed substratification and nomenclature.
Disease type I	'Type I diseases are incident in both rich and poor countries, with large numbers of vulnerable population in both' (21).	Diseases for which the disease burden in low- and middle-income countries (LMIC) is not more than three times higher than in high-income countries (HIC), measured in DALYs (disability-adjusted life years) per 100,000 inhabitants (13, 18).	Type Ia diseases, or strongly affluence-related diseases, with an income relation factor, $IRF < 0.33$. Type Ib diseases, or moderately affluence-related diseases, with $0.33 \geq IRF < 0.66$. Type Ic diseases, or diseases unrelated to the level of economic development, with $0.66 \geq IRF < 3$.
Disease type II	Type II diseases 'are incident in both rich and poor countries, but with a substantial proportion of the cases in poor countries' (21).	Diseases for which the disease burden in LMIC is at least three but not more than 35 times higher than in HIC (13, 18).	Type II diseases, or moderately poverty-related diseases, with $3 \geq IRF < 35$ (13, 18).
Disease type III	Type III diseases are diseases 'that are overwhelmingly or exclusively incident in developing countries' (21).	Diseases for which the disease burden in LMIC is more than 35 times higher than in HIC (13, 18).	Type II diseases, or strongly poverty-related diseases, with $IRF \geq 35$ (13, 18).

For R&D expenditure, we used data provided by G-FINDER (Global Funding of Innovation for Neglected Diseases) (23, 24) and Chakma et al. (25). G-FINDER includes comprehensive R&D expenditure data on 30 diseases fulfilling three criteria: 1) the disease disproportionately affects people in developing countries; 2) there is a need for new pharmaceutical products; and 3) there is a market failure, that is, a commercial market insufficient to attract industry R&D (23). Of these 30 diseases, we exclude four diseases which are not included in GBD 2010, and for which we therefore lack comparable disease burden data (see methodological appendix, Supplementary file 1, for details).

Development and regional distribution of the burden of poverty-related and neglected diseases

To track the public health relevance of poverty-related and neglected diseases (PRND) over time, and to understand possible reasons for their neglect, we analyze the development of the disease burden caused by PRND over the past 20 years, and the geographical distribution of the disease burden over the 21 regions covered in GBD 2010. For all figures based on GBD 2010 data, we calculate 95% uncertainty intervals based on the 95% uncertainty intervals as reported in GBD 2010 (please refer to the methodological appendix, Supplementary file 1, for details).

Results

Relatedness of diseases, injuries, and risk factors to the level of economic development

In 2010, the overall IRF for all causes was 1.4, indicating an approximately 1.4 times higher total disease burden per capita in LMIC compared to high-income countries (HIC). This is a decrease from 1990, when the overall IRF was 1.8. The relatedness of major disease groups to the level of economic development is presented in Table 2. Data for all 291 diseases, injuries, and cause groups included in the GBD 2010 are presented in Supplementary file 2. Table 3 presents the IRF for the main risk factor clusters analyzed in GBD 2010 (data on all 67 risk factors are provided in Supplementary file 3). In 2010, the disease burden attributable to risk factors associated with unimproved water and sanitation, as well as child and maternal undernutrition, was much higher in LMIC than in HIC (IRF 107 and 34, respectively). By contrast, the disease burden attributable to dietary risk factors, physical inactivity, physiological risk factors, alcohol and drug use, and tobacco smoking was 10–20% higher in HIC than in LMIC, resulting in an IRF between 0.9 and 0.8 (up from 0.7 to 0.6 in 1990).

R&D expenditure and neglect in R&D

Between 2008 and 2012, for the 26 PRND included in our analysis of neglect, on average a total of US$3,556 million (in nominal 2012 US$) was spent on R&D annually, based on G-FINDER data (23, 24). In the same time period, US$265,920 million (in nominal 2012 US$) was spent in average annually on total health-related R&D worldwide, based on figures published by Chakma et al. (25). Thus, between 2008 and 2012, 1.34% of total global health-related R&D expenditure was spent on the 26 PRND included in our analysis.

Of 2,490 million DALYs lost in 2010 to all causes of death and disability, 13.8% were caused by the 26 PRND included in our analysis (for details on each of these, see Fig. 2 and Table 4). From 2008 to 2012, on average 107 US$ per DALY was spent on health-related R&D annually. For the 26 PRND in our analysis, only 10.3 US$ per DALY was spent – 10 times less than the global average for all diseases. This is summed up by the NF of 10.3 for these 26 diseases combined, showing that the proportion of the global disease burden caused by these diseases is roughly 10 times larger than the proportion of total global health-related R&D expenditure spent on them. Figures 3 and 4 show detailed results for the 26 diseases and diseases groups. Figure 5 tracks the disease burden caused by these 26 diseases over the past 20 years, and Fig. 6 analyzes the geographical distribution of the disease burden caused by PRND.

Discussion

Relatedness of diseases, injuries, and risk factors to the level of economic development

Our analysis reveals that the number of poverty-related diseases is considerably larger than existing definitions of PRND suggest. Of the 241 individual diseases and injuries analyzed in the GBD 2010, approximately one third (81) are either strongly or moderately poverty related, causing 38% of the global disease burden in 2010, down from 51% in 1990.

The existing Type I disease category ($0 \geq \text{IRF} < 3$), encompassing all diseases not related to poverty, contains 165 diseases and injuries, responsible for 61% of the global disease burden in 2010. This disease group includes diseases such as Dengue (IRF 2.9), which causes three times more DALY per capita in LMIC compared to HIC, as well as diseases such as prostate cancer (IRF 0.16) causing approximately seven times more DALYs per capita in HIC than in LMIC. The large range of this category, and the large number diseases included, warrant a substratification.

Based on our proposed substratification, 43 diseases and injuries are either strongly affluence related (Type Ia, $\text{IRF} < 0.33$) or moderately affluence related (Type Ib, $0.33 \geq \text{IRF} < 0.66$), causing 13.2% of the global disease burden, a figure which has remained comparatively stable since 1990. In addition, approximately half of all diseases and injuries, responsible for half of the global disease

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Table 2. Relatedness of disease groups to the level of economic development

Cause or cause group	2010				1990			
	DALYs per 100,000 inhabitants		IRF	Disease type	DALYs per 100,000 inhabitants		IRF	Disease type
	LMIC	HIC			LMIC	HIC		
All causes	**38,041 (27,279–52,476)**	**26,421 (19,917–34,930)**	**1.4 (0.8–2.6)**	**Ic (Ic-Ic)**	**51,463 (36,115–73,296)**	**28,629 (22,174–36,789)**	**1.8 (1.0–3.3)**	**Ic (Ic-II)**
Communicable, maternal, neonatal, and nutritional disorders	**14,604 (10,322–20,676)**	**1,416 (1,084–1,869)**	**10.3 (5.5–19.1)**	**II (II-II)**	**26,602 (18,241–39,060)**	**2,084 (1,628–2,716)**	**12.8 (6.7–24.0)**	**II (II-II)**
HIV/AIDS and tuberculosis	2,214 (1,842 2,581)	150 (132 171)	14.7 (10.8 19.6)	II (II-II)	1,746 (1,444 2,160)	343 (305 384)	5.1 (3.8 7.1)	II (II-II)
Diarrhea, lower respiratory infections, meningitis, and other common infectious diseases	4,720 (3,173 7,104)	695 (534 921)	6.8 (3.4 13.3)	II (II-II)	12,252 (8,029 19,289)	840 (644 1,139)	14.6 (7.0 29.9)	II (II-II)
Neglected tropical diseases and malaria	1,856 (1,200 2,863)	25 (13 45)	74.8 (26.4 224.2)	III (II-III)	2,367 (1,507 3,760)	38 (19 69)	62.8 (21.9 194.3)	III (II-III)
Maternal disorders	273 (206 365)	14 (8 24)	19.9 (8.5 44.9)	II (II-III)	490 (385 627)	16 (12 23)	30.2 (16.7 50.7)	II (II-III)
Neonatal disorders	3,394 (2,455 4,644)	354 (283 443)	9.6 (5.5 16.4)	II (II-II)	6,134 (4,350 8,216)	624 (493 773)	9.8 (5.6 16.7)	II (II-II)
Nutritional deficiencies	1,440 (1,013 1,997)	118 (78 173)	12.2 (5.9 25.5)	II (II-II)	2,527 (1,869 3,396)	148 (104 209)	17.0 (8.9 32.5)	II (II-II)
Other communicable, maternal, neonatal, and nutritional disorders	707 (433 1,122)	61 (36 92)	11.6 (4.7 31.0)	II (II-II)	1,087 (657 1.612)	75 (49 118)	14.5 (5.6 33.0)	II (II-II)
Non-communicable diseases	**19,079 (13,870–25,683)**	**22,470 (16,895–29,815)**	**0.8 (0.5–1.5)**	**Ic (Ib-Ic)**	**19,841 (14,360–27,282)**	**23,442 (18,081–30,168)**	**0.8 (0.5–1.5)**	**Ic (Ib-Ic)**
Neoplasms	2,461 (1,783 3,157)	4,392 (3,401 5,596)	0.6 (0.3 0.9)	Ib (Ia-Ic)	2,459 (1,827 3,192)	4,575 (3,636 5,773)	0.5 (0.3 0.9)	Ib (Ia-Ic)
Cardiovascular and circulatory diseases	4,301 (3,639 4,986)	4,290 (3,877 4,973)	1.0 (0.7 1.3)	Ic (Ic-Ic)	4,334 (3,670 5,161)	5,774 (5,259 6,239)	0.8 (0.6 1.0)	Ic (Ib-Ic)
Chronic respiratory diseases	1,777 (1,386 2,299)	1,387 (1,068 1,795)	1.3 (0.8 2.2)	Ic (Ic-Ic)	2,431 (1,933 3,114)	1,453 (1,148 1,853)	1.7 (1.0 2.7)	Ic (Ic-Ic)
Cirrhosis of the liver	462 (347 601)	394 (320 465)	1.2 (0.7 1.9)	Ic (Ic-Ic)	462 (359 577)	464 (388 546)	1.0 (0.7 1.5)	Ic (Ib-Ic)
Digestive diseases except cirrhosis	491 (354 700)	391 (287 553)	1.3 (0.6 2.4)	Ic (Ib-Ic)	680 (478 922)	435 (325 601)	1.6 (0.8 2.8)	Ic (Ic-Ic)
Neurological disorders	1,029 (710 1,443)	1,342 (982 1,733)	0.8 (0.4 1.5)	Ic (Ib-Ic)	909 (612 1,294)	1,007 (743 1,324)	0.9 (0.5 1.7)	Ic (Ib-Ic)
Other mental and behavioral disorders	20 (13 30)	30 (19 44)	0.7 (0.3 1.6)	Ic (Ia-Ic)	21 (12 31)	26 (16 38)	0.8 (0.3 1.9)	Ic (Ia-Ic)
Diabetes, urogenital, blood, and endocrine diseases	1,761 (1,255 2,495)	1,916 (1,380 2,780)	0.9 (0.5 1.8)	Ic (Ib-Ic)	1,626 (1,098 2,536)	1,577 (1,152 2,211)	1.0 (0.5 2.2)	Ic (Ib-Ic)
Musculoskeletal disorders	2,247 (1,577 3,068)	3,762 (2,639 5,084)	0.6 (0.3 1.2)	Ib (Ia-Ic)	1,967 (1,364 2,690)	3,447 (2,414 4,664)	0.6 (0.3 1.1)	Ib (Ia-Ic)
Other non-communicable diseases	1,930 (1,092 3,180)	1,441 (787 2,443)	1.3 (0.4 4.0)	Ic (Ib-II)	2,504 (1,401 4,232)	1,705 (974 2,759)	1.5 (0.5 4.3)	Ic (Ib-II)
Injuries	**4,358 (3,087–6,117)**	**2,535 (1,937–3,246)**	**1.7 (1.0–3.2)**	**Ic (Ic-II)**	**5,020 (3,514–6,954)**	**3,104 (2,466–3,905)**	**1.6 (0.9–2.8)**	**Ic (Ic-Ic)**
Transport injuries	1,295 (946 1,773)	701 (570 874)	1.8 (1.1 3.1)	Ic (Ic-II)	1,200 (797 1,705)	1,060 (873 1,278)	1.1 (0.6 2.0)	Ic (Ib-Ic)
Unintentional injuries other than transport injuries	1,872 (1,351 2,549)	1,128 (850 1,482)	1.7 (0.9 3.0)	Ic (Ic-Ic)	2,722 (1,949 3,725)	1,182 (922 1,517)	2.3 (1.3 4.0)	Ic (Ic-II)
Self-harm and interpersonal violence	948 (647 1,315)	690 (508 865)	1.4 (0.7 2.6)	Ic (Ic-Ic)	957 (670 1,300)	848 (663 1,088)	1.1 (0.6 2.0)	Ic (Ib-Ic)
Forces of nature, war, and legal intervention	243 (142 481)	17 (10 26)	14.7 (5.6 46.2)	II (II-III)	141 (98 223)	14 (8 22)	10.2 (4.4 27.1)	II (II-II)

Own calculations based on Global Burden of Disease Study 2010 data. DALYs: disability-adjusted life years; LMIC: low- and middle-income countries; HIC: high-income countries; IRF: income relation factor, ratio of DALYs per 100,000 inhabitants in LMIC versus HIC; Disease Type Ia: strongly affluence-related diseases; Ib: moderately affluence related; Ic: unrelated to the level of economic development; II: moderately poverty related; III: strongly poverty related. In brackets, the 95% uncertainty interval is given, based on GBD 2010 figures. For details, please refer to the methodological appendix.

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Table 3. Relatedness of risk factors and risk factor clusters to the level of economic development

Risk factor or risk factor cluster	2010				1990			
	DALYs per 100,000 inhabitants		IRF	Risk factor type	DALYs per 100,000 inhabitants		IRF	Risk factor type
	LMIC	HIC			LMIC	HIC		
Unimproved water and sanitation	**362 (15–708)**	**3 (0–8)**	**106.8 (2.0–5146.9)**	**III (Ic-III)**	**1,191 (61–2,175)**	**9 (0–19)**	**137.9 (3.3–6081.3)**	**III (II-III)**
Unimproved water source	133 (8–281)	2 (0–3)	85.5 (2.4–3097.8)	III (Ic-III)	483 (33–972)	4 (0–9)	121.5 (3.8–4005.0)	III (II-III)
Unimproved sanitation	255 (6–516)	2 (0–4)	137.4 (1.5–11347.7)	III (Ic-III)	824 (25–1,559)	5 (0–11)	168.9 (2.3–13871.5)	III (Ic-III)
Air pollution	**2,649 (2,219–3,131)**	**590 (497–699)**	**4.5 (3.2–6.3)**	**II (II-II)**	**4,776 (3,961–5,601)**	**1,179 (1,011–1,341)**	**4.0 (3.0–5.5)**	**II (Ic-II)**
Ambient particulate matter pollution	1,203 (1,032–1,387)	577 (491–668)	2.1 (1.5–2.8)	Ic (Ic-Ic)	1,643 (1,366–1,946)	1,112 (973–1,248)	1.5 (1.1–2.0)	Ic (Ic-Ic)
Household air pollution from solid fuels	1,848 (1,397–2,358)	7 (0–27)	279.7 (52.1–74103.8)	III (III-III)	3,888 (3,038–4,705)	79 (26–126)	49.1 (24.1–183.5)	III (II-III)
Ambient ozone pollution	39 (13–68)	17 (6–32)	2.3 (0.4–12.1)	Ic (Ib-II)	52 (17–95)	28 (10–47)	1.9 (0.4–9.8)	Ic (Ib-II)
Other environmental risks	**240 (175–323)**	**197 (135–276)**	**1.2 (0.6–2.4)**	**Ic (Ib-Ic)**	**107 (80–139)**	**77 (61–97)**	**1.4 (0.8–2.3)**	**Ic (Ic-Ic)**
Residential radon	26 (3–72)	58 (8–131)	0.5 (0.0–9.5)	Ib (Ia-II)	Not assessed for 1990 because of absence of exposure data			
Lead exposure	214 (158–280)	139 (110–174)	1.5 (0.9–2.5)	Ic (Ic-Ic)	107 (80–139)	77 (61–97)	1.4 (0.8–2.3)	Ic (Ic-Ic)
Child and maternal undernutrition	**2,827 (2,283–3,477)**	**83 (59–118)**	**33.9 (19.3–58.8)**	**II (II-III)**	**7,748 (6,328–9,497)**	**134 (99–176)**	**58.0 (35.9–96.0)**	**III (III-III)**
Suboptimal breastfeeding	812 (474–1,213)	5 (3–8)	160.8 (58.4–475.8)	III (III-III)	2,518 (1,498–3,630)	21 (11–32)	122.6 (47.6–330.3)	III (III-III)
Childhood underweight	1,322 (1,040–1,674)	3 (2–5)	421.3 (217.2–792.6)	III (III-III)	4,520 (3,690–5,630)	12 (8–17)	362.5 (215.3–682.5)	III (III-III)
Iron deficiency	813 (564–1,147)	70 (47–103)	11.6 (5.5–24.4)	II (II-II)	1,167 (836–1,620)	91 (66–128)	12.8 (6.5–24.5)	II (II-II)
Vitamin A deficiency	184 (91–310)	1 (0–3)	149.6 (36.2–716.9)	III (III-III)	692 (321–1,287)	3 (1–6)	240.8 (54.7–1268.6)	III (III-III)
Zinc deficiency	156 (37–301)	4 (2–8)	35.3 (4.5–148.3)	III (II-III)	556 (113–1,073)	8 (4–15)	69.2 (7.7–287.7)	III (II-III)
Tobacco smoking. including secondhand smoke	**2,208 (1,853–2,540)**	**2,729 (2,376–3,072)**	**0.8 (0.6–1.1)**	**Ic (Ib-Ic)**	**2,722 (2,306–3,179)**	**3,696 (3,356–4,070)**	**0.7 (0.6–0.9)**	**Ic (Ib-Ic)**
Tobacco smoking	1,887 (1,546–2,204)	2,614 (2,252–2,957)	0.7 (0.5–1.0)	Ic (Ib-Ic)	1,899 (1,572–2,288)	3,463 (3,112–3,852)	0.5 (0.4–0.7)	Ib (Ib-Ic)
Secondhand smoke	321 (233–417)	115 (76–161)	2.8 (1.4–5.5)	Ic (Ic-II)	823 (591–1,068)	233 (165–300)	3.5 (2.0–6.5)	II (Ic-II)
Alcohol and drug use	**2,201 (1,901–2,547)**	**2,718 (2,448–2,997)**	**0.8 (0.6–1.0)**	**Ic (Ib-Ic)**	**2,039 (1,765–2,371)**	**3,376 (3,090–3,688)**	**0.6 (0.5–0.8)**	**Ib (Ib-Ic)**
Alcohol use	1,890 (1,630–2,199)	2,208 (2,015–2,422)	0.9 (0.7–1.1)	Ic (Ic-Ic)	1,793 (1,555–2,094)	2,919 (2,686–3,179)	0.6 (0.5–0.8)	Ib (Ib-Ic)
Drug use	316 (228–431)	527 (404–674)	0.6 (0.3–1.1)	Ib (Ib-Ic)	250 (178–353)	480 (370–617)	0.5 (0.3–1.0)	Ib (Ia-Ic)
Physiological risk factors	**4,149 (3,766–4,519)**	**4,764 (4,373–5,215)**	**0.9 (0.7–1.0)**	**Ic (Ic-Ic)**	**3,608 (3,314–3,937)**	**5,793 (5,426–6,145)**	**0.6 (0.5–0.7)**	**Ib (Ib-Ic)**
High fasting plasma glucose	1,302 (1,030–1,592)	1,269 (1,034–1,531)	1.0 (0.7–1.5)	Ic (Ic-Ic)	1,029 (828–1,244)	1,284 (1,057–1,526)	0.8 (0.5–1.2)	Ic (Ib-Ic)
High total cholesterol	553 (328–792)	843 (651–1,059)	0.7 (0.3–1.2)	Ib (Ia-Ic)	590 (441–747)	1,551 (1,310–1,809)	0.4 (0.2–0.6)	Ib (Ia-Ib)
High blood pressure	2,571 (2,213–2,915)	2,290 (1,922–2,654)	1.1 (0.8–1.5)	Ic (Ic-Ic)	2,410 (2,120–2,706)	3,570 (3,235–3,897)	0.7 (0.5–0.8)	Ic (Ib-Ic)
High body mass index	1,198 (931–1,485)	2,317 (1,969–2,692)	0.5 (0.3–0.8)	Ib (Ib-Ic)	756 (565–964)	2,089 (1,733–2,449)	0.4 (0.2–0.6)	Ib (Ia-Ib)
Low bone mineral density	67 (48–86)	130 (95–172)	0.5 (0.3–0.9)	Ib (Ia-Ic)	52 (41–67)	95 (71–124)	0.5 (0.3–0.9)	Ib (Ia-Ic)

Table 3 (*Continued*)

Risk factor or risk factor cluster	2010				1990			
	DALYs per 100,000 inhabitants		IRF	Risk factor type	DALYs per 100,000 inhabitants		IRF	Risk factor type
	LMIC	HIC			LMIC	HIC		
Dietary risk factors and physical inactivity	**3,669 (3,347–3,977)**	**3,924 (3,639–4,248)**	**0.9 (0.8–1.1)**	**Ic (Ic-Ic)**	**3,132 (2,840–3,435)**	**4,550 (4,194–4,859)**	**0.7 (0.6–0.8)**	**Ic (Ib-Ic)**
Diet low in fruits	1,582 (1,210–1,914)	1,141 (862–1,415)	1.4 (0.9–2.2)	Ic (Ic-Ic)	1,521 (1,168–1,848)	1,575 (1,168–1,946)	1.0 (0.6–1.6)	Ic (Ib-Ic)
Diet low in vegetables	568 (357–778)	530 (362–693)	1.1 (0.5–2.2)	Ic (Ib-Ic)	564 (350–778)	776 (526–1,014)	0.7 (0.3–1.5)	Ic (Ib-Ic)
Diet low in whole grains	621 (481–755)	440 (336–539)	1.4 (0.9–2.2)	Ic (Ic-Ic)	559 (432–685)	559 (425–688)	1.0 (0.6–1.6)	Ic (Ib-Ic)
Diet low in nuts and seeds	730 (468–956)	846 (538–1,101)	0.9 (0.4–1.8)	Ic (Ib-Ic)	666 (429–867)	1,289 (833–1,656)	0.5 (0.3–1.0)	Ib (Ia-Ic)
Diet low in milk	25 (7–43)	62 (18–105)	0.4 (0.1–2.4)	Ib (Ia-Ic)	23 (7–38)	60 (18–101)	0.4 (0.1–2.2)	Ib (Ia-Ic)
Diet high in red meat	22 (10–38)	55 (26–86)	0.4 (0.1–1.5)	Ib (Ia-Ic)	17 (7–28)	53 (25–83)	0.3 (0.1–1.1)	Ia (Ia-Ic)
Diet high in processed meat	271 (82–483)	499 (182–804)	0.5 (0.1–2.6)	Ib (Ia-Ic)	261 (73–465)	669 (201–1,123)	0.4 (0.1–2.3)	Ib (Ia-Ic)
Diet high in sugar-sweetened beverages	126 (72–199)	119 (73–182)	1.1 (0.4–2.7)	Ic (Ib-Ic)	101 (52–168)	114 (68–179)	0.9 (0.3–2.5)	Ic (Ia-Ic)
Diet low in fiber	228 (95–371)	306 (149–468)	0.7 (0.2–2.5)	Ic (Ia-Ic)	215 (92–347)	444 (204–689)	0.5 (0.1–1.7)	Ib (Ia-Ic)
Diet low in calcium	33 (23–43)	68 (44–94)	0.5 (0.3–1.0)	Ib (Ia-Ic)	29 (21–38)	62 (41–85)	0.5 (0.2–0.9)	Ib (Ia-Ic)
Diet low in seafood omega-3 fatty acids	412 (294–528)	406 (291–532)	1.0 (0.6–1.8)	Ic (Ib-Ic)	368 (266–474)	636 (465–807)	0.6 (0.3–1.0)	Ib (Ia-Ic)
Diet low in polyunsaturated fatty acids	163 (75–252)	214 (103–324)	0.8 (0.2–2.5)	Ic (Ia-Ic)	159 (75–244)	334 (160–512)	0.5 (0.1–1.5)	Ib (Ia-Ic)
Diet high in trans fatty acids	154 (108–202)	254 (184–330)	0.6 (0.3–1.1)	Ib (Ia-Ic)	107 (74–142)	383 (273–492)	0.3 (0.2–0.5)	Ia (Ia-Ib)
Diet high in sodium	907 (583–1,212)	806 (512–1,080)	1.1 (0.5–2.4)	Ic (Ib-Ic)	844 (542–1,125)	1,046 (665–1,403)	0.8 (0.4–1.7)	Ic (Ib-Ic)
Physical inactivity and low physical activity	958 (793–1,134)	1,311 (1,126–1,510)	0.7 (0.5–1.0)	Ic (Ib-Ic)	Not assessed for 1990 because of absence of exposure data			
Occupational risk factors	**984 (740–1,272)**	**491 (382–623)**	**2.0 (1.2–3.3)**	**Ic (Ic-II)**	**1,128 (862–1,420)**	**686 (565–831)**	**1.6 (1.0–2.5)**	**Ic (Ic-Ic)**
Occupational carcinogens	35 (20–52)	62 (44–83)	0.6 (0.2–1.2)	Ib (Ia-Ic)	26 (16–41)	68 (51–93)	0.4 (0.2–0.8)	Ib (Ia-Ic)
Occupational asthmagens	31 (20–50)	21 (14–31)	1.5 (0.7–3.7)	Ic (Ib-II)	43 (26–74)	26 (18–38)	1.6 (0.7–4.1)	Ic (Ic-II)
Occupational particulate matter, gases, and fumes	150 (70–237)	38 (14–66)	4.0 (1.1–16.5)	II (Ic-II)	210 (98–327)	41 (16–70)	5.1 (1.4–20.4)	II (Ic-II)
Occupational noise	56 (33–90)	19 (11–31)	3.0 (1.1–8.4)	Ic (Ic-II)	60 (35–97)	26 (15–44)	2.3 (0.8–6.4)	Ic (Ic-II)
Occupational risk factors for injuries	382 (250–574)	112 (93–140)	3.4 (1.8–6.2)	II (Ic-II)	434 (285–629)	260 (220–302)	1.7 (0.9–2.9)	Ic (Ic-Ic)
Occupational low back pain	330 (214–476)	240 (156–347)	1.4 (0.6–3.1)	Ic (Ib-II)	355 (228–513)	264 (173–376)	1.3 (0.6–3.0)	Ic (Ib-Ic)

Table 3 (Continued)

Risk factor or risk factor cluster	2010				1990			
	DALYs per 100,000 inhabitants		IRF	Risk factor type	DALYs per 100,000 inhabitants		IRF	Risk factor type
	LMIC	HIC			LMIC	HIC		
Sexual abuse and violence	**353 (245–482)**	**286 (212–379)**	**1.2 (0.6–2.3)**	**Ic (Ib-Ic)**				
Childhood sexual abuse	110 (78–150)	136 (102–176)	0.8 (0.4–1.5)	Ic (Ib-Ic)	Not assessed for 1990 because of absence of exposure data			
Intimate partner violence	259 (162–380)	161 (101–240)	1.6 (0.7–3.8)	Ic (Ic-II)				

Own calculations based on Global Burden of Disease Study 2010 data. DALYs: disability-adjusted life years; LMIC: low- and middle-income countries; HIC: high-income countries; IRF: income relation factor, ratio of DALYs per 100,000 inhabitants in LMIC versus HIC; Risk factor Type Ia: strongly affluence-related risk factors; Ib: moderately affluence related; Ic: unrelated to the level of economic development; II: moderately poverty related; III: strongly poverty related. Figures in parentheses represent 95% uncertainty intervals. For details see statistical appendix.

burden (49% in 2010, up from 34% in 1990), are unrelated to the level of economic development (disease Type Ic, $0.66 \geq \text{IRF} < 3$). Most non-communicable diseases, including many cardiovascular and neuropsychiatric disorders, are found in this category.

This highlights general patterns in the global epidemiological transition. The IRF figures clearly illustrate the double burden of communicable and non-communicable diseases faced by LMIC, showing that while communicable diseases (IRF 10.3) are strongly concentrated in LMIC, non-communicable diseases (IRF 0.8) are causing almost as many DALYs per capita in LMIC as in HIC. Neoplasms (IRF 0.6) are the only main disease group causing a considerably smaller number of DALYs per capita in LMIC than in HIC, while still qualifying as only moderately affluence related.

Remarkably, this double burden has decreased since 1990, as the burden of non-communicable diseases has decreased simultaneously in LMIC and in HIC (IRF 0.8 constant since 1990), while the burden of communicable diseases has decreased more rapidly in LMIC than in HIC (IRF 10.3 in 2010, down from 12.8 in 1990). The burden of injuries has decreased both in LMIC and in HIC, but slightly faster in HIC (IRF 1.7 in 2010, up from 1.6 in 1990). Thus, while it is true that LMIC face actually a triple burden of communicable diseases, non-communicable diseases, and injuries, this phenomenon has grown less acute since 1990.

Our analysis of the relatedness of risk factors to the level of economic development reveals similar patterns for the year 2010, showing a double burden of risk factors in LMIC: among the 10 major risk factor clusters analyzed in the GBD 2010, there are two which are strongly poverty related (unimproved water and sanitation, and child and maternal undernutrition), one which is moderately poverty related (air pollution) and seven which are unrelated to the level of economic development, causing a similar amount of DALYs in HIC and in LMIC. Global disparities in risk factor exposure patterns were higher than those in disease burden patterns in 1990, and have converged more consistently since then.

Among the 81 strongly or moderately poverty-related conditions, a considerable number are infectious diseases which can be treated or prevented with existing pharmaceuticals. For others, for example, accidents, intentional injuries, and certain maternal and neonatal conditions such as birth trauma and abortion, pharmaceuticals are of limited usefulness. This shows that the lack of pharmaceutical R&D on neglected diseases is only one among many health challenges specific to LMIC. Moreover, this highlights that for a considerable number of poverty-related causes of death and disability, policy action beyond the traditional field of health policy might be needed.

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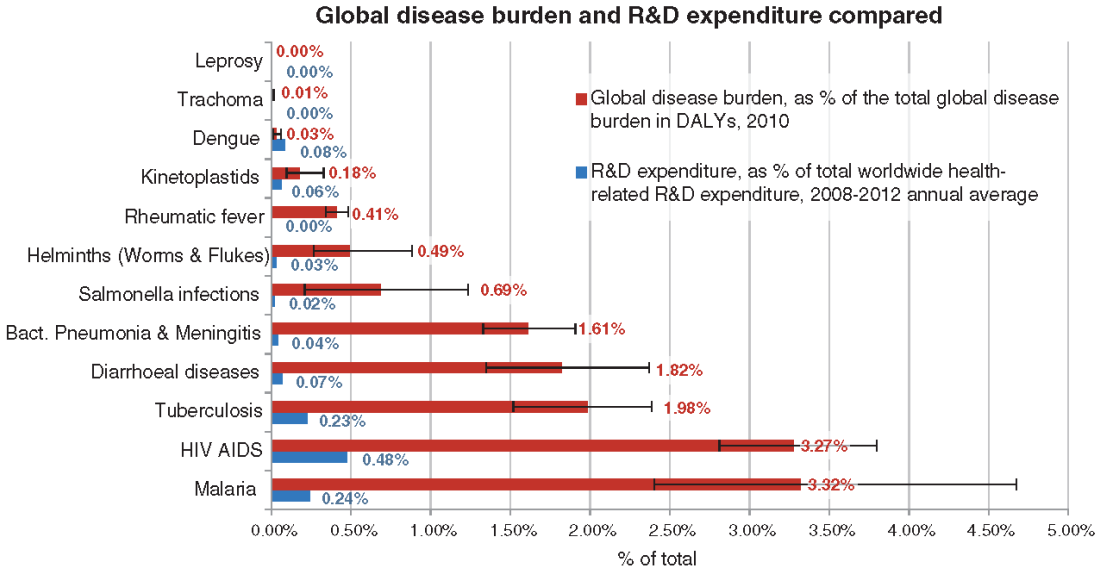

Fig. 2. Disease burden in DALYs (as % of total global disease burden, 2010) and R&D Expenditure (as % of total global health R&D Expenditure, annual average for 2008–2010) for 11 diseases and disease groups as defined by G-FINDER. Source: Own calculation based on Global Burden of Disease Study 2010 and G-FINDER data and data published by Chakma et al. DALYs: disability adjusted life years; R&D: research and development.

Health-related R&D expenditure and neglect in R&D

The 26 PRND included in our analysis are responsible for 14% of the global disease burden, but receive only 1.3% of global health-related R&D expenditure. In 1990, the Global Commission on Health Research identified a '10/90 Gap', in global health R&D, based on the assumption that in 1990, less than 5% of global health R&D was spent on diseases specific to developing countries, while 93% of the world's preventable mortality occurs in this group of countries (26). Following this commonly used terminology and based on the results of our analysis, we can thus identify a '1.3/14 Gap' in global health-related R&D. However, variation within this group of PRND is large, as shown by the wide range of the NF (median: 19; range: 544 (0.06–544); interquartile range (IQR): 47 (6–52)) and the Dollar per DALY metric (median: 28; range: 9,570 (1–9,571); IQR: 83 (10–94)). Despite this variation, our results clearly show that a large shortfall in R&D funding for PRND persists.

The relative contribution of these 26 PRND to the global disease burden has remained relatively stable over the past 20 years (13.8% in 2010 down from 14.4% in 1990), with shifting shares of individual PRND (see Fig. 5). By contrast, the role of the larger set of strongly and moderately poverty-related diseases identified in the first part of our analysis has decreased strongly from 51% of the global disease burden in 1990 to 38% in 2010. This shows that the 26 PRND in our analysis are, unlike the larger set of poverty-related diseases, not only poverty related but also neglected. While poverty-related diseases more generally are receding, the R&D gap for PRND, and their contribution to the global disease burden, over the past 20 years, has not grown significantly smaller in the course of the global epidemiological transition. It is therefore unlikely to disappear without increased action by public and private actors. For this action to be effective, however, better data on PRND is needed, suggesting a rationale for a WHO Global Health R&D Observatory (13, 17). Moreover, recent national and international policy initiatives such as the WHO R&D Demonstration Projects should be considered in this context (27).

Limitations

In our categorization of diseases into diseases Types I, II, and III, we followed the approach used by the WHO Secreteriat and Røttingen et al., although noting limitations outlined by them (13, 18). The choice of the cut-off values between the different disease categories is arbitrary to a certain degree, which is aggravated by the fact that the relative size of the disease categories is highly sensitive to the cut-off value. In addition, the DALY figures used are not age weighted.

Moreover, it should be noted that the IRF metric used in our analysis was originally developed for use with data from the GBD 2004 study, which uses a different methodology compared to the one used by GBD 2010. Therefore, our results are not directly comparable to the results reported in the original WHO background document (17) and Røttingen et al. (13). (For details please refer to the methodological annex.) It is also important to

Table 4. R&D expenditure (2008–2012 annual average) and disease burden (2010) compared

Cause or cause group	DALYs (% of total)	R&D (% of total)	Neglect factor	Dollar per DALY	DALYs per 100,000 inhabitants		IRF	Disease type
					LMIC	HIC		
All causes	100 (100–100)	100.00	1 (1–1)	107 (83–139)	38041.42 (27279.01–52476.16)	26421.32 (19916.73–34930.07)	1.44 (.78–2.63)	Ic (Ic-Ic)
All G-FINDER diseases	13.82 (10.35–18.14)	1.34	10.3 (7.7–13.6)	10 (8–13)	5808.1 (4,243–7,765)	468.9 (385–573)	12.4 (7–20)	II (II-II)
HIV AIDS	3.27 (2.81–3.80)	0.48	6.9 (5.9–8.0)	16 (14–17)	1376.3 (1,188–1,571)	108.9 (98–121)	12.6 (10–16)	II (II-II)
Malaria	3.32 (2.40–4.68)	0.24	13.7 (9.9–19.3)	8 (6–10)	1414.6 (961–2,050)	0.1 (0–1)	11465.2 (1,268–1,303,421)	III (III-III)
Tuberculosis	1.98 (1.52–2.39)	0.23	8.8 (6.7–10.6)	12 (11–15)	837.9 (654–1,010)	41.4 (34–51)	20.3 (13–30)	II (II-II)
Diarrheal diseases	1.82 (1.35–2.37)	0.07	27.1 (20.0–35.2)	4 (3–5)	769.0 (533–1,068)	47.3 (31–70)	16.3 (8–35)	II (II-II)
Rotavirus	0.75 (.55–.97)	0.02	34.6 (25.3–44.8)	3 (3–4)	315.8 (221–428)	18.7 (12–27)	16.9 (8–35)	II (II-II)
Enterotoxigenic E. coli (ETEC)	0.28 (.21–.35)	0.00	104.8 (80.7–133.6)	1 (1–1)	114.9 (83–155)	17.5 (11–26)	6.6 (3–14)	II (II-II)
Cholera	0.18 (.13–.25)	0.01	14.9 (10.5–20.5)	7 (6–10)	76.3 (46–119)	0.0 (0–0)	3156.8 (708–13,273)	III (III-III)
Shigella	0.28 (.22–.36)	0.01	30.9 (23.5–39.4)	3 (3–4)	119.3 (87–162)	7.5 (5–11)	15.9 (8–33)	II (II-II)
Cryptosporidium	0.34 (.25–.44)	0.00	82.5 (60.2–108.7)	1 (1–2)	142.6 (95–205)	3.6 (2–6)	39.8 (15–107)	III (II-III)
Dengue	0.03 (.01–.06)	0.08	0.4 (.2–.7)	266 (155–637)	13.3 (5–29)	4.7 (2–8)	2.9 (1–14)	Ic (Ib-II)
Kinetoplastids	0.18 (.10–.33)	0.06	2.8 (1.5–5.3)	38 (22–66)	74.7 (38–140)	5.4 (3–11)	13.9 (3–55)	II (II-III)
Chagas disease	0.02 (.01–.04)	0.01	2.3 (1.1–4.7)	46 (24–93)	8.5 (4–18)	4.9 (2–10)	1.7 (0–8)	Ic (Ib-II)
Leishmaniasis	0.13 (.08–.21)	0.02	5.5 (3.4–8.6)	19 (13–30)	56.7 (33–92)	0.5 (0–1)	117.7 (45–290)	III (III-III)
Sleeping sickness	0.02 (.00–.08)	0.02	1.4 (.2–4.6)	78 (25–574)	9.6 (1–30)	–	a	III (III-III)
Helminths (worms & flukes)	0.49 (.27–.88)	0.03	14.9 (8.0–26.7)	7 (4–13)	209.6 (114–381)	1.6 (1–3)	130.4 (37–479)	III (III-III)
Roundworm (ascariasis)	0.05 (.03–.10)	0.00	63.3 (32.4–119.9)	2 (1–3)	22.4 (12–40)	0.4 (0–1)	50.6 (12–205)	III (II-III)
Hookworm (Ancylostomiasis & Nectoriasis)	0.13 (.06–.24)	0.00	34.3 (17.0–64.5)	3 (2–6)	55.1 (27–102)	0.9 (0–2)	59.5 (16–212)	III (II-III)
Whipworm (trichuriasis)	0.03 (.01–.05)	0.00	60.3 (31.2–106.3)	2 (1–3)	10.9 (6–18)	0.0 (0–0)	1110.4 (323–3,864)	III (III-III)
Lymphatic filariasis (elephantiasis)	0.11 (.07–.17)	0.01	19.4 (11.9–29.7)	5 (4–8)	47.5 (31–69)	–	a	III (III-III)
Onchocerciasis (river blindness)	0.02 (.01–.03)	0.00	4.8 (3.3–6.8)	22 (17–30)	8.5 (6–11)	–	a	III (III-III)
Schistosomiasis (bilharziasis)	0.13 (.06–.27)	0.01	13.0 (6.3–26.1)	8 (4–16)	56.6 (27–127)	–	a	III (III-III)
Tapeworm (cysticercosis/taeniasis)	0.02 (.01–.03)	0.00	19.1 (13.5–26.6)	6 (4–7)	8.6 (6–13)	0.2 (0–0)	37.7 (13–116)	III (II-III)
Bacterial pneumonia & meningitis	1.61 (1.33–1.91)	0.04	41.3 (34.1–48.9)	3 (2–3)	654.9 (528–805)	178.6 (151–209)	3.7 (3–5)	II (Ic-II)
Streptococcus pneumoniae	1.40 (1.16–1.66)	0.03	51.1 (42.4–60.4)	2 (2–2)	567.9 (458–697)	171.0 (145–200)	3.3 (2–5)	II (Ic-II)
Neisseria meningitidis	0.21 (.17–.25)	0.01	35.2 (28.3–42.6)	3 (3–4)	87.0 (70–107)	7.6 (6–9)	11.4 (8–17)	II (II-II)
Salmonella infections	0.69 (.21–1.23)	0.02	35.9 (10.9–64.5)	3 (2–9)	289.7 (83–513)	14.7 (8–23)	19.6 (4–65)	II (II-III)
Non-typhoidal Salmonella enterica (NTS)	0.19 (.14–.25)	0.01	29.7 (22.1–38.6)	4 (3–5)	81.1 (55–117)	10.5 (7–15)	7.7 (4–16)	II (II-II)
Typhoid and paratyphoid fever (S. typhi, S. paratyphi A)	0.49 (.06–.98)	0.01	56.4 (7.4–112.6)	2 (1–14)	208.7 (28–395)	4.2 (1–8)	49.4 (3–725)	III (II-III)
Leprosy	0.00 (.00–.00)	0.00	0.1 (.0–.1)	1,914 (1,026–4,361)	0.1 (0–0)	0.0 (0–0)	65.8 (8–1,110)	III (II-III)
Rheumatic fever	0.41 (.34–.48)	0.00	544.2 (458.6–642.8)	0 (0–0)	162.1 (136–190)	66.2 (58–76)	2.4 (2–3)	Ic (Ic-II)
Trachoma	0.01 (.01–.02)	0.00	5.8 (4.0–8.0)	18 (14–25)	5.7 (4–8)	–	a	III (III-III)

Own calculations based on Global Burden of Disease Study 2010 and G-FINDER data and data published by Chakma et al. (25). DALYs: disability-adjusted life years; LMIC: low- and middle-income countries; HIC: high-income countries; IRF: income relation factor, ratio of DALYs per 100,000 inhabitants in LMIC versus HIC; Disease Type Ia: strongly affluence-related diseases; Ib: moderately affluence related; Ic: unrelated to the level of economic development; II: moderately poverty related; III: strongly poverty related. aDisease not prevalent in HIC.

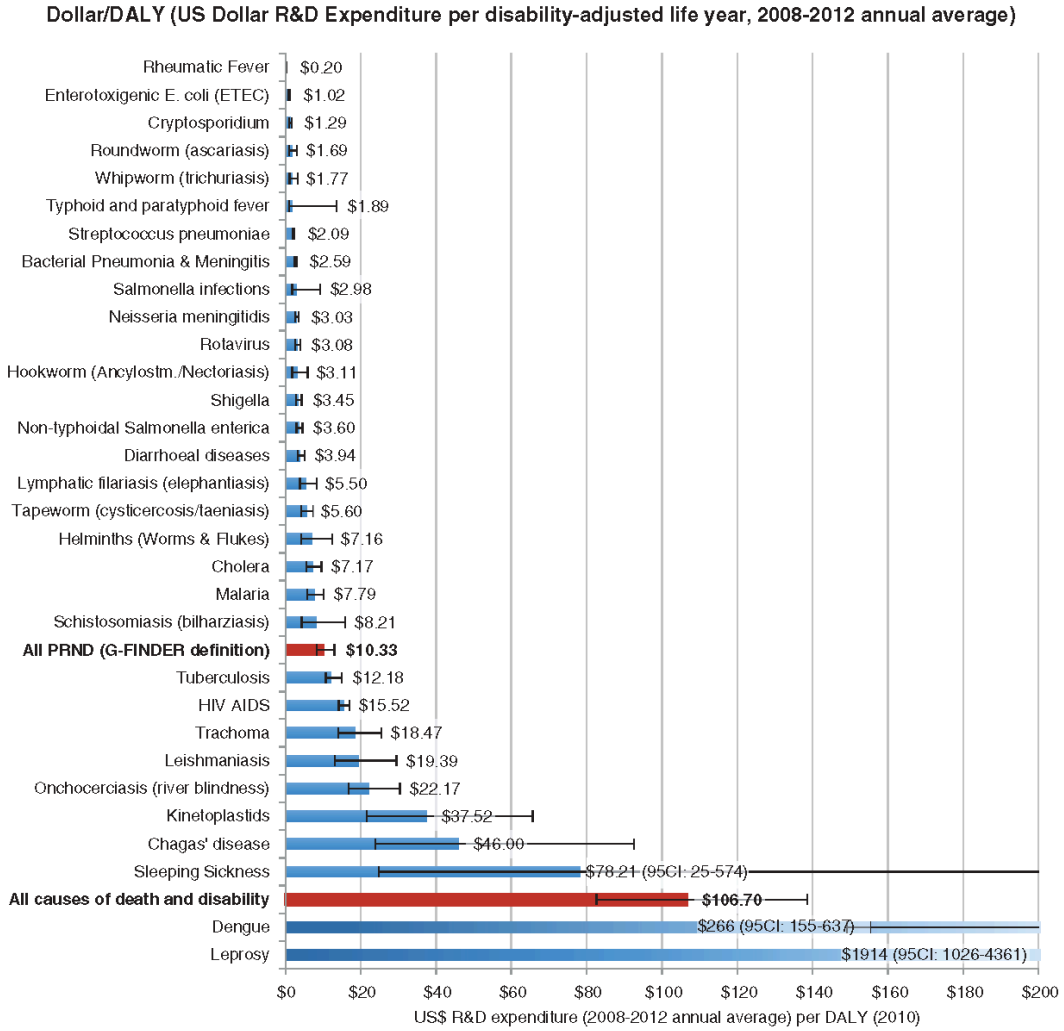

Fig. 3. R&D expenditure (2008–2012 annual average, in 2012 nominal US$) per DALY (2010). Source: Own calculations based on Global Burden of Disease Study 2010, G-FINDER data and data published by Chakma et al. DALYs: disability adjusted life years; R&D: research and development.

note that the IRF captures only health disparities across countries, and not those within countries.

Our analysis of neglect in R&D based on R&D expenditure and disease burden also has a number of limitations. Even for diseases not related to poverty, additional R&D needs specific to resource-poor settings may exist, which may not be addressed by commercially driven R&D geared toward high-income settings. This 'intra-disease R&D gap' is not captured by our analysis. Moreover, the disease burden measured in DALYs is a very crude measure for R&D needs. The equitable and efficient level of R&D on a specific disease might depend, among other things, on: 1) the relative epidemiological and public health relevance of the disease; 2) the suitability and viability of existing medical and non-medical prevention and treatment options, and thus the medical need for new or improved pharmaceuticals; 3) the scientific and technical prospects of successfully developing new or improved pharmaceuticals for the disease in question; 4) the potential contribution these new remedies could make in fighting the disease under the given political, economic, social, and socioeconomic conditions. All four factors depend at least partly on facts which are unknown, uncertain, controversial, and/or difficult to assess in a systematic, comprehensive, and scientifically rigorous way, while only the first point is addressed by the DALY measure which we have used. This is a considerable limitation. Particularly important in light of the concentration of PRND in the poorest countries (see Fig. 6) is that weak health systems limit access to existing drugs, and

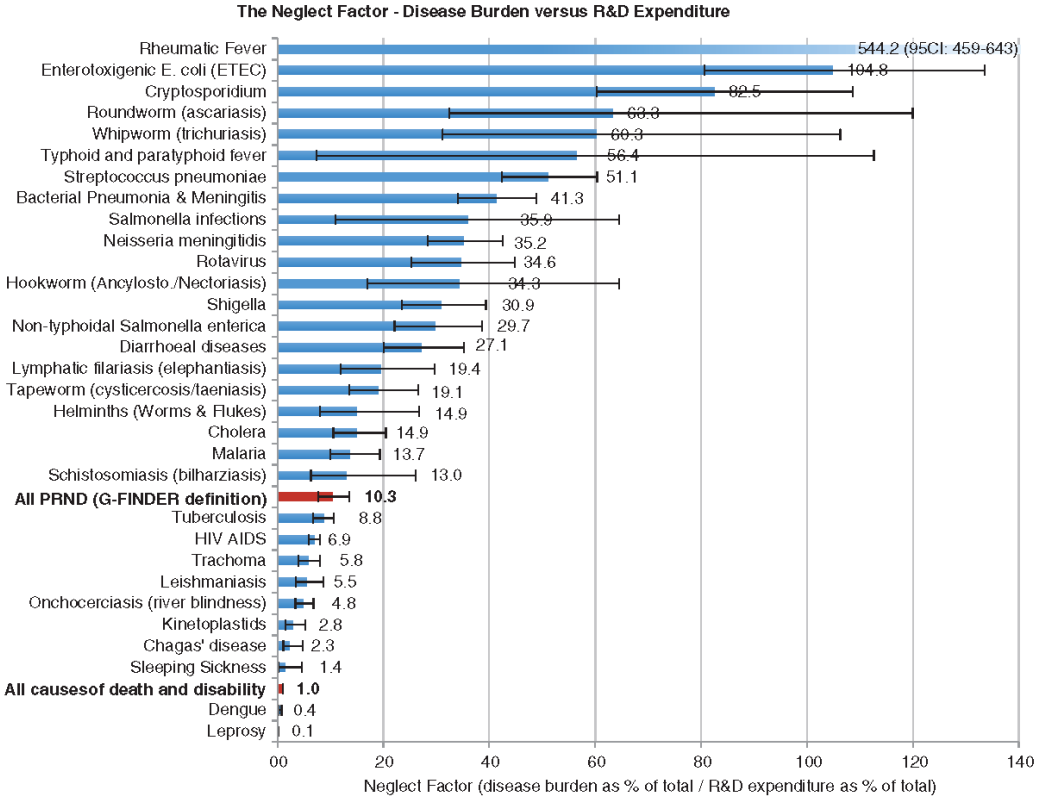

Fig. 4. The neglect factor for 26 poverty-related diseases. The neglect factor is the ratio of disease burden in DALYs (as a percentage of the total global disease burden, 2010) versus R&D expenditure (as a percentage of total global health-related R&D expenditure, 2008–2012 average). Source: Own calculations based on Global Burden of Disease Study 2010, G-FINDER data and data published by Chakma et al. DALYs: disability adjusted life years; R&D: research and development.

will severely limit the benefits of any new drugs for PRND. This implies that measures to address the R&D gap will only realize their full potential if complemented with a strengthening of national health systems.

Moreover, considerable uncertainties are attached to the data we have used in our analysis, namely the disease burden data and the R&D expenditure data for total global biomedical R&D and for specific neglected diseases, which we have taken from different sources (19, 20, 23, 24). For figures on specific neglected diseases, we used the G-FINDER, which uses very strict inclusion criteria and only considers funding data verified both by donors and receiving R&D organizations (23). This implies that G-FINDER data on R&D funding are lower-bound estimates. By contrast, for total world-wide biomedical R&D expenditure, we used figures provided by Chakma et al., who use publicly reported as well as interpolated data (25). Moreover, uncertainties are attached to the measures used by Chakma et al. for inflation and purchasing power adjustments, as pointed out by Young et al. (28).

For our own calculations, we used the National Institutes of Health Biomedical R&D Price Index to adjust for inflation, which is an equally imperfect measure (28). Uncertainties are also attached to the disease burden data we use (19, 20). These may be particularly large for the neglected tropical diseases we have analyzed (29, 30). Moreover, varying definitions of PRND exist (3, 13, 23, 31–33), of which we have chosen only one.

Results of similar studies

The results of our study are consistent with earlier studies on disparities in disease burden patterns and global health R&D. Røttingen et al. showed that in 2010 roughly 1% of global health-related R&D investment was spent on PRND (13). Pedrique et al. show that only 1% of clinical trials registered between 1999 and 2011 are devoted to PRND and between 2000 and 2011 only 1.2% of new chemical entities were developed for PRND that accounted for 11% of global disease burden (3, 7). Hotez et al. and Viergever found large variations between selected PRND when estimating neglect in R&D using the Dollar/DALY metric (6, 22). Evans et al. analyze the number of articles, systematic reviews, and clinical trials indexed in MEDLINE for 111 prominent medical conditions, and found that

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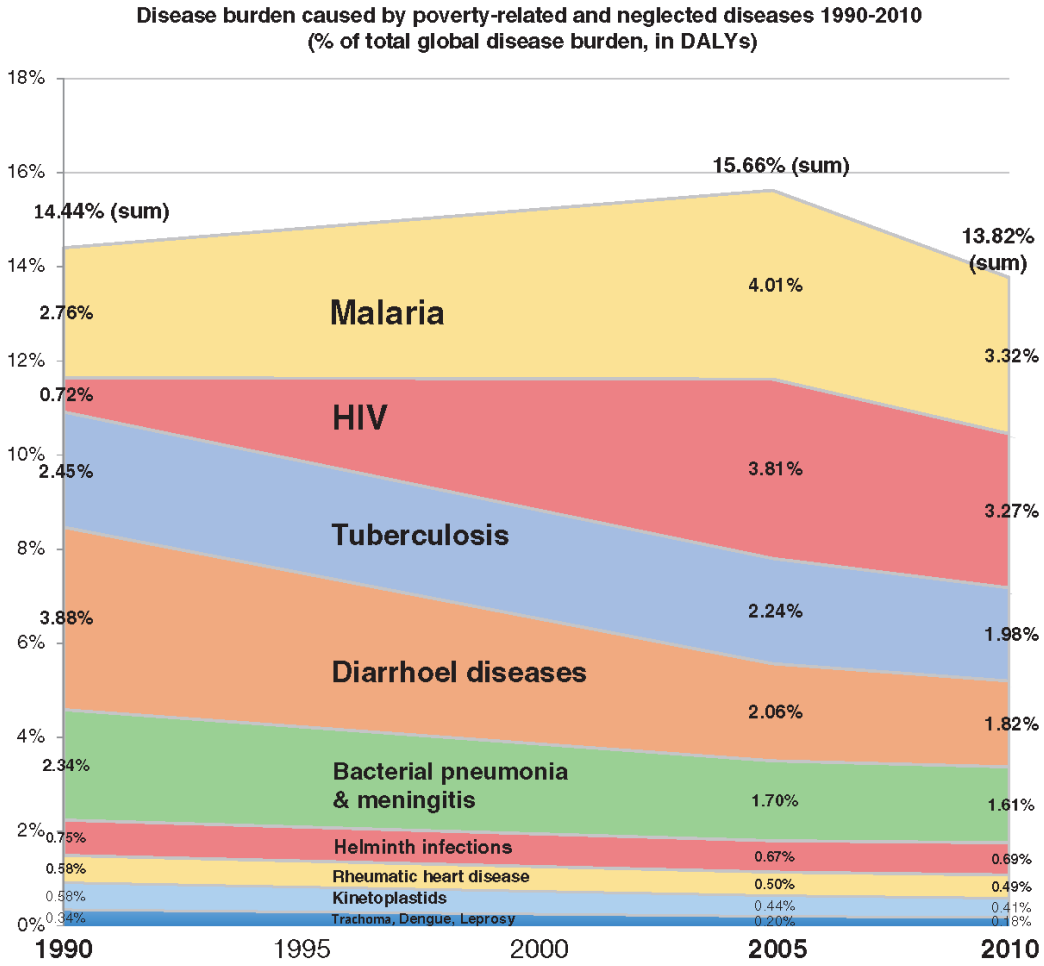

Fig. 5. The overall contribution of PRND to the global burden of disease has remained comparatively stable over the past 20 years, with marked changes in the relative weight of individual disease. Source: Own calculations based on Global Burden of Disease Study 2010. Disease groups are defined as in G-FINGER, excluding four diseases for which no disease burden data were available.

global DALYs for each condition had a small, significant negative relationship with the production of each type of MEDLINE articles for that condition (3). Trouiller et al. had reported earlier that of 1,393 new chemical entities marketed between 1975 and 1999, only 16 or roughly 1% was for tropical diseases and tuberculosis, while these diseases were responsible for 11.4% of the global disease burden (11). However, Cohen et al. found for the same time period and the same set of diseases a considerably higher number of new chemical entities (32 or roughly 2%) (34). Viergever, Karam, and Terry find that for every million DALYs caused by communicable, maternal, perinatal, and nutritional conditions, by non-communicable diseases, or by injuries, the WHO's International Clinical Trials Registry Platform (ICTRP) database contains an estimated 7.4, 52.4, and 6.0 trials, respectively (35). Despite differences in methodology, scope, and time frame, these findings are consistent with the results of our analysis.

Conclusions

The disease burden caused by individual diseases, disease groups, and risk factors varies strongly with the level of economic development, as demonstrated by the wide range of the IRF. Communicable, neonatal, maternal, and nutritional disorders cause a 10 times larger disease burden per capita in LMIC than in HIC (IRF 10.3). Non-communicable diseases cause only a slightly smaller disease burden per capita in LMIC than in HIC (IRF 0.8), demonstrating the double burden of communicable and non-communicable diseases in LMIC. The 26 poverty-related diseases included in our analysis of neglect in

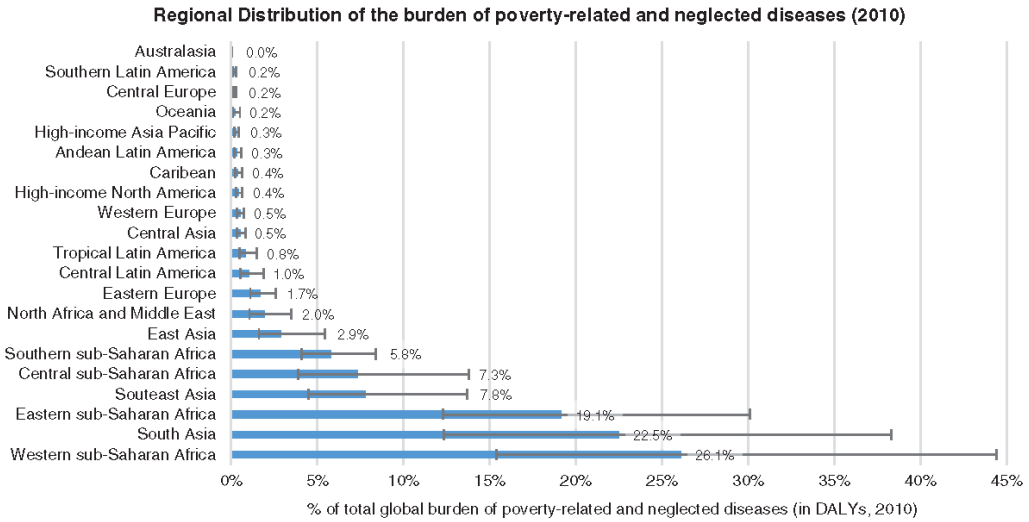

Fig. 6. PRND are strongly concentrated in only three world regions: Western and Eastern sub-Saharan Africa, and South Asia together account for more than 60% of the global burden of PRND, illustrating the concentration of PRND in the poorest countries. Source: Own calculations based on Global Burden of Disease Study 2010.

R&D are responsible for 13.8% of the global disease burden, but receive only 1.34% of global health-related R&D expenditure. These findings reveal a considerable shortfall in R&D funding for PRND. The degree of neglect, however, as captured by the Dollar per DALY metric and the NF, varies considerably among the different PRND.

Authors' contributions

PvP and FS wrote the article and did the statistical analysis with input from MB, SR, and PT. MB, SR, and PT provided conceptual input and research support. PT provided guidance on the implementation of the work. All authors have seen and approved the final version of the abstract for publication.

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Gesundheitssysteme und ihre Relevanz für die Gesundheitsversorgung

Kohler S, Asadov DA, Bründer A, Healy S, Khamraev AK, Sergeeva N, **Tinnemann P.** Health system support and health system strengthening: two key facilitators to the implementation of ambulatory tuberculosis treatment in Uzbekistan. Health Econ Rev. 2016 Dec;6(1):28. doi: 10.1186/s13561-016-0100-z

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Um zukünftig relevant zu sein, könnte die Forschung und Entwicklung an den Gesundheitsbedarfen oder der Krankheitslast von Bevölkerungen ausgerichtet werden, ähnlich wie Gesundheitssysteme weltweit bereits an Kosteneffektivität, Wirksamkeit und Ressourcensparsamkeit orientieren. So empfiehlt die WHO beispielsweise, die ambulante Behandlung der Tuberkulose in Ländern mit niedrigem- und mittlerem Einkommen ambulant durchzuführen.

In Usbekistan konnte daher mittels Gesundheitsreform, durch die der Gesetzgeber die Aufgaben der Tuberkulosefürsorge aus dem stationären in den ambulanten Sektor verlegte, die Anzahl der Krankenhausbetten, die Dauer stationärer Behandlungen und die Anzahl der Behandlungszentren für Tuberkulose stark reduziert werden.

Zu den Reformbemühungen wurden Interviews mit Akteuren aus dem öffentlichen Gesundheitsdienst durchgeführt, um unterschiedliche Perspektiven auf die Bereiche der Gesundheitssystemstärkung, der Gesundheitssystemunterstützung und die zur Verfügung stehenden Ressourcen zu identifizieren.

Dabei stellt sich heraus, dass ausreichende finanzielle Anreize im ambulanten Systems Usbekistans fehlten, um die traditionelle Versorgung nach dem sowjetischen Semashko Modell zu ersetzen und das stationäre System weiterhin finanziell profitierte. Darüber hinaus fehlte insbesondere das Personal, um den wachsenden Aufgaben ambulant gerecht zu werden.

Allerdings gab es unter den Mitarbeiter/innen gibt es großes Interesse an Erfahrungen, um die Reformen auch gemeinsam mit Beteiligten jenseits des Gesundheitswesens voranzutreiben und umzusetzen zu können.

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Health system support and health system strengthening: two key facilitators to the implementation of ambulatory tuberculosis treatment in Uzbekistan

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Abstract

Uzbekistan inherited a hospital-based health system from the Soviet Union. We explore the health system-related challenges faced during the scale-up of ambulatory (outpatient) treatment for drug-susceptible and drug-resistant tuberculosis (TB) in Karakalpakstan in Uzbekistan. Semi-structured interviews were conducted with key informants of the TB services, the ministries of health and finance, and their TB control partners. Structural challenges and resource needs were both discussed as obstacles to the expansion of ambulatory TB treatment. Respondents stated need for revising the financing mechanisms of the TB services to incentivize referral to ambulatory TB treatment. An increased workload and need for transportation in ambulatory TB care were also pointed out by respondents, given the quickly rising outpatient numbers but per capita financing of outpatient care. Policy makers showed strong interest in good practice examples for financing ambulatory-based management of TB in comparable contexts and in guidance for revising the financing of the TB services in a way that strengthens ambulatory TB treatment. To facilitate changing the model of care, TB control strategies emphasizing ambulatory care in hospital-oriented health systems should anticipate health system support and strengthening needs, and provide a plan of action to resolve both. Addressing both types of needs may require not only involving TB control and health financing actors, but also increasing knowledge about viable and tested financing mechanisms that incentivize the adoption of new models of care for TB.

Keywords: Ambulatory care, Financing, Health system, Hospitalization, Outpatient care, Scale-up, Stakeholder perceptions, Tuberculosis, Uzbekistan

Introduction

Ambulatory-based management of tuberculosis (TB), including multidrug-resistant tuberculosis (MDR-TB), appears to be effective and cost-effective in a variety of settings [1–6]. With potential to increase the cost-effective use of resources and to reduce the lag between diagnosis and start of treatment, ambulatory treatment of drug-susceptible as well as drug-resistant TB can help improve quick and universal access to TB treatment, which in turn mitigates the spread of TB in the population. In addition, ambulatory treatment can reduce the risk of nosocomial TB transmission to hospital staff and among patients, and it enables patients to reduce the costs associated with reduced time at work or home [7–9]. The World Health Organization (WHO) has encouraged outpatient TB management in resource-limited settings since the '90s [10] and conditionally recommends ambulatory treatment of MDR-TB since 2011 [11]. The WHO reiterated these recommendations in its post-2015 global TB strategy, labelled the End TB Strategy [12], and has advised ambulatory-based management of MDR-TB in all post-2011 Global Tuberculosis Reports [13–16]:

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"Ambulatory services should be given preference over hospitalization, which should be limited to severe cases." (WHO End TB Strategy)

"Greater use of ambulatory care as part of decentralized PMDT [programmatic management of drug-resistant TB] services is necessary to expand access." (WHO Global Tuberculosis Report 2015)

For the WHO European Region, a new TB action plan was adopted in September 2015. It states that all WHO high-priority countries for TB control in the European region should specify strategies and mechanisms for expanding and maintaining ambulatory TB treatment by 2016 [17]. Presently, the treatment practices for TB involve high levels of hospitalization in several high MDR-TB burden countries. The hospitalization level of MDR-TB patients (at least for part of the treatment) was between 75 and 100 % in Eastern European countries, with the lowest levels in Central Asia (30–40 % in Kazakhstan, Tajikistan and Uzbekistan). The hospitalization level varied widely in the African Region (21 % of patients in the Democratic Republic of the Congo to 100 % in Nigeria) [15]. Hospitalization for 100 % of MDR-TB patients in 2013 was reported for India, China and the Russian Federation, the three highest MDR-TB burden countries in the world, and in 2014 for China and the Russian Federation together with 8 other high MDR-TB burden countries [15, 16]. Hence, many more TB patients could and, based on the preliminary evidence on effectiveness and cost-effectiveness of ambulatory MDR-TB treatment [2-6], probably should be treated using ambulatory-based care rather than hospital-based care in several high MDR-TB burden countries.

Uzbekistan has reduced the number of TB beds from more than 15,000 in 2008 to less than 11,000 in 2012, and decreased the duration of hospitalization for MDR-TB patients from 270 to 90 days during the same period [13]. In 2011, *Presidential Decree No. 1652* [18] ordered a further reduction of the number of state-funded hospital beds, including TB beds. The decree instructed a decrease in the number of buildings in the tuberculosis care network from 152 (pre-2012) to 76, once fully implemented [18, 19]. Notwithstanding this nationwide reduction in TB-bed capacity and the inclusion of ambulatory-based TB care in the Uzbek strategy to achieve universal access to TB treatment [20], the treatment practice of TB remained hospital-based until October 2014 in all parts of Uzbekistan except for two regions with pilot programs for ambulatory-based TB care, the Republic of Karakalpakstan and Tashkent city. The reason was *Decree No. 160* and other *prikazes* (decrees) of the Ministry of Health (MoH) of Uzbekistan, which required the treatment of all TB patients, other than exceptional cases, to start in a TB hospital [21].

Starting as well as continuing TB treatment on an ambulatory basis was permitted nationwide throughout Uzbekistan on October 24, 2014, when the MoH of Uzbekistan issued *Decree No. 383* "On improvement of TB care activities in the Republic of Uzbekistan" [22]. *Decree No. 383* specifies groups of TB patients to be selected for ambulatory-based treatment. These groups consist of drug-susceptible and drug-resistant TB patients with negative sputum smear status whose condition does not require continuous monitoring, TB patients with uncomplicated active extrapulmonary TB, TB-infected children without risk factors and, with permission of a medical expert commission, exceptional cases in which a sputum smear positive TB patient wishes ambulatory treatment. In addition, the decree states that sputum smear positive TB patient may be treated home-based if adherence as well as specified criteria for uninterrupted treatment and infection control can be assured.

In Karakalpakstan, a republic in the northwestern part of Uzbekistan, ambulatory treatment from day one has been offered to patients with drug-susceptible and drug-resistant forms of TB, including MDR-TB, already since February 2011. The MoH of Karakalpakstan and Médecins Sans Frontières (MSF) began implementing a program, called "Comprehensive TB Care for All" [8], which introduced rapid testing of drug-resistance and integrated directly observed treatment, short-course (DOTS) and DOTS-Plus treatment into a common ambulatory TB care strategy for drug-susceptible and MDR-TB patients. The deviation from the national regulation that, until October 2014, required hospitalization for at least part of any TB treatment was made possible through *Decree No. 39* of the MoH of Karakalpakstan, which gave permission for ambulatory treatment of drug-susceptible and drug-resistant TB from the day of diagnosis onward, unless a patient's poor health or socio-hygienic living conditions require hospitalization [23]. The aim of the "Comprehensive TB Care for All" program is to scale-up the ambulatory TB care model until universal access to TB treatment in Karakalpakstan is achieved [24].

Despite having established the regulatory basis for the expansion of ambulatory treatment of drug-susceptible and drug-resistant TB the incentives set by the Uzbek health system, which finances hospitals based on their bed occupancy, have been perceived to work against a fast and full adoption of ambulatory-based TB care in Karakalpakstan. The experience of this setback has been described in an MSF information booklet about the "Comprehensive TB Care for All" program already at an early stage of implementation [8]:

"Ambulatory [TB] care should be offered to all patients from the very start of treatment, unless there

are specific medical indications requiring admission. Ambulatory treatment should generally be preferred to hospital-based treatment because it reduces the chance of cross-infection of hospitalized patients with drug-resistant strains, and because it could likely reduce adherence problems related to prolonged hospital stays, such as the isolation of the patient from their social environment. [...] Presently, health system financing in Uzbekistan is based on bed occupancy, on the "per number of beds" principle. This creates incentives for keeping patients in hospital for longer than is necessary, which is exactly the opposite of the desired situation. Instead, a system needs to be introduced, with advice from appropriate experts in health-system financing, which provides a proper mix of incentives for good-quality treatment." (MSF information booklet "Comprehensive TB Care for All")

The described problem of medically unnecessary hospital stays is known as overhospitalization. It has been discussed as an undesirable effect, in particular, in health systems which once created a large hospital capacity, such as those of former Soviet Union countries [19, 25]. While the general health sector has been and continues to be reformed in several former Soviet Republics since their independence, specialized health services, such as the TB care sector in Uzbekistan, have usually not been part of past health reforms and continue to work in the traditional way with a few exceptions [26–28]. Unsurprisingly, overhospitalization of TB patients has been described previously for post-Soviet states, for instance, after ambulatory DOTS programs were introduced in Russia [29, 30] or after the Stop TB strategy was implemented in Armenia [31, 32].

Based on the Karakalpakstan experience, this study illustrates how the traditional financing mechanisms of the TB services in the post-Soviet health system of Uzbekistan are perceived as disincentives to the adoption of a comprehensive ambulatory care model for drug-susceptible and drug-resistant TB. The study also shows that the perceived challenges to scale-up of ambulatory TB treatment fit into a classification of health system support and health system strengthening needs. The health system strengthening and support needs described by the study participants during individual and group interviews exemplify the range of challenges that can pose barriers to adopting comprehensive ambulatory-based management of TB as recommended by the WHO.

Background

TB and TB care in Karakalpakstan, Uzbekistan

Some of Uzbekistan's highest TB burden occurs in its northwestern part, the Republic of Karakalpakstan with a population of 1.8 million people. In 2013, the TB prevalence in this region was 107.7 per 100,000 population and the TB mortality was 10 per 100,000 population according to MoH data. Multidrug-resistance rates were 40.8 % among new and 78.1 % among retreated TB cases in 2010 [33].

The TB services are a specialized health service in Karakalpakstan. They are governed by similar principles as the Uzbek health system, which has evolved from the Soviet Semashko model of health care. The government-owned health system of Uzbekistan has been described as strictly hierarchical, using predominantly policy formulation as a mode of regulation. Subordinate levels of the health system are expected to follow the policies set by higher levels. Neither fiscal nor other forms of incentives are traditionally used for the regulation of health care providers [19, 34].

The TB services are budgeted by the treasury and operated through the MoH. In the ambulatory sector, primary health care facilities are funded based on the population of their catchment area, taking into account its age and gender composition. Consequently, health facilities do not receive additional financial resources that are directly tied to the growing number of outpatients during the expansion of ambulatory TB care. Given the per capita financing of outpatient care, the increasing outpatient numbers resulted in an availability of fewer resources per patient and a higher workload for the staff of the ambulatory TB services, despite an indexed budget that has grown. Hospital financing is based on the annual average of inpatient bed numbers and bed occupancy rates. Due to the bed-based funding, TB hospitals that refer patients to ambulatory treatment risk budget cuts. Past government decrees endorsed comprehensive ambulatory TB treatment and decreased the number of TB hospitals and beds available in Karakalpakstan [23, 35], but no regulation changed the system-inherent incentives to hospitalize TB patients. The regulation and financing mechanisms of the TB services in Karakalpakstan and the incentives they set are discussed in more detail elsewhere [27, 36] and are similar to those described for Armenia prior to 2014 [26].

The TB services in Karakalpakstan have been collaborating with MSF since 1998 to improve and expand TB treatment. Initially a DOTS program was implemented as a TB control strategy. The DOTS program had covered all districts in Karakalpakstan until August 2003. Starting in September 2003, a DOTS-Plus program added components for MDR-TB diagnosis, management and treatment. All patients diagnosed with active drug-susceptible TB and MDR-TB were admitted for an *intensive phase* of at least 2 and 8 months of inpatient treatment, respectively, or longer if needed to achieve sputum conversion. The subsequent *continuation phase* of treatment was administered through special DOTS

corners in outpatient clinics that only treated MDR-TB patients. In the course of the scale-up of the DOTS-Plus program, the management of drug-susceptible and drug-resistant TB was integrated for the *continuation phase*. Case detection, disease management and treatment were fully integrated for drug-susceptible and drug-resistant TB in 2010 ("Comprehensive TB Care for All"). Since February 2011, *Decree No. 39* of the MoH Karakalpakstan permits ambulatory intensive phase treatment of drug-susceptible and drug-resistant TB, and to hospitalize selectively only those patients whose clinical condition or living conditions require hospitalization [23]. Table 1 provides a chronology of the TB control program in Karakalpakstan.

The TB bed capacity in Karakalpakstan was reduced by more than 20 % (320 beds) from 2010 to 2014 based on *Decree No. 62* of the Cabinet of Ministers of the Government of the Republic of Uzbekistan entitled "On additional measures to decrease the incidence of tuberculosis in the Republic of Uzbekistan for 2011-2015" [35]. Savings achieved by the downsizing of the inpatient TB services were reinvested in the refurbishment and modernization of the equipment of the TB hospitals maintained. The MoH of Karakalpakstan plans to further reduce the available TB hospital capacity, but the MoH cannot reinvest savings from the inpatient TB services into the ambulatory TB services under the financing mechanisms in place.

Ambulatory TB care is offered through DOTs corners in polyclinics, primary health care facilities (*Selskie Vrachebniye Punkti*) and local health posts (former *Feldsher-Accoucheur points*) that operate as branches of the primary health care facilities. In 2014, inpatient TB care in the districts of Karakalpakstan was offered in seven specialized TB hospitals, comprising *rayon* (district) and inter-*rayon* hospitals. In addition, two Republican TB Hospitals (No. 1 and No. 2) remained in Nukus City after the closure of a third Republican TB Hospital (No. 3). Each TB hospital has a smear positive and smear negative ward, but only the Republican TB Hospitals in Nukus City and an inter-*rayon* TB hospital in Chimbay treat drug-resistant TB. Average costs of a hospital bed in Nukus City in 2013 for a drug-susceptible TB patient were UZS 30,169 (USD 15) per day and UZS 1,206,756 UZS (USD 603) per case treated. The average length of stay was 40 days for drug-susceptible patients and 100 days for patients with drug-resistant TB [9]. Cost or cost-effectiveness estimates comparing ambulatory and hospital-based treatment of MDR-TB in Karakalpakstan are not available.

Before the "Comprehensive TB Care for All" program, all MDR-TB patients had their treatment initiated in Republican TB Hospital No. 1 or No. 2. In districts without a TB inpatient department, patients were referred to the regional capital city Nukus or to the closest district

Table 1 Chronology of the TB control program in Karakalpakstan, Uzbekistan

Date	Activity
July 1998	First patient entered in DOTS program in Muynak district
June 2001	Launch of DST study
July 2002	First staff appointed to MDR-TB program (MDR-TB medical doctor position)
April 2003	Ministry of Health of the Republic of Uzbekistan issued *Decree No. 160* on management of TB [21]
August 2003	DOTS expanded to the last uncovered district Turtkul
September 2003	Start of DOTS-Plus program. First MDR-TB patients admitted to Republican TB Hospital No. 2 in Nukus
October 2004	Outpatient department opens in Nukus city for ambulatory care of MDR-TB patients discharged from MDR-TB hospital
May 2005	First MDR-TB patient cured
September 2005	Signed memorandum of understanding with Foundation for Innovative New Diagnostics for rapid DST
January 2006	GFATM TB program starts to supply second-line TB drugs for Karakalpakstan
October 2007	Ministry of Health of the Republic of Karakalpakstan issued *Decree No. 366* on expansion of ambulatory care of drug-resistant TB through early discharge into ambulatory care
May 2008	Ministry of Health of the Republic of Uzbekistan issued *Decree No. 180* on management of MDR-TB
August 2010	"Comprehensive TB Care for All" program approved in Karakalpakstan
February 2011	Ministry of Health of the Republic of Karakalpakstan issued *Decree No. 39* on "Comprehensive TB Care for All" program expansion and management of TB [23]
March 2011	Cabinet of Ministers of the Republic of Uzbekistan issued *Decree No. 62* on construction, reconstruction and refurbishment of TB facilities, and optimization of inpatient facilities through abolition of low capacity inefficient TB facilities [35]
December 2015	"Comprehensive TB Care for All" program implemented in all districts

DOTS directly observed treatment, short-course; *DOTS-Plus* is a management strategy for MDR-TB built upon the elements of DOTS, *DST* drug susceptibility testing, *GFATM* Global Fund to Fight AIDS, Tuberculosis and Malaria, *MDR-TB* multidrug-resistant tuberculosis, *MSF* Médecins Sans Frontières. Source: WHO [56] and own compilation

which has one. Patients receiving immediate ambulatory treatment typically start their treatment in a TB cabinet room and are then referred to the local outpatient primary health care facility. There is usually a TB cabinet room or TB dispensary (a specialized ambulatory facility) in all districts. It is regularly attended by a TB doctor, who is the only medical specialist with the authority to establish an official diagnosis of TB.

Looking at the economic context, Uzbekistan has faced steady economic growth over the past decade, and government expenditures on health were predicted to rise from 2.9 % of the GDP in 2010 to 4.4 % of the GDP in 2020 [37]. The budget of the TB services has also steadily increased over the past few years, with an annual increase of approximately 30 %.

Cost and cost-effectiveness of treatment for MDR-TB

The cost per MDR-TB patient treated in Uzbekistan in 2014 was reported to be USD 2935 [16]. One systematic review identified four studies on the cost and cost-effectiveness of MDR-TB treatment in other countries [3]. From the health system perspective, the cost (year 2005 USD) per disability-adjusted life-year (DALY) averted through ambulatory-based management of MDR-TB was estimated at USD 163 in Peru and USD 143 in the Philippines (no and 7 days average hospitalization) compared to USD 598 in Estonia and USD 745 in Tomsk. In Estonia and Tomsk, treatment was hospital-oriented with, on average, 192 days and 239 days of hospitalization, respectively. The cost per patient for MDR-TB treatment was USD 2423, USD 3613, USD 10,880 and USD 14,657, respectively. Synthesizing the data from these four studies and using probabilistic sensitivity analysis, the systematic review also appraised the likely cost and cost-effectiveness of MDR-TB treatment for 14 WHO subregions (covering 193 countries). Based on the model predictions, treatment of MDR-TB in either model of care appeared highly cost-effective in all 14 WHO subregions considered, according to the WHO threshold that a health care intervention is highly cost-effective if it costs less than the annual GDP per capita per DALY averted [38]. The usefulness of the WHO cost-effectiveness thresholds as a guide for policy-makers is under debate [39], but the four studies reviewed and the model predictions for the WHO subregions further indicated a better cost-effectiveness for outpatient versus inpatient models of care.

For the WHO subregion EUR B, which had an average GDP per capita of USD 3384 and includes the Central Asian republics Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan, cost per DALY averted were estimated to be USD 316 (123–672) per patient treated ambulatory and USD 801 (371–1,571) per patient treated hospital-based. Cost per patient treated were estimated to be USD 6,057 (2,955–11,692) in the outpatient model and USD 15,505 (8,063–29,015) in the inpatient model, respectively. These estimates from the probabilistic sensitivity analysis represent means with 5th and 95th percentiles of the cost distributions. The systematic review and other studies note that the main influences on cost are the model of care and the drugs included in the treatment regimen [3, 40, 41]. For patients, income loss often constitutes the largest financial risk from TB [41, 42].

Health reform in post-Soviet states and financing of TB services

There is a substantial body of literature on health reform in Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan) and other regions of the former Soviet Union [43–47]. Several post-Soviet states have reformed the provision of services in primary health care, and they have reduced the number of hospital beds since independence. With a few exceptions, the funding mechanisms for the specialized TB services remained unchanged. In Armenia, new financing mechanisms for both inpatient and outpatient TB services were introduced in 2014, along with new criteria for hospital admission and discharge. Bed-based financing for the inpatient TB services has been replaced by fixed and variable cost funding. Per-capita financing of the outpatient TB services has been replaced by performance-based funding. The new funding scheme also allows money saved to be reinvested into an outpatient oriented TB program and aims to produce a gradual shift of experienced TB doctors from hospitals to outpatient services [26, 27]. Belarus has started a pilot project in 2014, under which money that became available after a reduction in the number of beds in one TB hospital would be used to incentivize primary health care workers providing DOTS to rural outpatients [27]. Beginning in 2011, the TB services have been reformed and integrated into the primary health care in Georgia [28].

Theoretical framework

Supporting the health system can include any activity that improves services. Support activities improve outcomes primarily by increasing inputs. By contrast, strengthening the health system is accomplished by more comprehensive changes to policies and regulations, organizational structures and relationships across the health system building blocks. Strengthening activities motivate changes in behavior and/or allow a more effective use of resources to improve (multiple) health services. Hence, health system strengthening is about making the system function better permanently, not just filling gaps or supporting the system to produce better short-term outcomes [48].

A wide spectrum of health system strengthening interpretations exists. We adopted criteria suggested by Chee

et al. [48] in order to distinguish between health system strengthening and support. If the questions in Table 2 could be answered with "Yes", then coded interview content that related to a potentially needed activity or intervention was classified as a health system strengthening need, otherwise coded content was identified as a health system support need.

Chee et al. [48] also require a fourth question to be asked: "Do the interventions have cross-cutting benefits beyond a single disease?" We did not apply this fourth criterion because our study focused on the TB services, which are organized and funded as a separate health service with a disease-specific mandate within the general health system in Uzbekistan.

According to Chee at al. [48] not distinguishing health system support activities from strengthening ones can lead to neglect of critical system strengthening activities, as well as to unmet expectations of stronger health systems. They therefore argue that distinguishing between these two types of activities will improve programming impact.

Methods

Study setting and design

While making progress towards changing the model of care for TB toward a decentralized ambulatory approach since February 2011, MSF and the MoH of Krakalpakstan have noted that the existing health system financing fails to incentivize the use of ambulatory-based TB care. In response, this exploratory qualitative study was implemented aiming to assess the policy for allocation of funds for TB care in Karakalpakstan, the ways in which it undermines the implementation of decentralized ambulatory care, and how the health financing could be changed to support the expansion of ambulatory care for drug-susceptible and drug-resistant TB.

Interviews with one respondent and interviews with several respondents were conducted between September and October 2012 in Tashkent as well as in Nukus and two districts of Karakalpakstan. Arrangements were made to meet at a workplace convenient for all the participants in order for the interviews to be conducted. During a typical interview, the questions progressed from asking about the TB care financing in place, through perceived challenges with respect to implementing ambulatory TB care, to possible suggestions and solutions. Open questions that subsequently became more specific were asked within each topic. No prespecified set of questions was used throughout due to the various, usually natural settings in which interviews took place.

Table 2 Is it Health System Strengthening?

Criteria to distinguish between health system strengthening and support interventions
1. Do the interventions address policy and organizational constraints or strengthen relationships between the six WHO [57] building blocks of a health system (service delivery, health workforce, information, medical products, vaccines and technologies, financing, and leadership and governance)?
2. Will the interventions produce permanent systemic impact beyond the term of the project?
3. Are the interventions tailored to country-specific constraints and opportunities, with clearly defined roles for country institutions?

Source: Adapted from Chee et al. [48]

Study participants

Key informants with a high level of experience in the provision, organization or financing of the TB services in Karakalpakstan and/or the rest of Uzbekistan were identified and purposively contacted by staff of the Uzbek mission of MSF who were familiar with the potential participants. To learn about the views and perception of various stakeholders, participants were selected from the health and finance ministries, the TB services in Karakalpakstan and from TB control partners (Global Fund to Fight AIDS, Tuberculosis and Malaria; MSF, Project Hope). A total of 24 unique respondents (including authors AB, AK and NS) participated in 15 interviews. An interview with more than one respondent was conducted when more participants from the same group of participants could be met together. Group sizes varied from two to five respondents. Two respondents participated in a one-on-one interview and a group interview (Table 3).

Data collection

SK conducted all interviews. Interviews were either audio recorded or written summary notes were taken by SK. The majority of the conversations lasted between 45 minutes and 2 hours; two interviews lasted approximately 15 minutes. Interviews usually took place at the respondents' place of work, or, in one case, during a work-related commute between health facilities. The commute was chosen on purpose for one group interview with TB doctors because the commute constituted a calm time among peers during their work day. In eleven cases, an interview was conducted in a local language and translation was needed. Translation was provided by local MSF staff. A translator was only present if translation was needed. In five cases, one or two familiar people, such as colleagues or MSF staff, were present but were not involved in the core conversation. The number of discussions was not predetermined. Data collection continued until the ideas expressed were repetitions of concepts already identified, that is, data saturation had been reached.

Data management and analysis

The data collected in individual and group interviews were analyzed in the same manner using thematic analysis, a method for identifying, analyzing and reporting

Table 3 Study participants

Type of participant	Affiliation	Level	Tool
Government official or employee	Ministry of Health	Uzbekistan	Individual interview
	Ministry of Health, Treasury or government	Karakalpakstan	Individual interview[a]
			2 x Group interview[a] (2 participants per group)
TB care provider	TB services (inpatient and outpatient)	Karakalpakstan	2 x Individual interview
			4 x Group interview[b] (2–3 participants per group)
TB control partner	GFTMA	Uzbekistan	Individual interview
	Project Hope	Uzbekistan	Individual interview
	MSF[c]	Karakalpakstan and Uzbekistan	2 x Individual interview[d]
			Group interview[d] (5 participants)

MSF Médecins Sans Frontières, *GFATM* Global Fund to Fight AIDS, Tuberculosis and Malaria, *TB* tuberculosis
[a,d]One respondent participated in individual and group interview
[b]Included one city health department staff
[c]Included local and international MSF staff

patterns within qualitative data. The analysis was based on organizing sections of the data into recurrent themes and using quotes to illustrate the kind of data classified within each theme [49, 50]. Data analysis began after the first interview. The analysis was an ongoing process. Recordings were listened to and notes were read through several times to obtain a sense of the whole. Relevant parts of the audio recorded English conversations or the simultaneous English translations were transcribed verbatim into written form using a text editor.

The data set used for the analysis was all text extracted from the recording and notes. The analyst used codes to identify explicit content that appeared interesting to him regarding (financial) resources and incentives in TB care. Reflecting on the pattern in the data, codes were collated into potential themes. Thinking about the relationship between themes, different levels of themes were divided into main overarching themes and subthemes within them. The analyst reviewed and refined the potential subthemes and themes until he devised a satisfactory thematic map, taking into account his review of related literature and key documents. Finally, the analyst checked whether the themes identified work in relation to the coded extracts as well as the entire dataset. The theoretical framework by Chee et al. [48] to distinguish health system strengthening and support activities was used in the derivation of the final themes. All management and analysis was performed by SK.

Permissions

Permission to conduct the study was granted by the MSF desk in Berlin and the MSF mission in Uzbekistan. Potential study participants were contacted with information about the study. An interview was scheduled with those who agreed and were available to participate. Interviews were recorded if permission was given and the setting was suitable for recording. An opportunity to revise the quotes reproduced was granted. Written consent to reproduce the selected anonymized quotes was obtained.

Results

A wide range of issues relating to the implementation and expansion of ambulatory TB care was discussed. Interview content that related to the financing of ambulatory TB care and its expansion was finally stratified into three main themes: health system strengthening, health system support and resources available. The focal theme, health system strengthening, was further stratified into two subthemes: financial disincentives to ambulatory TB treatment and ideas for and enablers of change.

Health system strengthening

Financial disincentives to ambulatory TB treatment

Respondents reported the transition from hospital-based TB care to ambulatory treatment is proving difficult, given the financing of the TB services in Karakalpakstan. Three major financial disincentives that hinder the scale-up of ambulatory treatment were expressed.

Firstly, respondents explained that the funding of outpatient TB care facilities is based on the population size, age and sex composition of the area served. The resources available for ambulatory TB care were perceived as unresponsive to the increasing outpatient numbers experienced during the scale-up. Decreasing resources per patient and a higher workload for the staff of the ambulatory TB services due to expanding outpatient treatment of TB were described.

Secondly, the traditional bed-based financing of TB hospitals has been perceived to undermine the transition to mainly ambulatory TB treatment. The hospital financing in place was described as a reason for continuingly high

proportions of inpatient TB treatment, despite the new possibility to treat drug-susceptible and drug-resistant TB patients as outpatients from the day of diagnosis in the "Comprehensive TB Care for All" program districts.

> *"Going back to the beginning of last year, 2011, when we got the approval from Karakalpakistan that we could treat patients from day 1 on ambulatory care, then shortly afterwards we realized there are two forces which are working against each other. This issue of how the government is financing the system became so obvious. One force was that there is this prikaz [MoH of Karakalpakstan Decree No. 39] which pushes people into ambulatory care from day 1, so they are not coming to the hospital. And the other force goes against this, but you have to fill up your beds in the hospital. So on the first day the doctors were agreeing to treat the patient in an ambulatory way, and the next day they grab the same patient, the same doctors grab the same patient back into the hospital to fill up the beds, because that is how they get the money." (Group interview 1)*

> *"The past practice was to finance the inpatient facilities' activities based on the number of the beds. And one of the indicators of the medical facility activity is to fulfill the plan of bed occupancy. In such cases, you have to keep some patients longer than necessary and not to discharge them from the hospital. It is, therefore, the right decision to discuss the issue of financing based on the number of patients. So, irrespectively of where a patient is receiving his treatment, the financial amount assigned for his treatment will follow him." (Interview 4)*

Thirdly, respondents described separate budgets for inpatient and outpatient TB services, and that funds allocated to inpatient TB care, including savings from TB bed reductions, cannot be reallocated by the MoH to the expansion of ambulatory TB care. One respondent further pointed out that the failure of the TB care financing to reward successful treatment can also contribute to a high rate of hospitalization of TB patients in Karakalpakstan:

> *"The treatment outcome does not really affect the financing. So, it is a slight problem because if the facility gets the funding according to the number of the treated, like cured patients, then more focus would be on the treatment outcome, successful outcome. It is either cured or treatment completed. But as such an approach does not work, so the facility is only interested in having the beds occupied. Someone goes, another one comes and fills in the bed. So it is not a treatment outcome-oriented or patient-oriented approach at all. So it is about occupying your beds." (Interview 2)*

Ideas for and enablers of change

While disincentives to the implementation of ambulatory TB treatment were repeatedly described in precise and elaborate ways, only a few respondents put forward ideas for alternative TB care financing mechanisms and their suitability for the local context. Prompting for viable options to modify the TB care financing in place, case-based financing mechanisms, pay for performance that gives financial incentives for better health outcomes, and remuneration that is adjusted for the caseload and the complexity of cases were all suggested as possible elements of an alternative to the current funding of the TB services. These ideas were expressed without an implementation plan, for instance, describing that financing of TB services should be for the actual number of cases treated, should take into account treatment outcomes or that salary should be according to the difficulty of the job and depending on the number of patients.

Respondents were interested in training and real-life examples on how to strengthen ambulatory TB care as a specialized service in their health system. They indicated that it would be useful to learn from the experience of other countries, in particular post-Soviet states, which have implemented financing reforms for their TB services.

> *"Because if it comes out and the state does not have a real proof that it works, they may not change anything, in the financing either. So I think they need proof at a very high level like consultancy that it has worked in similar settings, like other post-soviet countries, because now almost everywhere the system is unchanged." (Interview 2)*

Health system support

The focus of the interviews conducted was to elicit structural barriers in the health system that work against the scale-up of ambulatory TB treatment. Nevertheless, immediate resource needs also came up during the conversations, particularly if respondents were involved in the day-to-day provision rather than the management or organization of the TB services. The main needs reported included a lack of ambulatory staff, due to an increased workload resulting from the scale-up of ambulatory treatment, and a lack of transport capacity between facilities. Some respondents said that they knew of ambulatory staff in the TB services who had paid out of their own pocket for transportation or work-related phone calls in the past because the resources provided were sometimes insufficient.

Resources available

Responses in our study indicated an existing awareness that health system strengthening needs to accompany health system support within the TB services. In addition, there appeared to be willingness to change the hospital-based system and respondents shared a positive attitude toward ambulatory TB treatment.

> *"There is certain interest in outpatient treatment from all stakeholders, including the national partners. We hear more and more about the possibility and necessity to go more for outpatient care. Levels as high as the ministry would also say the same. They are looking for such a change, and they are looking for the consultants to advise them on this, how to go through this reform. This is the situation now." (Interview 2)*

Discussion

Most former Soviet Union countries have strong roots in providing hospital-based TB care, and they had often created a large capacity of hospital beds in a centralized health care system. The traditional financing mechanisms of the TB services, which continued to be in place in Uzbekistan and other post-Soviet states after the dissolution of the Soviet Union, provide no incentives for earliest possible referral to ambulatory care and fail to reallocate resources towards the expansion of ambulatory TB treatment [36]. Interview participants in this qualitative study in the context of the expansion of ambulatory treatment for drug-susceptible and drug-resistant TB in Karakalpakstan described a range of health system support and strengthening needs that were perceived as barriers to changing the model of TB care.

The health system strengthening needs for the TB services, which were enumerated during interviews, resembles the common health system challenges of post-Soviet Union states after their independence. Firstly, a substantial proportion of medical treatment takes place in hospitals that are financed based on bed numbers and occupancy rates, despite the fact that several procedures could probably be done efficiently and cost-effectively in an ambulatory setting. Secondly, the ambulatory sector needed for comprehensive outpatient care is underdeveloped and underfinanced [19, 46]. A further aspect related to overhospitalization is specific to TB care, namely that hospitalization of TB patients without sufficient isolation poses a threat to the patients' and medical staff's health as it may cause infection with more resistant strains of TB during treatment in hospital [51].

In the study context of Karakalpakstan, the stakeholders involved in the organization and provision of the TB services appeared committed and willing to change the present TB care financing in order to implement and scale-up ambulatory TB care. Positive attitudes of key stakeholders toward change help implement new TB treatment strategies and may increase the pace of change and the sustainability of change when achieved [52]. However, the local public health decision-makers interviewed described that lack of relevant evidence, best practice examples or expert advice on desirable TB care financing mechanisms hinders reforming the financing of the TB services.

Few past health system strengthening activities have focused specifically on revising the traditional financing mechanisms of the TB services in former Soviet states [26, 27], despite the fact that these financing mechanisms work against the adoption of ambulatory TB treatment approaches. This may reflect that further operational and health systems research for improving the performance and introduction of new TB care delivery strategies is needed [53]. As it may not be feasible to archive a reform focused specifically on the financing mechanisms of the TB services, health financing reform addressing inefficiencies, like overhospitalization, may need to be sought and adopted in a broader context, taking into account specialized health sectors, such as the TB services in many post-Soviet countries.

Health system changes that support the ambulatory treatment model have already been achieved in Karakalpakstan in an area other than financing of the TB services. As ambulatory treatment of TB patients uses more decentralized structures than inpatient treatment, the clinical management has been decentralized. Traditionally, every decision for each drug-susceptible and drug-resistant TB patient went to a single *consilium*, the medical expert commission authorized to make TB treatment decisions, where each case is debated by specialists. Meanwhile, most cases are reviewed by several *mini consilia* within the districts. However, achieving this reform in the health system has been described as difficult in an MSF information booklet about the scale-up of ambulatory TB treatment [24]:

> *"Since 2011 there has been significant system change, although achieving this has been a lengthy process requiring the devolution of the decision making process on TB diagnosis and care from a single, centralised consilium to district level." (MSF information booklet "The Path to Scale-up")*

Strengths and limitations

The results of this study are subject to several limitations. Some informants on the national level were unavailable due to a busy working schedule. Not all interviews were audio recorded and only notes were taken. The variety of stakeholders interviewed facilitated broad rather than specific insights. Responses frequently involved centralized decision-making and top-down regulation as a driver of

change, possibly due to the predominant experience of the study participants with the present system. Translators were experienced with medical translation, but provided real-time translation on partially new topics. In some instances, the information and quotations translated may, therefore, reflect content summaries rather than actual wording. Interviewing more than one person at the same time may have reduced the diversity of opinions. On the other hand, interviewing a group can supplement interviewing individuals, and it could have assisted respondents to reevaluate a previous position or statement in need of "amplification, qualification, amendment or contradiction" [54]. We acknowledge that the variation in interviewing methods limits the scope for understanding their individual strengths and limitations in our study context.

A coherent picture emerged across the individual interviews and group interviews, but our findings may be biased by the small study sample and lack of independent data. Three interview participants have been involved in the conception and design of the study and contributed to writing the manuscript. None of them has been involved in data analysis and management. Finally, the interview partners were a selected group of respondents with close ties to each other, many of whom were involved in TB care and the scale-up of ambulatory TB treatment. By contrast, the familiarity among the relatively small number of key people involved with TB care in Karakalpakstan ensured an in-depth coverage of the local situation. We, therefore, believe that the insights gained from this study are representative of the health system strengthening and support needs experienced by the TB services in Karakalpakstan in the course of the scale-up of ambulatory-based management of TB.

Conclusions

Health systems may receive substantial support for effective TB control, but complementary health system strengthening can help to make adjustments to incentivize the adoption of new treatment approaches, such as comprehensive ambulatory-based care of patients with drug-susceptible and drug-resistant TB. The findings of this study show that health system strengthening has been perceived to be necessary for implementing and expanding ambulatory TB treatment in Karakalpakstan, Uzbekistan, notwithstanding the support received or requested. The experience of Karakalpakstan illustrates the range of factors that may need to be considered to develop an effective TB control strategy in post-Semashko health systems, and that further research on improving the introduction of new TB care delivery strategies is needed.

To facilitate the adoption of ambulatory models of care, TB control strategies should anticipate both health system support and strengthening needs, and the possible consequence of involving health and finance ministries, as well as TB control and health financing reform partners in the process of restructuring the model of care for TB. Anticipating health system support and strengthening might help identify key collaborators early, which has been recommended as good practice in MDR-TB program development and implementation [55].

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Authors' contributions
The study was conceived and designed by AB, AK, NS and SH. Interviews and data analysis were conducted by SK. SH and PT commented on early results. SK prepared the first draft and revised subsequent drafts. All authors contributed to the revisions. All authors read and approved the final manuscript.

Competing interests
SK consulted for MSF. AB was Head of the MSF mission in Uzbekistan. SH was MSF Humanitarian Affairs Adviser. NS was MSF Regional Advocacy Officer for Central Asia. AK is Deputy Chairman of the Parliament of the Republic of Karakalpakstan. AB, AK and NS participated in interviews.

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Bedeutung der Gesundheitsversorgung

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Gesundheitsversorgung darf nicht nur auf einzelne Erkrankungen oder Versorgungsbereiche ausgerichtet sein. Die WHO fordert von ihren Mitgliedsstaaten, dass diese für alle Menschen und ohne Ausnahme eine bezahlbare, gesundheitsfördernde, präventive, kurative und rehabilitative Gesundheitsversorgung auf höchsten Niveau garantieren. Aber leider werden in der globalisierten Welt der letzten Jahrzehnte Krankenversorgungs- und Sozialsysteme zunehmend fragmentiert und gesundheitliche Ungleichheiten nehmen zu. Mit der Folge, dass der Zugang zu Gesundheitsversorgung in vielen Ländern unzureichend ist und so den sozialen Zusammenhalt gefährdet.

Einige Länder mit mittlerem Einkommen bemühen sich daher, durch Gesundheitsreformen eine allgemein zugängliche Gesundheitsversorgung (*universal health coverage, UHC*) sicherzustellen insbesondere für sozioökonomisch Benachteiligte und vulnerable Bevölkerungsgruppen. Ziel der Untersuchung war es, Lücken in der Gesundheitsversorgung älterer Menschen mit chronischen Erkrankungen in sechs exemplarischen Ländern mit niedrigem- und mittlerem Einkommen zu analysieren.

Dabei zeigte sich, dass sozioökonomisch benachteiligte Menschen ungleich schwerer Zugang zu Gesundheitsversorgung haben und die Ausgaben der Ärmsten der Bevölkerung am Häufigsten einen so großen Anteil des Haushaltseinkommens ausmachen, dass der ganze Haushalt von diesen Ausgaben nachteilig betroffen ist. In den untersuchten Bevölkerungsgruppen bot eine Krankenversicherung prinzipiell

daher auch keinen Schutz vor finanziellen Schwierigkeiten, obwohl diese Menschen große Hoffnungen an eine allgemeine Gesundheitsversorgung knüpften.

Wenn dagegen Länder mehr Geld für eine allgemeine Gesundheitsversorgung zur Verfügung stellten, verbesserten sich Leistungen des Gesundheitssektors und mehr Gelder standen für die Versorgung sozioökonomisch Benachteiligter zur Verfügung. Allerdings garantierte dies nicht gleichzeitig eine bessere oder gerechtere Gesundheitsversorgung.

Um Lücken in der Gesundheitsversorgung zu schließen ist es daher wichtig das Gesundheitsreformen neben der Qualität der Gesundheitsleistungen auch eine stärkere soziale Teilhabe und demokratische Kontrolle der Gesundheitsversorgung sicherstellen.

Research

Assessment of universal health coverage for adults aged 50 years or older with chronic illness in six middle-income countries

Christine Goeppel,[a] Patricia Frenz,[b] Linus Grabenhenrich,[a] Thomas Keil[a] & Peter Tinnemann[a]

Objective To assess universal health coverage for adults aged 50 years or older with chronic illness in China, Ghana, India, Mexico, the Russian Federation and South Africa.

Methods We obtained data on 16 631 participants aged 50 years or older who had at least one diagnosed chronic condition from the World Health Organization Study on Global Ageing and Adult Health. Access to basic chronic care and financial hardship were assessed and the influence of health insurance and rural or urban residence was determined by logistic regression analysis.

Findings The weighted proportion of participants with access to basic chronic care ranged from 20.6% in Mexico to 47.6% in South Africa. Access rates were unequally distributed and disadvantaged poor people, except in South Africa where primary health care is free to all. Rural residence did not affect access. The proportion with catastrophic out-of-pocket expenditure for the last outpatient visit ranged from 14.5% in China to 54.8% in Ghana. Financial hardship was more common among the poor in most countries but affected all income groups. Health insurance generally increased access to care but gave insufficient protection against financial hardship.

Conclusion No country provided access to basic chronic care for more than half of the participants with chronic illness. The poor were less likely to receive care and more likely to face financial hardship in most countries. However, inequity of access was not fully determined by the level of economic development or insurance coverage. Future health reforms should aim to improve service quality and increase democratic oversight of health care.

Abstracts in عربي, 中文, Français, Русский and Español at the end of each article.

Introduction

The World Health Assembly in 2005 and the United Nations General Assembly in 2012 called for universal health coverage to reinforce the human right to health. All Member States were requested to guarantee affordable promotive, preventive, curative and rehabilitative health care of the highest attainable standard for everyone, without distinction.[1,2] However, over the past three decades, market deregulation and political crises have led to increased inequalities in income and opportunity in many countries. These inequalities are reflected in highly fragmented health and social security systems, which are increasingly differentiated by socioeconomic strata, and in setbacks for publicly funded health services. As a result, poorer social groups, including the historically marginalized and those more recently excluded from social protection systems, are forced either to forego care or to pay for access to increasingly costly health-care services. Consequently, access to health care in many countries has deteriorated to such an extent that health problems have become a threat to social development and cohesion.[3]

At the same time, the rise in chronic noncommunicable diseases makes international development goals more difficult to achieve and complicates strategies for attaining universal health coverage. Moreover, the epidemiological transition, which is characterized by a sharp increase in population growth and a change in the leading causes of death, is rapidly accelerating in the poorest strata of society, where people are less likely to have access to appropriate services and are at risk of catastrophic health-care costs.[4,5] Many middle-income countries, including those we investigated, have scaled up efforts to achieve universal health coverage through substantial health reforms with a particular emphasis on the poor and vulnerable. These reforms have adopted a range of voluntary and social health insurance schemes in their attempt to increase service utilization while avoiding financial hardship and encouraging equity of access.[6]

The aim of this study was to investigate gaps in universal health coverage for specific socioeconomic groups by focusing on older adults with chronic illness in China, Ghana, India, Mexico, the Russian Federation and South Africa. We examined five key issues: (i) access to basic chronic care; (ii) protection against financial hardship; (iii) the influence of health insurance schemes; (iv) the influence of place of residence; and (v) general satisfaction with the health-care system. We also examined progress towards universal health coverage in the six countries.

Methods

The World Health Organization's (WHO's) Study on Global Ageing and Adult Health (SAGE) provides comparable, publicly available data on adults aged 50 years and older based on nationally representative household surveys for six countries: China, Ghana, India, Mexico, the Russian Federation and South Africa.[7] These countries have some of the fastest growing economies globally and together contain more than 40% of the world's population spread over four regions.[8] We analysed cross-sectional data from wave 1 of the study carried out between 2007 and 2010. The response rate in individual surveys ranged from 52% in Mexico to 93% in China.[7]

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Our study population consisted of all participants in the Study on Global Ageing and Adult Health who could be categorized as older adults with chronic illness: they were aged 50 years and older and reported being diagnosed with at least one chronic disease, such as arthritis, hypertension, stroke, angina, diabetes, chronic lung disease, asthma or depression. Universal health coverage was assessed on three dimensions: (i) access to basic chronic care; (ii) income-related equity of access; and (iii) protection against financial hardship. We also investigated the influence of health insurance on both access to basic chronic care and financial hardship and the influence of rural or urban habitation on access and we compared levels of satisfaction with the health system between people who did and did not use outpatient care.

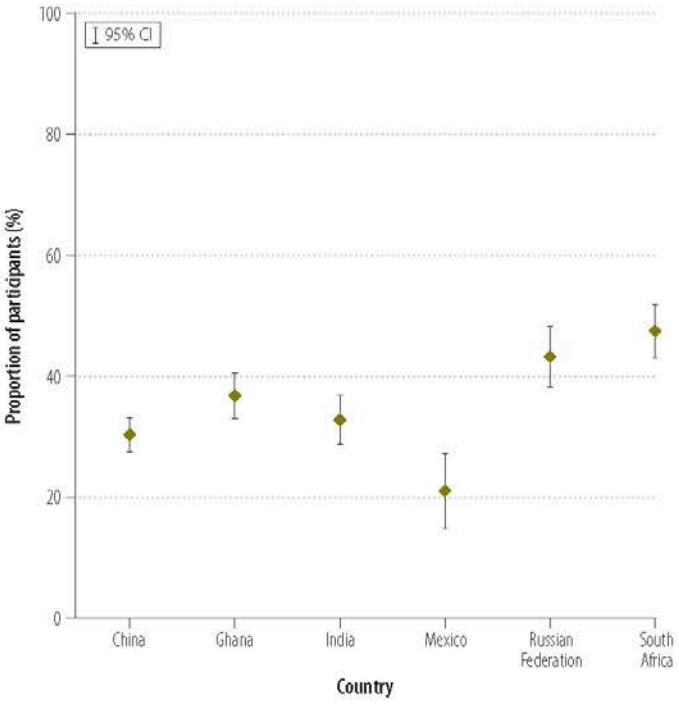
Access to basic chronic care was assessed using a compound indicator with three components: (i) the provision of treatment, such as medications or advice on physical activity or diet, for each of the patient's conditions; (ii) visiting outpatient services for the chronic condition or conditions one or more times in the last reported year; and (iii) maintenance of a stable health state after the last outpatient visit. In the surveys, health-care providers were categorized as medical doctors, nurses, physiotherapists or traditional practitioners. Equity of access was assessed on the basis of equal treatment for equal health needs.[9] Since all study participants had chronic conditions, they all needed access to health care. Therefore, any income-related disparity in access to basic chronic care within a country indicated the existence of an inequity.

Financial hardship was defined in two ways: (i) catastrophic household spending on health in the last reported year of more than 30% of annual average household income, after the deduction of food expenditure – health expenditure included prepayments and out-of-pocket expenses; and (ii) catastrophic out-of-pocket expenditure for the last outpatient visit of more than 30% of annual household per capita income, after the deduction of food expenditure – expenditure on the outpatient visit included doctor fees and the cost of medications, diagnosis and transport. For our analysis, we based household income quintiles on annual household per capita income.[10] A person with any type of health insurance was classified as insured. Dissatisfaction with the health-care system was assessed using two indicators: (i) dissatisfaction with health-care services; and (ii) insufficient involvement in health-care decision-making.

Statistical analysis

We adjusted study data for differences between countries in survey design and data collection in Stata version 13.1 (StataCorp. LP, College Station, United States of America) using person-level analysis weights based on selection probabilities in the survey sampling design and a post-stratification factor. All percentage estimates are weighted. Differences between countries in access to basic chronic care and financial hardship were described using weighted population means. Within countries, we assessed the effect of poverty by stratifying data by household income quintile and looked particularly at differences between the poorest quintile and the population mean. Differences in equity of access between countries were compared using concentration curves and indices. We employed logistic regression modelling to estimate: (i) the effect of health insurance on access to basic chronic care and financial hardship; (ii) the effect of rural or urban residence on access; and (iii) the effect of using outpatient services on dissatisfaction with the health system. Models were adjusted for sex, age, place of residence, educational level, income quintile, comorbidity and insurance. Finally, we examined the effect of macroeconomic and social factors on universal health coverage in different countries by determining whether gross national income per capita, public health expenditure per capita or the Gini coefficient was

Fig. 1. **Access to basic chronic care by adults aged 50 years or older with chronic illness in six middle-income countries, 2007–2010**



CI: confidence interval.
Note: Chronic illness was defined as being diagnosed with at least one chronic disease.

Table 1. **Demographic and socioeconomic characteristics of participants, study of universal health coverage for adults aged 50 years or older with chronic illness, 2007–2010**

Characteristic	China	Ghana	India	Mexico	Russian Federation	South Africa
Study population,[a] *n*	6558	1327	2623	1341	2916	1866
Prevalence of chronic disease in the SAGE population,[b] % (95% CI)	50.5 (48.5 to 52.4)	32.0 (29.8 to 34.4)	41.8 (39.2 to 44.4)	55.0 (49.5 to 60.3)	72.7 (69.1 to 76.0)	50.5 (47.3 to 53.7)
Age in years, mean (SE)	64.2 (0.2)	66.3 (0.4)	62.3 (0.3)	64.8 (0.9)	65.2 (0.7)	62.4 (0.4)
Female sex, % (95% CI)	54.5 (53.2 to 55.7)	54.6 (50.9 to 58.2)	47.5 (44.6 to 50.4)	62.0 (54.3 to 69.1)	61.9 (57.7 to 66.0)	62.8 (59.2 to 66.3)
Comorbidity,[c] % (95% CI)	38.4 (36.6 to 40.3)	29.4 (26.4 to 32.6)	37.5 (34.5 to 40.7)	36.1 (29.0 to 44.0)	63.3 (59.0 to 67.4)	42.7 (38.6 to 46.9)
Urban residence, % (95% CI)	55.0 (53.1 to 56.9)	52.3 (48.4 to 56.3)	33.5 (26.8 to 41.0)	81.6 (74.5 to 87.1)	71.3 (58.6 to 81.3)	68.7 (63.7 to 73.3)
Health insurance, % (95% CI)						
None	10.9 (9.2 to 12.8)	52.5 (48.7 to 56.4)	94.9 (92.7 to 96.4)	27.4 (17.1 to 40.8)	0.2 (0.1 to 0.6)	79.8 (76.4 to 82.8)
Mandatory	76.5 (73.1 to 79.5)	2.3 (1.4 to 3.8)	2.3 (1.4 to 3.6)	53.8 (43.1 to 64.1)	98.3 (96.4 to 99.2)	7.0 (5.2 to 9.4)
Voluntary	5.9 (4.8 to 7.3)	43.2 (39.3 to 47.1)	2.7 (1.5 to 4.7)	18.6 (13.0 to 25.9)	0.7 (0.2 to 2.3)	9.9 (7.4 to 13.0)
Both mandatory and voluntary	6.8 (4.6 to 9.8)	2.0 (1.2 to 3.2)	0.2 (0.1 to 0.5)	0.3 (0.1 to 1.2)	0.7 (0.2 to 2.8)	3.3 (2.1 to 5.1)
Educational level, % (95% CI)						
Less than primary school	38.2 (35.2 to 41.3)	55.4 (51.3 to 59.4)	43.8 (39.6 to 48.1)	53.0 (44.8 to 61.1)	1.8 (1.1 to 2.9)	44.9 (40.3 to 49.5)
Primary school	21.0 (18.4 to 23.9)	10.0 (8.0 to 12.4)	17.9 (14.8 to 21.4)	23.5 (17.6 to 30.8)	6.4 (4.1 to 9.9)	24.6 (21.2 to 28.5)
Secondary school	21.3 (19.5 to 23.2)	6.5 (5.0 to 8.6)	16.6 (13.8 to 19.8)	15.2 (8.6 to 25.5)	19.9 (15.1 to 25.8)	16.4 (13.3 to 20.1)
More than secondary school	19.5 (16.5 to 22.8)	28.1 (25.0 to 31.5)	21.7 (17.6 to 26.4)	8.2 (4.8 to 13.6)	71.8 (64.7 to 78.0)	14.1 (10.9 to 18.1)

CI: confidence interval; SAGE: Study on Global Ageing and Adult Health; SE: standard error.
[a] The study population comprised chronically ill participants in wave 1 of the World Health Organization's SAGE.
[b] Percentage of participants in wave 1 of SAGE, which included only people aged 50 years or older, who were diagnosed with a chronic condition.
[c] Comorbidity was defined as having at least two chronic conditions.
Notes: Chronic illness was defined as being diagnosed with at least one chronic disease. Percentages are weighted.

associated with access to basic chronic care without incurring catastrophic out-of-pocket expenditure for the last outpatient visit.[11–17]

Results

Our study population comprised 16631 individuals who formed nationally representative samples. The proportion of females was highest in South Africa (62.8%; 95% confidence interval, CI: 59.2 to 66.3) and lowest in India (47.5%; 95% CI: 44.6 to 50.4) and the mean age of participants ranged from 62.3 years (standard difference, SD: 0.3) in India to 66.3 years (SD: 0.4) in Ghana (Table 1). The proportion living in an urban area ranged from 33.5% (95% CI: 26.8 to 41.0) in India to 81.6% (95% CI: 74.5 to 87.1) in Mexico and the proportion with health insurance ranged from 99.7% (95% CI: 99.4 to 99.9) of Russians to only 5.2% (95% CI: 3.6 to 7.3) of Indians.

Access to basic chronic care varied widely: the proportion of participants with access to basic chronic care was highest in South Africa (47.6%; 95% CI: 43.3 to 51.9) and the Russian Federation (43.5%; 95% CI: 38.6 to 48.4). The figures for Ghana, India and China were 36.9% (95% CI: 33.3 to 40.6), 32.9% (95% CI: 29.2 to 36.8) and 30.5% (95% CI: 27.8 to 33.4), respectively, and in Mexico it was only 20.6% (95% CI: 15.1 to 27.4; Fig. 1). Access rates were highest for the richest household income quintile in all countries. In Ghana, there was a continuous gradient from poor to rich. In India, the access rate decreased from the poorest to the second poorest quintile and then increased continuously to the richest quintile. There was a sharp increase in the access rate for the fourth and fifth income quintiles in Mexico and, for the richest quintile, in the Russian Federation. In China and South Africa, only small changes in the proportion with access were observed across the quintiles (Fig. 2). Moreover, the concentration curves for all countries except South Africa lay below the equity line and tested dominant (Fig. 3, available at: http://www.who.int/bulletin/volumes/94/4/15-163832), which indicates that the rich had disproportionate access to chronic care. Inequity of access was most pronounced for Mexico. The related concentration index varied substantially from 0.003 (95% CI: −0.045 to 0.050) for South Africa to 0.249 (95% CI: 0.087 to 0.403) for Mexico – higher values indicate greater inequity between rich and poor (Fig. 4).

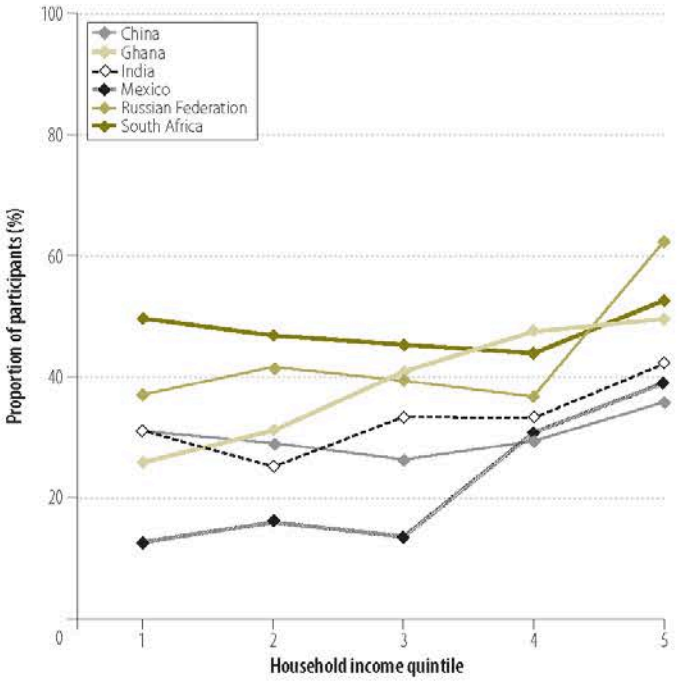
The proportion of households that faced catastrophic health spending in the last reported year varied between 23.5% (95% CI: 19.3 to 28.3) in South Africa and 65.5% (95% CI: 60.6–69.8) in Ghana. Financial hardship was present in all socioeconomic strata, though the proportion affected was generally highest in the poorest household income quintile, except in Mexico, where the proportion affected was highest in the third quintile (Fig. 5, available at: http://www.who.int/bulletin/volumes/94/4/15-163832). The proportion with catastrophic out-of-pocket expenditure for the last outpatient visit varied between 14.5% (95% CI: 12.7–16.4) in China and 54.8% (95% CI: 49.1 to 60.4) in Ghana. The proportion of the poorest quintile that experienced such expenditure ranged from 25.5% (95% CI: 10.1 to 51.0) in the Russian Federation to 94.5% (95% CI: 81.6 to 98.5) in Mexico (Fig. 6, available at: http://www.who.int/bulletin/volumes/94/4/15-163832).

Participants with health insurance were significantly more likely to have access to basic chronic care than those without in China, Ghana, India and Mexico but not South Africa (Table 2). In India, insurance increased the odds more than threefold. Nevertheless, insurance did not necessarily protect against financial hardship. In China, Ghana, India and South Africa, the risk of catastrophic health spending in the last reported year was the same or even higher for the insured as the uninsured. In India, health insurance was also associated with a higher risk of catastrophic out-of-pocket expenditure for the last outpatient visit. However, in Mexico insurance coverage was associated with a significantly lower risk of catastrophic out-of-pocket expenditure for the last outpatient visit (odds ratio, OR: 0.35; 95% CI: 0.14 to 0.84) and a nonsignificantly lower risk of catastrophic health spending in the last reported year (OR: 0.49; 95% CI: 0.22 to 1.07). In Ghana, the insured had a significantly lower risk of catastrophic out-of-pocket expenditure (OR: 0.38; 95% CI: 0.23 to 0.62) but a nonsignificantly higher risk of catastrophic health spending in the last year (OR: 1.22; 95% CI: 0.86 to 1.73). Living in a rural rather than an urban area was not associated with a lower likelihood of access to basic chronic care in any country except Ghana, where people living in rural areas were significantly less likely to have access (Table 3).

Only 4.5% (95% CI: 3.0 to 6.7) of the participants in Ghana were dissatisfied or very dissatisfied with health-care services, as were only 6.3% (95% CI: 5.2 to 7.5) in China (Table 4, available at: http://www.who.int/bulletin/volumes/94/4/15-163832). The highest proportion who were dissatisfied or very dissatisfied was in Mexico (20.8%; 95% CI: 16.0 to 26.7), where, in addition, 19.1% (95% CI: 14.3 to 25.1) rated their involvement in health-care decision-making as "bad" or "very bad". In China, Ghana, Mexico, the Russian Federation and South Africa, people who did not use outpatient care tended to be less satisfied with the health system than those who did (Table 4).

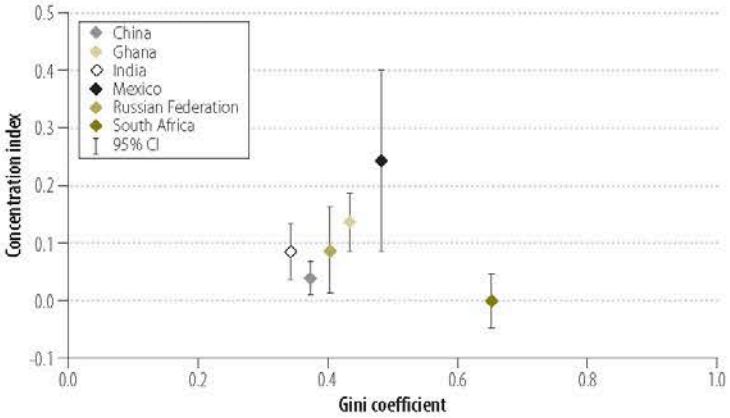
The six countries in our study differed markedly in their level of economic and social development: for example, gross national income per capita in the Russian Federation was approximately six times that in Ghana (Table 5, avail-

Fig. 2. **Access to basic chronic care by adults aged 50 years or older with chronic illness, by household income quintile, in six middle-income countries, 2007–2010**



Notes: Chronic illness was defined as being diagnosed with at least one chronic disease. Household income quintiles were based on annual household per capita income. Quintile 1 represents the poorest and quintile 5 represents the richest.

Fig. 4. **Concentration index for access to basic chronic care for adults aged 50 years or older with chronic illness, by Gini coefficient, in six middle-income countries, 2007–2010**



CI: confidence interval.
Notes: Chronic illness was defined as being diagnosed with at least one chronic disease. The concentration index varies from −1 to +1 and is 0 for equity of access to basic chronic care. A value greater than 0 indicates that the rich have better access to care than the poor. The Gini coefficient measures the extent to which the distribution of income or consumption expenditure among individuals or households within an economy deviates from a perfectly equal distribution: a coefficient of 0 represents perfect equality, whereas a coefficient of 1 implies perfect inequality.

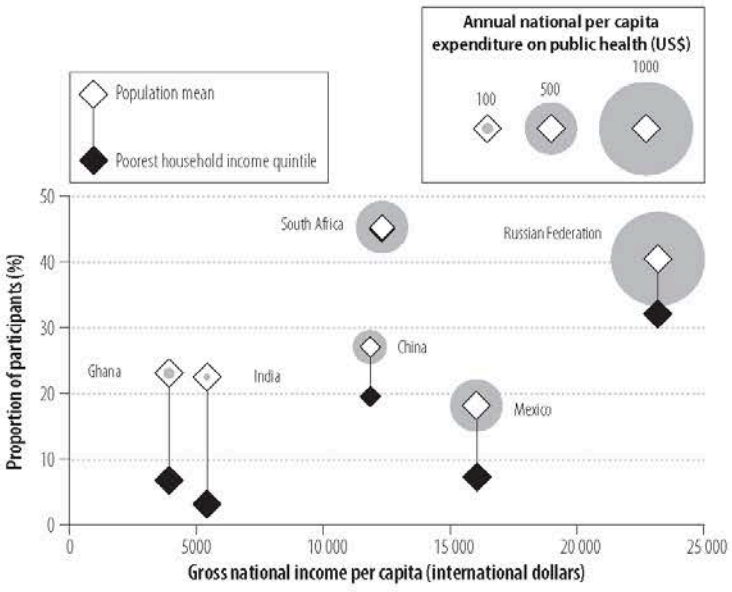
Table 2. **Health insurance, access to care and catastrophic expenditure for adults aged 50 years or older with chronic illness in six middle-income countries, 2007–2010**

Indicator of universal health coverage	OR (95% CI)[a] for indicator for insured[b] versus uninsured participants[c]					
	China	Ghana	India	Mexico	Russian Federation[d]	South Africa
Access to basic chronic care[e]	1.54 (1.02 to 2.33)	1.69 (1.25 to 2.28)	3.03 (1.88 to 4.87)	2.73 (1.40 to 5.33)	N/A	1.01 (0.67 to 1.52)
Catastrophic health spending in last year[f]	1.50 (1.13 to 1.99)	1.22 (0.86 to 1.73)	1.96 (1.00 to 3.85)	0.49 (0.22 to 1.07)	N/A	3.39 (2.01 to 5.70)
Catastrophic out-of-pocket expenditure[g]	0.94 (0.54 to 1.63)	0.38 (0.23 to 0.62)	1.90 (1.14 to 3.17)	0.35 (0.14 to 0.84)	N/A	1.42 (0.38 to 5.25)

CI: confidence interval; N/A: not applicable; OR: odds ratio.
[a] ORs and 95% CI were calculated using logistic regression models that controlled for sex, age, urban or rural residence, educational level, household income quintile and comorbidity.
[b] Health insurance included voluntary and mandatory insurance.
[c] Participants had reported being diagnosed with at least one chronic disease.
[d] As insurance coverage was almost universal in the Russian Federation no ORs could be calculated.
[e] Basic chronic care included: (i) the provision of treatment, such as medications or advice on physical activity or diet, for each of the patient's conditions; (ii) visiting outpatient services for the chronic condition or conditions one or more times in the last reported year; and (iii) maintenance of a stable health state after outpatient care.
[f] Catastrophic health spending in the last year was defined as the household spending more on health in the last reported year than 30% of annual household income, after deduction of food expenditure.
[g] Catastrophic out-of-pocket expenditure was defined as spending more on the last outpatient visit than 30% of annual household per capita income, after deduction of food expenditure.

able at: http://www.who.int/bulletin/volumes/94/4/15-163832). Generally, countries with larger socioeconomic inequalities had greater inequities in access to basic chronic care. The exception was South Africa, where access to basic chronic care was equally distributed across household income quintiles despite the country having one of the highest levels of social inequality in the world (Fig. 4). In fact, South Africa performed best in terms of achieving universal health coverage: 45.5% (95% CI: 41.1 to 50.0) of all participants had access to basic chronic care without incurring catastrophic out-of-pocket expenditure for the last outpatient visit (Fig. 7). The Russian Federation had the highest gross national income per capita and the highest public health expenditure per capita. Generally, access to basic chronic care without financial hardship in the country was similar to that in South Africa, but the poorest quintile was disadvantaged. Although China's gross national income per capita was comparable to South Africa's, both public health expenditure and the proportion of participants with access to basic chronic care without financial hardship were lower. Mexico had the second highest public health expenditure but performed poorly in terms of providing universal health coverage:

Fig. 7. **Access to basic chronic care without catastrophic expenditure for adults aged 50 years or older with chronic illness, by national income and health expenditure, in six middle-income countries, 2007–2010**



US$: United States dollars.
Notes: Chronic illness was defined as being diagnosed with at least one chronic disease. Catastrophic out-of-pocket expenditure was defined as expenditure more than 30% of annual household per capita income, after the deduction of food expenditure at the last outpatient visit. Household income quintiles were based on annual household per capita income. Figures for gross national income per capita were adjusted for purchasing power parity.

Table 3. **Area of residence and access to basic chronic care by adults aged 50 years or older with chronic illness in six middle-income countries, 2007–2010**

Access to basic chronic care	China (*n* = 6558)	Ghana (*n* = 1327)	India (*n* = 2623)	Mexico (*n* = 1341)	Russian Federation (*n* = 2916)	South Africa (*n* = 1866)
Proportion of rural residents with access,[a] % (95% CI)	30.3 (26.0 to 35.1)	30.0 (24.8 to 35.7)	30.4 (27.2 to 33.8)	31.5 (18.0 to 49.0)	46.6 (37.0 to 56.3)	52.1 (45.4 to 58.8)
Proportion of urban residents with access,[a] % (95% CI)	30.7 (27.3 to 34.3)	43.2 (38.6 to 47.9)	38.0 (28.7 to 48.4)	18.1 (12.7 to 25.2)	42.2 (36.8 to 47.9)	45.5 (41.3 to 49.8)
Odds of access for rural versus urban residents, OR (95% CI)[b]	1.12 (0.85 to 1.48)	0.61 (0.45 to 0.84)	0.93 (0.60 to 1.45)	1.64 (0.83 to 3.28)	1.19 (0.78 to 1.81)	1.22 (0.86 to 1.75)

CI: confidence interval; OR: odds ratio.

[a] Proportion of residents with access to basic chronic health care.

[b] The ORs and 95% CIs were calculated using a logistic regression model that controlled for sex, age, health insurance, educational level, household income quintile and comorbidity.

Notes: Chronic illness was defined as being diagnosed with at least one chronic disease. Percentages are weighted.

only 7.3% (95% CI: 3.0 to 17.1) of the poorest quintile had access to basic chronic care without financial hardship and the proportion with access to basic chronic care without catastrophic out-of-pocket expenditure was the lowest of all six countries, including Ghana and India, which both had lower gross national incomes per capita.

Discussion

The prevalence of diagnosed chronic conditions in people aged 50 years or more varied widely among the six study countries and was higher in the more developed and more urbanized areas. This may be due to the negative health impact of the lifestyle changes accompanying modernization.[18] None of the six countries provided access to basic chronic care for more than half the participants, which is in line with evidence of gaps in essential services for noncommunicable diseases in low- and middle-income countries.[19] Although it is often assumed that wealthier countries may be better at providing health services for noncommunicable diseases, we found no evidence that a higher level of development was associated with greater universal health coverage.[20]

The inequities in health coverage we observed in middle-income countries and that have been reported in other studies persist despite substantial health reforms aimed at improving universal health coverage, especially for poor and vulnerable groups.[21–24] The poor chronically ill were less likely to receive basic chronic care and more likely to face financial hardship than the better off in all countries in our study, except in South Africa, where primary health care is provided free to all citizens.[25] Although previous evidence suggests that rural residents have more limited access to primary care than urban residents and are less likely to have health insurance,[26] we found that participants in rural and urban areas had similar access to basic chronic care in all study countries except Ghana. More detailed country-specific data are required to explore this potential difference in greater depth.

In Mexico, we found that almost 80% of the participants did not have access to basic chronic care, which is consistent with the Mexican President Peña Nieto's statement in 2013 that much of the population cannot exercise their right to health.[27] In 2014, the Mexican National Council for the Evaluation of Social Development Policy reported that only 21.4% of the population received medical care for their health problems but that between 84% and 97% of people with health problems did receive medical treatment.[28] The inconsistency may be due to the difference between perceived and medically defined health needs. Since individuals' experiences and expectations of the probable outcome of medical care can shape perceptions of their health status, many older people may not think their health problem requires medical care despite being diagnosed with a chronic condition.[29] We found that people who were dissatisfied with the health system were less likely to seek care despite medical need. The same appears to be true for people who perceive it as ineffective.[30] In India, the common belief that the private sector offers better quality care coupled with inadequate public provision has led many people to use private facilities and bear high out-of-pocket costs despite increased investment in public health and the exemption of vulnerable groups from user fees.[4]

We found that both the insured and uninsured could experience financial hardship in all study countries. Although health insurance improved access to health care, it also increased the risk of catastrophic health spending in most countries. In the Russian Federation, universal health insurance became mandatory in 1993 and health services are provided free at the point of care. However, the cost of pharmaceuticals excluded from guaranteed packages and informal payments can result in catastrophic expenditure.[29] In Ghana, where a national health insurance scheme was established in 2003, we found that insurance increased access to basic chronic care and protected against catastrophic out-of-pocket expenditure for the last outpatient visit, in agreement with the previous findings.[31] However, insured households were more likely to incur catastrophic spending during the last year, perhaps due to more frequent service utilization by the insured.[31]

In China, health insurance did not significantly influence the likelihood of catastrophic out-of-pocket expenditure for the last outpatient visit but the insured were more likely to experience catastrophic spending during the last year, as reported previously.[32,33] This suggests that recent social health insurance programmes in China have neither reduced the risk of catastrophic spending nor relieved the financial burden on older people with chronic conditions. In India and South Africa, a small minority of insured people had an increased risk of catastrophic spending – they were mainly covered by private insurance

schemes that may have encouraged the use of specialist providers with higher co-payments.[21,24] In Mexico, insurance generally increased protection against financial hardship. However, our findings provide only partial evidence that the voluntary *Seguro Popular* insurance scheme introduced in 2003 protected against financial hardship because health service utilization was extremely low, especially among the poor, and little information was available on insurance schemes in Mexico's highly fragmented health insurance system.[25,26]

Our study had several limitations. The WHO Study on Global Ageing and Adult Health provides the best, available, comparable data on older adults with chronic illness in middle-income countries because it uses a unified method but the self-reported prevalence of noncommunicable disease is less than the actual prevalence in older people. In particular, in some countries the poor are less likely to be given a diagnosis.[20] Accordingly, the level of access to basic chronic care may have been overestimated and, consequently, inequities may have been underestimated. Although the national representativeness of the household survey could have been weakened by the variation in response rate between countries, the results of our sensitivity analysis confirmed the validity of the samples (data available from the corresponding author).

Universal health coverage remains a distant hope for many older adults with chronic illness in middle-income countries. Although allocating a higher share of a country's gross national income to health might improve services and subsidize health care for the poor, economic development does not in itself guarantee universal health coverage or greater equity. Nevertheless, lower socioeconomic inequality generally leads to more equal distribution of health services. Yet, as evident in South Africa, the provision of free primary health care can help achieve equitable universal health coverage despite high socioeconomic inequality, which suggests that universal social protection may guard better against catastrophic expenditure than insurance schemes. If gaps in universal health coverage are to be closed, it is essential that the care provided is acceptable to the population. Consequently, health reforms should aim to improve service quality and promote democratic oversight of health care through increased social participation in addition to expanding insurance schemes. The provision of universal health coverage for older people with chronic conditions is particularly challenging for low- and middle-income countries, especially given the ongoing epidemiological transition. It is crucial, therefore, that future health policies are tailored to the specific needs of older people. ■

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ملخص

تقييم مستوى التغطية الصحية الشاملة للبالغين بسن 50 عامًا أو أكبر والذين يعانون من أمراض مزمنة في ستة بلدان متوسطة الدخل

الغرض لتقييم مستوى التغطية الصحية الشاملة للبالغين بسن 50 عامًا أو أكبر والذين يعانون من أمراض مزمنة في الصين وغانا والهند والمكسيك والاتحاد الروسي وجنوب أفريقيا.

الطريقة حصلنا على بيانات خاصة بعدد 16631 مشاركًا تبلغ أعمارهم 50 عامًا أو أكبر والمصابين بحالة مرضية مزمنة واحدة على الأقل تم تشخيصها في الدراسة التي أجرتها منظمة الصحة العالمية بشأن التقدم في السن على الصعيد العالمي وصحة البالغين. تم تقييم سبل الحصول على الرعاية الأساسية للأمراض المزمنة والصعوبات المالية وتم تحديد تأثير التأمين الصحي والإقامة في المناطق الريفية أو الحضرية من خلال تحليل التحوف اللوجيستي.

النتائج تراوحت نسبة الأرجحية للمشاركين الحاصلين على الرعاية الأساسية للأمراض المزمنة من 20.6٪ في المكسيك إلى 47.6٪ في جنوب أفريقيا. لم يتم توزيع معدلات الاستفادة من الرعاية الصحية الأساسية بصورة متكافئة ما أدى إلى حرمان الفقراء من الحصول عليها، وسجلت جنوب أفريقيا استثناءً لهذه الحالة حيث تُقدم فيها الرعاية الصحية الأساسية مجانًا للجميع. ولم تؤثر الإقامة في المناطق الريفية على سبل الاستفادة. وقد تراوحت نسبة الإنفاق الشخصي الباهظة للزيارة الأخيرة للمريض الذي يتلقى العلاج خارج المستشفى من 14.5٪ في الصين إلى 54.8٪ في غانا. كانت الصعوبات المالية هي الأكثر شيوعًا بين الفقراء في معظم البلدان ولكنها أثرت على جميع فئات الدخل. وأدى التأمين الصحي إلى زيادة سبل الحصول على الرعاية بشكل عام ولكنه لم يمنح الحماية الكافية في مواجهة الصعوبات المالية.

الاستنتاج لم توفر أي بلد سبلاً للحصول على الرعاية الأساسية للأمراض المزمنة لعدد يزيد عن نصف المشاركين الذين يعانون من أمراض مزمنة. كان الفقراء الأقل احتمالاً لتلقي الرعاية والأكثر احتمالاً لمواجهة صعوبات مالية في معظم البلدان. وعلى الرغم من ذلك، لم يتم تحديد حالات عدم الإنصاف في توفير سبل الحصول على الرعاية بالكامل من خلال مستوى التنمية الاقتصادية أو التغطية التأمينية. وينبغي على الإصلاحات في الخدمات الصحية في المستقبل أن تهدف إلى تطوير جودة الخدمات وزيادة الرقابة الديموقراطية على الرعاية الصحية.

摘要

针对六个中等收入国家 50 岁或以上慢性病患者的全民医疗覆盖情况的评估

目的 旨在评估俄罗斯、加纳、墨西哥、南非、印度和中国 50 岁或以上慢性病患者全民医疗覆盖的情况。

方法 我们从《世界卫生组织全球老龄化和成年人健康研究》中获取 16631 名 50 岁或以上且经诊断患有至少一种慢性病的参与者数据。 我们评估了获得基础慢性病治疗和资金的困难，并通过逻辑回归分析确定了城

乡居民医疗保险的影响。
结果 接受基础慢性病治疗的参与者所占加权比例范围从墨西哥的 20.6% 到南非的 47.6%。除主要医疗护理全民免费的南非以外，其他国家接受率分布不均匀且贫困群体处于弱势地位。农村居民并不影响接受率。最后一次看门诊支出大量现金的比例范围从中国的 14.5% 到加纳的 54.8%。在大多数国家内，资金困难在贫困群体中更为普遍，但所有收入群体都会受到影响。医疗保险通常能提高护理接受率，但无法充分解决资金困难问题。
结论 半数以上的慢性病参与者，未能从其国家获得基础慢性病治疗。在大多数国家，贫困群体接受治疗的可能性更低且面临资金困难的可能性更高。但是，接受率不均并不完全由经济发展水平或保险覆盖率决定。未来医疗改革应该以提高服务质量和改进医疗护理的民主监督为目标。

Résumé

Évaluation de la couverture sanitaire universelle pour des adultes de 50 ans ou plus, atteints de maladie chronique, dans six pays à revenu intermédiaire

Objectif Évaluer la couverture sanitaire universelle pour des adultes de 50 ans ou plus, atteints de maladie chronique, en Afrique du Sud, en Chine, dans la Fédération de Russie, au Ghana, en Inde et au Mexique.
Méthodes À partir de l'étude de l'OMS sur le vieillissement et la santé des adultes dans le monde (SAGE), nous avons obtenu des données sur 16 631 participants, âgés de 50 ans ou plus, chez qui au moins une maladie chronique a été diagnostiquée. L'accès à des soins chroniques de base et les difficultés financières ont été évalués, et des analyses par régression logistique ont permis de déterminer l'influence d'avoir une assurance maladie et l'influence de vivre en milieu rural ou urbain.
Résultats La part pondérée des participants bénéficiant d'un accès à des soins chroniques de base varie entre 20,6% au Mexique et 47,6% en Afrique du Sud. Les taux d'accès sont inégalement répartis et en défaveur des personnes pauvres, sauf en Afrique du Sud, où les soins de santé primaires sont gratuits pour tous. Le fait d'habiter en milieu rural n'a pas d'incidence sur cet accès. La proportion des participants ayant dû assumer des dépenses directes catastrophiques pour leur dernière consultation ambulatoire s'établit entre 14,5% en Chine et 54,8% au Ghana. Dans la plupart de ces pays, les difficultés financières sont plus fréquentes chez les personnes pauvres, mais elles affectent toutes les tranches de revenus. Les assurances maladie améliorent généralement l'accès aux soins mais offrent une protection insuffisante contre les difficultés financières.
Conclusion Aucun des pays étudiés ne permet à plus de la moitié des participants atteints de maladie chronique d'accéder aux soins chroniques de base. Dans la majorité de ces pays, les personnes pauvres sont moins susceptibles de bénéficier de soins et plus exposées aux difficultés financières. Néanmoins, l'inégalité en termes d'accès aux soins n'est pas entièrement déterminée par le niveau de développement économique ou par la couverture d'assurance. Les réformes à venir des systèmes de santé devraient viser à améliorer la qualité des services et à favoriser une supervision plus démocratique des soins de santé.

Резюме

Оценка обеспечения всеобщего охвата услугами здравоохранения взрослого населения в возрасте от 50 лет, страдающего хроническими заболеваниями, в шести странах со средним уровнем доходов

Цель Оценить обеспечение всеобщего охвата услугами здравоохранения взрослого населения в возрасте от 50 лет, страдающего хроническими заболеваниями, в Гане, Индии, Китае, Мексике, Российской Федерации и Южной Африке.
Методы На основе исследования Всемирной организацией здравоохранения по проблемам глобального старения и здоровья взрослых людей были получены данные по 16 631 участнику исследования в возрасте от 50 лет, у которых диагностировано по меньшей мере одно хроническое заболевание. В результате проведения анализа с использованием модели логистической регрессии были оценены доступность базовой медицинской помощи для лечения хронических заболеваний и финансовые трудности, а также определено влияние наличия медицинской страховки и проживания в сельских или городских условиях.
Результаты Взвешенная доля участников, имеющих доступ к базовой медицинской помощи для лечения хронических заболеваний, варьировалась от 20,6% в Мексике до 47,6% в Южной Африке. Доступность помощи была неравномерно распределена; самая низкая степень доступности была зафиксирована для малоимущего населения, за исключением населения Южной Африки, где первичная медицинская помощь бесплатна для всех. Проживание в сельской местности не сказалось на доступности. Доля людей, превысивших предел расходов из собственных средств при последнем обращении в поликлинику, варьировалась от 14,5% в Китае до 54,8% в Гане. Финансовые трудности в большем числе случаев испытывало малоимущее население в большинстве стран, но они затронули все группы по уровню доходов. Наличие медицинской страховки в целом способствовало повышению доступности медико-санитарной помощи, однако страховка не предоставляла достаточной защиты от финансовых трудностей.
Вывод Ни в одной стране большей части участников, страдающих хроническими заболеваниями, не предоставлялся доступ к базовой медицинской помощи для лечения хронических заболеваний. В большинстве стран вероятность получения помощи малоимущими участниками была ниже, а вероятность столкновения с финансовыми трудностями — выше. Тем не менее неравномерность доступа не в полной мере определялась степенью экономического развития или наличия страховки. Будущие реформы здравоохранения должны ставить перед собой цель улучшения качества и повышения общедоступности медико-санитарной помощи.

Resumen

Evaluación de la cobertura sanitaria universal para adultos de 50 años o más con enfermedades crónicas en seis países de ingresos medios

Objetivo Evaluar la cobertura sanitaria universal para adultos de 50 años o más con enfermedades crónicas en China, Federación de Rusia, Ghana, India, México y Sudáfrica.

Métodos Se obtuvieron datos de 16 631 participantes de 50 años o más diagnosticados con, al menos, una enfermedad crónica del Estudio de la OMS sobre envejecimiento y salud de los adultos en el mundo. Se evaluaron el acceso a atención crónica básica y las dificultades económicas y se determinó la influencia del seguro sanitario y de la residencia rural o urbana mediante un análisis de regresión logística.

Resultados La proporción ponderada de participantes con acceso a atención crónica básica varió desde un 20,6% en México a un 47,6% en Sudáfrica. Las tasas de acceso estaban desigualmente distribuidas y la población pobre se encontraba en desventaja, salvo en Sudáfrica, donde la atención sanitaria primaria es gratuita para todo el mundo. La residencia rural no afectaba al acceso. La proporción de gastos catastróficos directos durante la última visita ambulatoria varió desde un 14,5% en China a un 54,8% en Ghana. Las dificultades económicas eran más comunes entre los pobres en la mayoría de países, pero afectaron todos los grupos de ingresos. Por norma general, los seguros sanitarios aumentaron el acceso a la asistencia, pero no ofrecieron la suficiente protección frente a las dificultades económicas.

Conclusión Ningún país ofrecía acceso a atención crónica básica a más de la mitad de los participantes con enfermedades crónicas. En la mayoría de los países, los pobres tenían menos posibilidades de recibir asistencia y más de sufrir dificultades económicas. No obstante, la desigualdad en el acceso no estaba totalmente condicionada por el nivel de desarrollo económico o la cobertura del seguro. Las futuras reformas sanitarias deberían tener como objetivo mejorar la calidad del servicio y aumentar la supervisión democrática de la atención sanitaria.

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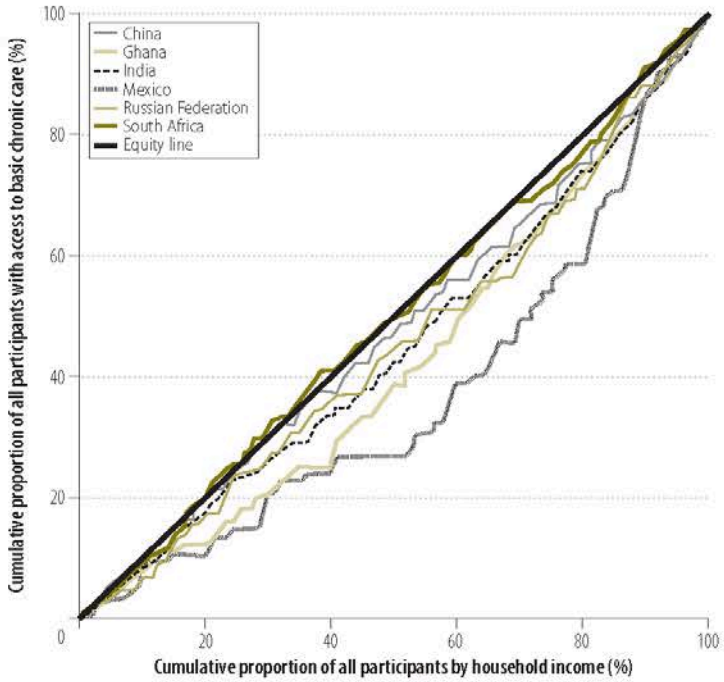
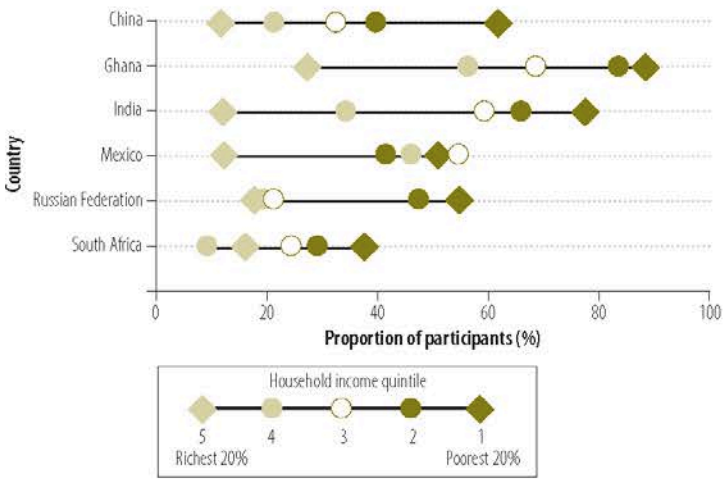
Fig. 3. **Concentration curves for access to basic chronic care, by household income and country, in six middle-income countries, 2007–2010**



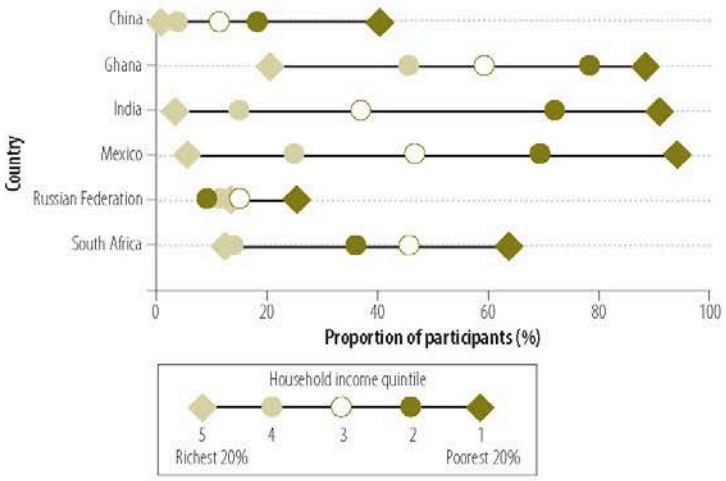
Notes: A curve lying below the equity line indicates that the poor have less access to basic chronic care than the rich: the greater the deviation from the equity line, the greater the inequity. Chronic illness was defined as being diagnosed with at least one chronic disease.

Fig. 5. **Catastrophic health spending in last reported year by adults aged 50 years or older with chronic illness, by household income and country, in six middle-income countries, 2007–2010**



Notes: Chronic illness was defined as being diagnosed with at least one chronic disease. Catastrophic health spending in the last year was defined as the household spending more on health in the last reported year than 30% of annual household income, after deduction of food expenditure. Household income quintiles were based on annual household per capita income. The greater the distance between quintiles, the greater the effect of household income on the likelihood of catastrophic health spending.

Fig. 6. **Catastrophic out-of-pocket expenditure for last outpatient visit for adults aged 50 years or older with chronic illness, by household income and country, in six middle-income countries, 2007–2010**



Notes: Chronic illness was defined as being diagnosed with at least one chronic disease. Catastrophic out-of-pocket expenditure was defined as expenditure more than 30% of annual household per capita income, after the deduction of food expenditure at the last outpatient visit. Household income quintiles were based on annual household per capita income. The greater the distance between quintiles, the greater the effect of household income on the likelihood of catastrophic out-of-pocket expenditure.

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Table 4. **Dissatisfaction with the health system among adults aged 50 years or older with chronic illness in six middle-income countries, 2007–2010**

Measure of dissatisfaction	China (*n* = 6558)	Ghana (*n* = 1327)	India (*n* = 2623)	Mexico (*n* = 1341)	Russian Federation (*n* = 2916)	South Africa (*n* = 1866)
Dissatisfaction with health-care services[a]						
Proportion dissatisfied, % (95% CI)	6.3 (5.2 to 7.5)	4.5 (3.0 to 6.7)	14.7 (12.0 to 17.8)	20.8 (16.0 to 26.7)	16.8 (12.5 to 22.3)	18.9 (15.6 to 22.6)
Risk of dissatisfaction for nonusers versus users of outpatient care,[b,c] OR (95% CI)	1.56 (1.15 to 1.98)	1.61 (0.47 to 2.74)	1.05 (0.66 to 1.44)	1.65 (0.41 to 2.90)	1.68 (0.93 to 2.43)	1.39 (0.94 to 1.84)
Insufficient involvement in health-care decision-making[d]						
Proportion reporting insufficient involvement, % (95% CI)	5.0 (4.0 to 6.2)	9.8 (8.0 to 11.9)	13.7 (11.4 to 16.3)	19.1 (14.3 to 25.1)	15.5 (10.3 to 22.7)	19.7 (16.6 to 23.1)
Risk of insufficient involvement for nonusers versus users of outpatient care,[b,c] OR (95% CI)	1.88 (1.24 to 2.53)	1.47 (0.83 to 2.11)	1.24 (0.77 to 1.72)	1.07 (0.37 to 1.77)	1.79 (0.87 to 2.72)	1.53 (1.10 to 1.96)

CI: confidence interval; OR: odds ratio.

[a] An individual was regarded as being dissatisfied with health-care services if he or she reported being "dissatisfied" or "very dissatisfied" with the way health-care services were run.

[b] ORs and 95% CI were calculated using a logistic regression model that controlled for household income quintile.

[c] A user of outpatient care was defined as an individual who received outpatient care in the 12 months before the *Study on global ageing and adult health* survey.

[d] An individual was regarded as having insufficient involvement in health-care decision-making if he or she rated their involvement in decisions about what services were provided and where they were provided as "bad" or "very bad".

Note: Chronic illness was defined as being diagnosed with at least one chronic disease. Percentages are weighted.

Table 5. **National macroeconomic and social indicators in six middle-income countries, 2007–2010**

National indicator	China	Ghana	India	Mexico	Russian Federation	South Africa
Macroeconomic						
Gross national income per capita in 2013, international dollars[a]	11 850	3900	5350	16 110	23 190	12 240
Public health expenditure as a fraction of gross domestic product in 2012, (%)	3.0	3.0	1.3	3.2	3.8	4.2
Public health expenditure per capita in 2012, (US$)	331.8	110.4	68.8	515.3	896.7	515.9
Out-of-pocket payments as a fraction of total health expenditure in 2012, (%)	34.3	28.7	57.6	44.1	34.3	7.2
Social						
Gini coefficient[b] (year estimated)	0.37 (2011)	0.43 (2006)	0.34 (2012)	0.48 (2012)	0.40 (2009)	0.65 (2011)
Income share held by richest 10% of population (year estimated)	30.0 (2010)	32.8 (2006)	28.8 (2010)	38.9 (2012)	31.0 (2009)	53.8 (2011)

US$: United States dollars.

[a] Figures were adjusted for purchasing power parity.

[b] The Gini coefficient measures the extent to which the distribution of income or consumption expenditure among individuals or households within an economy deviates from a perfectly equal distribution: a coefficient of 0 represents perfect equality, whereas a coefficient of 1 implies perfect inequality.

Data source: World Bank.[1–7]

Die Position der Bundesregierung zur Globalen Gesundheit

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Die deutsche Bundesregierung erkannte, dass sich das Feld der Globalen Gesundheit derzeit schnell und dynamisch entwickelt. Um auf mögliche zukünftige Herausforderungen der Globalen Gesundheit vorbereitet zu sein und um auf diese Einfluss nehmen zu können, erarbeiteten mehrere Bundesministerien zu dem Thema ein übergreifendes Konzept und veröffentlichten dieses 2013.

Dabei verblieb die Position der Bundesregierung einerseits innerhalb traditioneller Perspektiven der binären Nord-Süd-Entwicklungshilfe und internationaler Politik. Andererseits wurde zeitgemäß auf der Basis des Grundrechtes auf Gesundheit, für eine allgemeine Gesundheitsversorgung, eine Stärkung der WHO sowie eines Ausbaus von intersektoralen Kooperationen argumentiert.

Damit verpasste die Bundesregierung in ihrem Konzept leider, zukunftsweisend und kohärent zu sein z.B. im Sinne einer „Gesundheit in allen Politikfeldern“ (*health in all policies*) oder im Kontext geistiger Eigentumsrechte im Bereich von Forschung und Entwicklung zu armuts-assoziierten und vernachlässigten Erkrankungen.

Ähnlich unzeitgemäß positionierte sich die Bundesregierung auch zu bekannten sozialmedizinischen Erkenntnissen. Während die Einflüsse der sozialen Determinanten auf die ungleiche Verteilung von Gesundheit gerade auch in Ländern mit niedrigem- und mittlerem-Einkommen unbestritten sind, formulierte das Konzept der Bundesregierung eine Orientierung hin zu technologischen Lösungen und dem Export von Fachexpertisen und nicht in Richtung von sozialer Gerechtigkeit. Diese politische Ausrichtung lässt leider einen umfassenden systematischen Ansatz mit einer multilateralen globalen Orientierung vermissen.

Das erste Konzept der Bundesregierung zu Globaler Gesundheit ist daher zwar ein wichtiger Schritt, wünschenswert wäre darüber hinaus aber eine zukunftsweisendere und umfassendere Strategie der Bundesregierung zu diesem wichtigen Thema.

Global Health Action

COACTION

CURRENT DEBATE

The global health concept of the German government: strengths, weaknesses, and opportunities

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Recognising global health as a rapidly emerging policy field, the German federal government recently released a national concept note for global health politics (July 10, 2013). As the German government could have a significant impact on health globally by making a coherent, evidence-informed, and long-term commitment in this field, we offer an initial appraisal of the strengths, weaknesses, and opportunities for development recognised in this document. We conclude that the national concept is an important first step towards the implementation of a coherent global health policy. However, important gaps were identified in the areas of intellectual property rights and access to medicines. In addition, global health determinants such as trade, economic crises, and liberalisation as well as European Union issues such as the health of migrants, refugees, and asylum seekers are not adequately addressed. Furthermore, little information is provided about the establishment of instruments to ensure an effective inter-ministerial cooperation. Finally, because implementation aspects for the national concept are critical for the success of this initiative, we call upon the newly elected 2013 German government to formulate a global health strategy, which includes a concrete plan of action, a time scale, and measurable goals.

Keywords: *global health; foreign policy; health policy; governance; globalisation; policy analysis*

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To date, German governmental institutions have paid little attention to the concept of global health, which is an emerging policy field (1). The country's involvement in the field (2) has been referred to as literally invisible (3) and in a stage of infancy (4). For this reason, the authors welcome the launch of a first national concept document for global health politics entitled *Globale Gesundheitspolitik gestalten – Gemeinsam handeln – Verantwortung wahrnehmen* (Shaping Global Health – Taking Joint Action – Embracing Responsibility – 10 July 2013) (5).

In line with other countries that have already launched national global health strategies – such as Switzerland (2006), the United Kingdom (2008), Norway and Japan (2010), Sweden (2011), as well as the European Union (6) (EU) – with the release of this document, the German federal government also expresses its commitment to advancing health and wellbeing on a global scale.

The primary goal stated in the government's national concept (5) is to make an active and consolidated contribution to solving pressing global health challenges of our time. It defines five key areas of action where

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Germany can play a vital role in improving health on a global level: 1) tackling cross-border threats to health; 2) strengthening health systems worldwide (by enhancing systems of social health protection and improving public access to health care services); 3) ensuring intersectoral cooperation for health; 4) promoting/strengthening health research and the health care industry; and 5) strengthening the global health architecture (5).

We maintain that as an important voice in the international community, Germany has a special responsibility towards global health both at the European and the global level. The government has traditionally embraced its responsibility for health in developing countries primarily via bilateral (and to a lesser extent multilateral) aid. Health policy at the European level, in contrast, has been mainly embraced via legal frameworks within the EU. Presenting a coherent, evidence-informed, and far-sighted global health concept that overcomes these North–South binaries and draws upon the strengths of other countries' recent strategies could thus have a significant impact on health globally.

The effort of the German government to prepare the presented global health concept is highly valued and its release has already initiated debate about gaps and ambitions (4, 7). In order to provide a rationale for proposals for further improvement related to the concept, the strengths, weaknesses, opportunities, and threats identified in the national concept have been analysed and are detailed in this paper. Four authors (KB, WB, MK, OR) independently read the concept of the federal government with the task to evaluate the major strengths and weaknesses in the document. Common issues identified by more than one author were fed into a preliminary list of items considered to be most important. This list was reviewed and scrutinised until all authors reached consensus.

We identified three major strengths relating to important issues on the global health agenda: Firstly, a clear and unequivocal commitment to Universal Health Coverage (UHC) (8) based on the 'human right to health' (HR2H) (9) approach, including health systems strengthening; equality and equity in access to quality health care; protection against catastrophic health expenditure (10); and the acknowledgement of the regulatory role of states in this context.

Secondly, there was an equally clear and unequivocal commitment to strengthen the leadership role of WHO as the sole coordinating agency for global health policy. This includes, in line with the Paris Declaration on Aid Effectiveness, a clear commitment to counter attempts to create new organisations and initiatives in the (global) health sector duplicating existing mandates and tasks. Noteworthy is particularly the commitment to strengthen the 'core mandate' of the WHO in setting *binding* norms and standards for its member countries *and* all other actors in global health – an issue widely discussed in the context of a Framework Convention on Global Health (11).

Thirdly, the national concept aims to strengthen intersectoral cooperation (12) in order to improve population health by adopting a public health approach instead of an individual, exclusively biomedical approach.

On the contrary, the national concept contains some important gaps and weaknesses. For example, no reference is made to the important debates on the impact of intellectual property rights on access to medicines and innovation in health. In particular, policy coherence with regard to the WHO General Strategy and Plan of Action on Public Health, Innovation and Intellectual Property (GSPoA) and its follow-up, which are central for the problem of adequate incentives for medical research, remains unaddressed (13). In this particular context, the government's concept falls short of the EU council conclusions (6). With the elaborations on falsified medicinal products, ignoring the role of generics and compulsory licenses, the government's concept (consciously or unconsciously) adopts lines of arguments of private pharmaceutical industries (13). A progressive IPR policy, coherent with international resolutions (14), would resolve that 1) no trade or investment treaty initiates intellectual property rights that go beyond those articulated under the multilateral TRIPS agreement, and that 2) the specific wording of the 2001 Doha Declaration on the right to issue compulsory licences be written into all future trade and investment treaties.

Given that strengthening the German health care industry is an explicit primary goal of the concept (5, p. 34), the above discrepancy with international policy recommendations (6, 13, 14) might not be surprising. The national concept places a particular emphasis on the promotion of the 'Export Initiative [for the German] Health Industry' and the 'German Healthcare Partnership' (p. 36). Given that poor health in low-income countries is a problem mostly driven by inequity and social determinants (12) rather than by a lack of technology, there is a risk that the aim of utilising 'the strengths of the German health care industry for the benefit of global health' (5, p. 34) diverts scarce resources in low- and middle-income countries to costly technologies from urgently needed social interventions promoting equity.

Significantly, the national concept provides an extensive inventory of past and on-going conventional approaches to international health (15), reflecting a 'sending culture' of resources, competencies and experts to 'developing' countries with an over-emphasis on bilateral agreements (4). This lens tends to neglect the rise and importance of truly 'global' (16) issues such as

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economic crises (17), international trade (18) and liberalisation (19), as well as the political economy of health (20), including global inequity (12). Addressing the health impacts of these global determinants (16) should be considered a primary motive or 'leading thought' of any global health concept.

A comprehensive, systemic approach – which acknowledges that global health starts 'at home' – would move towards coherence with ratified UN resolutions on UHC (21) and HR2H (22) and address the serious limitations related to the right to the highest attainable state of health for migrants, refugees and asylum seekers in the EU, including Germany (23). It would also outline a far-sighted strategy to stimulate global health research and education in Germany beyond isolated programs.

Importantly, the government's commitment to strengthen WHO (5, pp. 38–39) details out several measures to improve the organisation's efficiency (by improving budget setting-procedures, goal-orientation and financial management, transparency, internal control mechanisms, and implementation of regular external evaluation measures) but remains vague as far as other important organisational aspects are concerned. While efficiency is important, the organisation's effectiveness depends, not least, on financial independence as far as goal and priority setting is concerned. Thus, any serious commitment to strengthening WHO should – in line with the EU council's conclusions (6) – declare a willingness to increase non-earmarked financial contributions in support of the institution. Attempts of internal structural reform should be based on solid evidence that this is an adequate strategy to strengthen the institution's capacity of effectively fulfilling its mandate in contemporary complex-adaptive systems.

Finally, the concept of the federal government would greatly benefit from a transparent, operational and binding strategy on how to organise the all-important inter-ministerial cooperation (1) in the national context, particularly between the Ministries of Health (BMG), Development and Economic Cooperation (BMZ), Foreign Affairs (AA), Finances (BMF), Economy (BMWi), Justice (BMJ), and Research and Education (BMBF). Within a commitment to 'achieve the greatest possible degree of consistency among the policymakers responsible for questions related to global health' (5, p. 41), the federal government explicitly refers to foreign and development policies only, but not to economic policies. A clear strategy is needed on how to interweave global health within interrelated national German policies.

The Swiss 'Gesundheitsaußenpolitik' (Health Foreign Policy) already provides several instruments designed for this task: the establishment of a coordinating office for health foreign policy, implementation of bi-annual meetings of inter-ministerial working groups, an annual inter-ministerial conference on health foreign policy, establishment of a coordinating office for global health policy, and the creation of an interdepartmental information platform for global health (24, p. 16). Without institutional innovations the laudable commitment to UHC and HR2H might remain mere rhetoric, since major powerful determinants of health (17) are outside the scope of development politics or health politics.

Conclusions

The national concept of the German federal government is an important first step towards a coherent national global health policy. Based on our appraisal, we are concerned that the current strategy might fail to achieve its overarching goal of making a consolidated contribution to solving the pressing global health challenges of our time because of the described gaps and weaknesses related to conceptual and implementation issues. We urge the new German government to develop a concrete plan of action to support global health, including a time scale and measurable goals.

Author contributions

KB, WB, MK, and OR performed the initial SWOT analysis and jointly drafted a first version of the manuscript. WH, RK, and PT revised the manuscript for important intellectual content. KB revised subsequent versions and drafted the final version of the manuscript. All authors made substantial contributions to the final version.

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Conflict of interest and funding

KB, WB, MK and PT are founding members of the 'Global Health Alliance', a network of academics and students promoting education in global health. WB, PT, RK and WH were invited participants of an official 'public dialogue' event between civil-society and the Federal Ministries of Health (BMG), Foreign Affairs (AA) and Development Cooperation (BMZ) prior to the formulation of the strategy.

RK is an external consultant to specific programs of the 'Gesellschaft für Internationale Zusammenarbeit' (GIZ). The authors declare that they have no conflict of interest and funding.

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3. DISKUSSION

Globale Gesundheit im Kontext des deutschen Gesundheitswesens

In den vergangenen Jahren haben Regierungen und transnationale Institutionen vieles dazugelernt. Gerade der 2014/15 Ebola-Viruserkrankung Ausbruch in Westafrika und die in 2020 begonnene COVID-19 Pandemie haben vielen Entscheidungsträgern deutlich gezeigt, dass in der heutigen Welt Menschen komplex miteinander verbunden und dadurch auch voneinander abhängig sind (2). In der heutigen globalisierten Welt haben Krankheiten Einzelner bereits das Potential, schnell zu einer Bedrohung für die gesamte Menschheit weltweit zu werden. (3,7,49)

Die Bundesregierung hatte bereits 2013 ein Konzept für eine Globale Gesundheitspolitik verabschiedet und initiierte nach der Situation 2014/15 in West-Afrika ein Programm zum Globalen Gesundheitsschutz (Global Health Protection Programme, GHPP). (43,50) Aber die Weltgemeinschaft ist bis heute noch nicht ausreichend vorbereitet, auf bekannte sowie heute noch unbekannte (hoch-)infektiöse Erkrankungen effektiv zu reagieren. Trotz einiger nationaler Vorbereitungen hat SARS-CoV-II die meisten Nationalstaaten und ihr Krisenmanagement überrascht und überwältigt. Aber auch neben epidemisch auftretenden Infektionskrankheiten erkranken und sterben weiterhin zu viele Menschen zu früh an bekannten akuten und chronischen Krankheiten, die eigentlich vermeidbar wären. Dabei dürfen heute gerade auch die sogenannten armuts-assoziierten und vernachlässigten Krankheiten nicht vergessen werden, die global für einen großen Anteil an Morbidität und vorzeitiger Mortalität verantwortlich sind (51). Der mit dem demographischen Wandel einhergehende globale epidemiologische Wandel (*epidemiological transition*) führt dabei zur doppelten Belastung durch Krankheit (*double burden of disease*) insbesondere in Ländern mit niedrigem- und mittlerem Einkommen. Hier verursachen nicht-übertragbare chronische Erkrankungen pro Kopf fast so viele sogenannte behinderungs-bereinigte Lebensjahre (*disability adjusted life-years, DALY's*) wie in Ländern mit hohem Einkommen. (52)

Leider sind selbst in 2021 in den meisten Ländern die bestehenden Gesundheitssysteme nicht ausreichend vorbereitet, um zum Teil einfache Herausforderungen zu bewältigen, die lokal, überregional oder möglicherweise global

die Gesundheit von Bevölkerungen bedrohen. Die COVID-19 Pandemie hat dies der Welt deutlich vor Augen geführt (53). Sie hat deutlich gemacht, dass die Gesundheit aller Menschen weltweit immer von dem schwächsten Glied in der Kette abhängig ist. Wenn die Bevölkerungsgesundheit an einer Stelle nicht geschützt wird z.B. durch nicht vorhandene Impfungen birgt das eine Gefahr für die Gesundheit von vielen Menschen und für politische, ökonomische und soziale Instabilität. (2) Dass die Weltgemeinschaft bei der Überwachung und Bekämpfung von Gesundheitsproblemen mit globalen Auswirkungen heute noch immer schwach aufgestellt ist, zeigt deutlich das mangelndes Engagement für die öffentliche Gesundheit in Innen- und Außenpolitik. (54) Seit der Ausrichtung um ein stärkeres Engagement in der Globalen Gesundheit bemüht sich die Bundesregierung, auch in der COVID-19-Krise strategischen Einfluss auf die Arbeit der WHO zu nehmen (55).

Das zunehmende Engagement der Bundesregierung in Globaler Gesundheit zeigt das Globale Gesundheit neben den klassischen Funktionen der Außenpolitik wie z.B. dem Erhalt der nationalen Sicherheit, der Stärkung der nationalen Wirtschaftsmacht und der Mitwirkung in wichtigen Ländern grundlegend als ein wichtiges Thema angesehen wird und beständig an Relevanz gewinnt (43,54). Es zeigt auch eine Verschiebung der Wichtigkeit von Gesundheit, von einem in der Entwicklungspolitik marginalisierten und vernachlässigten Thema hin zu einem im Kontext von Sicherheit, Wirtschaft und Entwicklung wahrgenommenen Thema mit zunehmender außenpolitischer Relevanz in der globalisierten Welt.

Spätestens seit 2018 gilt die Bundesregierung als Vorreiter einer globalen Gesundheitspolitik, die Themen auf bundespolitischer Ebene festgelegt. Sie hat unter Federführung des BMG in 2017 die Erarbeitung einer neuen Strategie für die Globale Gesundheit in Auftrag gegeben. Dabei sollen verschiedene gesellschaftliche Akteure einbezogen werden. Dies eröffnet für Deutschland die Möglichkeit, eine strategische Position innerhalb der globalen Gesundheitsarchitektur anzustreben. (56)

Mit ihrem Konzeptpapier zur Globalen Gesundheit hat die Bundesregierung darüber hinaus gezeigt, dass sie realisiert hat, dass Mechanismen benötigt werden, die für alle Menschen weltweit sicherstellen, dass ausreichend funktionierende Gesundheits- und Fürsorgesysteme zur Verfügung stehen, um auch die Gesundheit der Menschen in Deutschland zu schützen. (22,43) Hier stellt sich jedoch die Frage, ob die bisher von

der Bundesregierung präsentierte Ideologie, deutsche Erfahrungen, Expertise und Mittel in sogenannte „Entwicklungsländer“ zu schicken, in einer globalisierten Welt noch zeitgemäßen (solidarischen) Mechanismen entspricht. Daneben allerdings beeindruckt das Konzept und die Strategie der Bundesregierung, mit einem klaren Bekenntnis die WHO in ihrer Rolle als weltweit führende Institution für Gesundheit zu stärken und bei der Realisierung von UHC zu unterstützten (43,44,57).

Leider hat die COVID-19-Krise auch gezeigt, dass in einer globalen Pandemie Nationalstaaten die Interessen ihrer eigenen Bevölkerung priorisieren. Es besteht weiterhin eine Führungsschwäche der multilateralen Organisationen, insbesondere der WHO, die hinterfragt, was von der globalen Gesundheit erwartet wird und wie diese gesteuert (*governed*) werden kann. (58)

Medizinische Gesundheitsversorgung

Der medizinische Fortschritt in der Krankenversorgung der letzten beiden Jahrhunderte reicht heute nur noch bedingt aus, um die Auswirkungen der Komplexität des modernen Lebens auf die Gesundheit angemessen zu bewältigen. Die Frage, wie die Bevölkerungsgesundheit in Deutschland wie auch global sichergestellt werden kann wird dabei politisch und gesellschaftliche zukünftig ein wichtiges Thema. In diesem Zusammenhang wird die Bedeutung des öffentlichen Gesundheitswesens d.h. der Bereich des Gesundheitswesens, den die Nationalstaaten durch Gesetze regeln und so Zuständigkeiten festlegen, in den kommenden Jahrzehnten weiterwachsen. Parallel werden das Gesundheitswesen insgesamt sowie seine Akteure mehr wirtschaftliches Gewicht und politische Aufmerksamkeit erhalten als bisher. (47)

Zur Verbesserung der Gesundheit der Menschen müssen zukünftig Gesundheitssysteme zentral um Menschen organisiert werden, aber auch die Gesundheit anderer Lebewesen und der Ökosysteme muss dabei mehr berücksichtigt werden (2). Dieses ist insbesondere der Fall in den Gesundheitswesen, die in der Vergangenheit vor allem auf Behandlungen in Krankenhäusern ausgerichtet waren und zukünftig die ambulante Versorgung priorisieren wollen, wie beispielsweise in den Staaten der ehemaligen Sowjetunion (59). Dabei sollte die Steuerung (*governance*) der Gesundheitseinrichtungen primär durch die lokalen Gemeinden (*communities*) erfolgen, zu denen diese gehören (*ownership*) und für diese eine umfassende

gesundheitliche Grundversorgung (*primary health care, PHC*) sicherstellen. Tatsächlich scheinen weltweit Ungleichheiten in der Gesundheitsversorgung insbesondere für sozioökonomisch benachteiligte und vulnerable Bevölkerungsgruppen nach substantiellen Reformen in etlichen Länder weiter zu bestehen auch obwohl diese Länder UHC eingeführten haben (60). Daher ist zu erwarten, dass das in den 1970er Jahren entwickelte PHC Konzept mit Fokus auf individuelle Gesundheitskompetenzen, Krankheitsprävention, Krankenversorgung und gesunde Lebensumstände, um Menschen ein gesundes Leben zu ermöglichen (*social determinantes of health, SDH*), wieder als passende Vorlage für ein modernes Gesundheitssystem dienen wird. (20,61–63) Da die Gesundheit sozioökonomisch benachteiligter Menschen weltweit mehr von den bestehenden SDH abhängt als von technischen Lösungen, ist der im 2013 Konzeptpapier der Bundesregierung verfolgte Ansatz, die deutsche Gesundheitswirtschaft zum Wohle der globalen Gesundheit zu stärken, allerdings fraglich (57).

Globale Gesundheit an den medizinischen Fakultäten

Wissenschaft soll gemeinsam mit der Gesellschaft, der Politik und der Wirtschaft gesellschaftliche Visionen entwickeln und dazu die entsprechend notwendigen Innovation generieren. Damit dieser Auftrag erfüllt werden kann, stellt die Gesellschaft den Universitäten Mittel zu Verfügung. Im Gegenzug orientiert sich die universitäre Forschung und Lehre daran, bestehende Probleme zu identifizieren und für diese geeignete Lösungen zu finden. In einer globalisierten Welt mit großen Herausforderungen sollten diese Lösungen für die Gesellschaft sozial, nachhaltig und klimaverträglich sein.

Lehre

Medizinische Fakultäten vermitteln Medizinstudierenden heute relevantes Wissen und Kompetenzen für praktische klinische Tätigkeiten. Um Studierende auf die Herausforderungen der Globalisierung auf Gesundheit besser vorzubereiten muss die Qualifizierung der zukünftigen Ärztinnen und Ärzten erweitert werden. (64,65) Leider hat die Lancet "*Commission on Medical Education for the twenty-first century*" dazu festgestellt, dass an medizinischen Fakultäten bisher noch kein Bezug zwischen den

vermittelten Kompetenzen und den Anforderungen an zukünftige Generationen, die in einer zunehmend interdependenten Welt Medizin praktizieren sollen, hergestellt wurde (64). Eine Analyse von Curricula im Vereinigten Königreich hat beispielhaft gezeigt, dass nur sechs Curricula spezifische Kompetenzen mit Bezug zu Globaler Gesundheit hatten, obwohl die Vorteile für das nationale Gesundheitswesen klar beschrieben und deutlich sind, wenn bei der Bereitstellung von Gesundheitsfürsorge und – vorsorge eine Globale Gesundheits-Perspektive eingenommen wird. (66,67)

Um die Bevölkerungsgesundheit zu schützen und zu verbessern, braucht es ein Gesundheitssystem, das multidisziplinäre Expertise aus unterschiedlichen Bereichen miteinander verbindet und wertschätzt. Um dieses zu ermöglichen, sollten medizinische Fakultäten in Deutschland zukünftig Medizinstudierenden über die ärztliche Qualifizierung hinaus gemeinsam mit weitere Berufsgruppen im Gesundheits- und Krankheitsversorgungssystem interprofessionell qualifizieren (57).

Durch interprofessionelle Qualifizierung an medizinischen Fakultäten kann so ein Problembewusstsein entwickelt und das systemisches Denken erlernt werden. Die medizinischen Fakultäten könnten mit einer Reformagenda (*transformative agenda*) in der Lehre dazu beitragen, neue Organisationsformen zu schaffen, die dann Innovationen generieren können. Das deutsche Gesundheitswesen könnte dabei von international entwickelten Modellen profitieren und sowohl auf kommunaler wie auch auf regionaler, nationaler und supranationaler Ebene ein Vorreiter sein, ähnlich wie Bismarck es vor über 100 Jahren bereits mit der Grundsteinlegung für das deutsche Gesundheitswesen war.

Die globalen Auswirkungen auf die Bevölkerungsgesundheit, z.B. auch durch die Klimazerstörung, nehmen zu und die Bemühungen von Regierungen, die Bevölkerungen vor diesen zu schützen sind bisher unzureichenden. Das führt bereits heute zu einem immer aktiveren Engagement von Ärztinnen und Ärzte, auf das die medizinischen Fakultäten auch systematisch und zielgerichtet vorbereiten sollten. (68)

Globale Gesundheit im Bezug zur wissenschaftlichen Sozialmedizin

(Das von Alfred Grotjahn an der Charité entwickelte Konzept hat heute noch Gültigkeit)

Im Bereich der Globalen Gesundheit sind Prioritäten notwendig. Zum Teil werden Prioritäten bereits durch internationale Vereinbarungen definiert, wie beispielsweise die Nachhaltigen Entwicklungsziele (*sustainable development goals, SDGs*) (69). Es bleibt jedoch häufig unklar, wie die von den Regierungen beschlossenen Prioritäten und dahingehend geschlossenen Vereinbarungen zustande kommen (*governance*), welche (empirischen) Fakten die Entscheidungen beeinflussen (*evidence-base*) und wie die Vereinbarungen in der Praxis umgesetzt werden können (*translation*).

Um zukünftig Rationalität, Transparenz und Praktikabilität bei Entscheidungen zu Globaler Gesundheit zu gewährleisten, benötigt es eine Ausrichtung an der besten verfügbaren Evidenz, basierend auf Daten und unter einer methodisch gestützten Vorgehensweise. Dazu sind neue Organisationsformen und die entsprechenden Kapazitäten und Kompetenzen in der Wissenschaft gefordert.

Forschung

Entsprechend müssen explizit Möglichkeiten für Forschung zur (Globalen) Gesundheit im Kontext der Globalisierung und der daraus resultierenden gesellschaftlichen Herausforderungen geschaffen werden. Dazu müssen in der universitären Lehre die Grundlagen eines normativen Diskurses gelegt, aber auch die Selbstreflexion und die Eigenverantwortung gefördert werden. Um dies gewährleisten zu können, sollte in der universitären Lehre ein partizipativer Ansatz gewählt werden, der die Auseinandersetzung und Identifikation mit behandelten Inhalten anregt (64). Außerdem sollte die Globale Gesundheit an Universitäten durch die Einrichtung mit eigenen Lehrstühlen gestärkt werden. Um zukünftig ein systemisches Verständnis der Auswirkungen der Globalisierung auf Gesundheit in der Forschung zu ermöglichen, müssen die Grenzen der Fachdisziplinen überschritten werden (64).

Transparenz

In der medizinischen Forschung werden heute oft Interessen von privaten, transnationalen Unternehmen oder Stiftungen über die der steuerzahlenden Allgemeinheit gestellt und dabei die Interessen von der Privatwirtschaft, der Politik und

der steuerfinanzierten Forschungseinrichtungen gefährlich vermengt (70). Auch weigern sich Staaten im Schatten ihrer nationalen Souveränität wie auch zunehmend Universitäten, ihre Daten für die öffentliche Nutzung (*public-use*) freizugeben. Leider ist es für Wissenschaftlerinnen und Wissenschaftler damit schwierig, beispielsweise auf nationale Daten oder Forschungsergebnisse steuerfinanzierter Universitäten zuzugreifen (71). Dies macht es unabhängigen Wissenschaftlerinnen und Wissenschaftlern sowie der engagierten Zivilgesellschaft zunehmend schwer bis unmöglich, bekannte Behauptungen zu überprüfen und zu replizieren. Für die Zukunft müssen daher Grundlagenwissenschaften und die angewandten Wissenschaften sicherstellen, dass innovative Ergebnisse an und in die nächste Generation zukünftiger Wissenschaftler weitergegeben werden können – und diesen auch zugänglich ist. (72,73) Die globale Gemeinschaft an Wissenschaftlerinnen und Wissenschaftler sollte daher ihre Daten und Analysen zusammen mit ihren Ergebnissen frei (*open access*) zur Verfügung stellen.

Wenn Globale Gesundheit als eigenständiger transdisziplinärer Bereich aufgebaut wird, sollte berücksichtigt werden, dass es beim Aufbau neuer Forschungsbereichen wichtig zu sein scheint, dass die zentralen Akteure eines neu entstehenden Forschungsnetzwerks neben der Wissensdissemination auch aktiv die Rolle übernehmen, neue Akteure und neues Wissen in die bestehenden Netzwerke zu integrieren (71). Hierzu benötigt es neue Forschungsstrukturen und – netzwerke.

4. ZUSAMMENFASSUNG

Die moderne Medizin ist eine der größten gesellschaftlichen Leistungen zum Schutz der Gesundheit, zur Bekämpfung von Krankheiten und zur Verlängerung des Lebens. Vor dem Hintergrund weltweiter Auswirkungen der Globalisierung, die sich über die Grenzen von Nationalstaaten hinweg ausbreitet und sowohl die Gesundheit von Menschen und Tieren sowie die Umwelt als auch nationalstaatliche Gesundheitssysteme weltweit herausfordern, muss Gesundheit weltweit und systematisch neu betrachtet und bewertet werden.

In Deutschland hat das Thema der Globalen Gesundheit bereits seit der Ebola Epidemie 2014/15 in West-Afrika, aber insbesondere seit Beginn der COVID-19 Pandemie an politischer Aufmerksamkeit gewonnen. Durch diese sind die Bedrohungen viraler Erkrankungen für die wirtschaftliche, politische und gesellschaftliche Stabilität weltweit offensichtlich gewordenen.

Um zukünftigen Herausforderungen der Globalen Gesundheit begegnen zu können, wird innovative und transformative Kapazität benötigt. Da sich die erwarteten politischen, sozialen, wirtschaftlichen und ökologischen Veränderungen weltweit immer schneller verändern, wird Innovation bereits heute notwendig. Gleichzeitig muss bereits heute über zukünftige Herausforderungen nachgedacht werden, um in der Lage zu sein, den zukünftigen und noch nicht vorhersehbaren Herausforderungen (*known unknowns*) begegnen zu können. Dazu ist die Unterstützung und Finanzierung von unabhängiger transdisziplinärer Wissenschaft zum Thema Globale Gesundheit im ausschließlichen Interesse des Allgemeinwohls zwingend notwendig.

In diesem Prozess sollte überdacht werden, wo und wie das biomedizinische Modell der krankheitsfokussierten Medizin durch sozialmedizinischen Innovationen sinnvoll ergänzt werden kann. Das setzt auch voraus, dass die Curricula der medizinischen und gesundheitswissenschaftlichen Lehre dahingehend überarbeitet werden.

Parallel müssen für Wissenschaftlerinnen und Wissenschaftler im Bereich der Globale Gesundheit die Bedingungen geschaffen werden, die Kreativität und den Umgang mit Risiken erlauben, denn sich auf etwas Neues einzulassen, bedeutet immer auch ein Risiko einzugehen bedeutet (*disruptive innovation*).

Wissenschaftliche Einrichtungen wie die Charité-Universitätsmedizin Berlin könnten dabei die Funktion eines Leuchtturms für die Gesundheitsaspekte in den Irren und Wirren der gesellschaftlichen Transformationen übernehmen und damit eine Tradition von über 300 Jahren an der Spitze des medizinischen Fortschritts und des Gesundheitswesens für die Zukunft fortschreiben.

Dazu müsste die Globale Gesundheit im Verständnis Virchows unter den heutigen gesellschaftlichen Bedingungen formuliert werden. Die Zukunft einer nachhaltigen Globalen Gesundheit muss dabei zwingend innerhalb der Grenzen des „Systems Erde“ formuliert werden und sollte sozialökonomisch, sozialökologisch und sozialmedizinisch im Dienste der Allgemeinheit ausgerichtet sein.

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Er hat mir die Möglichkeit gegeben, diese Habilitationsschrift zu erstellen, indem er als wichtiger Ansprechpartner in fachlichen und organisatorischen Angelegenheiten jederzeit erreichbar war und mir die notwendigen Freiräume und Unterstützung des Instituts zur Entwicklung und Durchführung eigener Forschungsprojekte ermöglicht hat.

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ERKLÄRUNG

§ 4 Abs. 3 (k) der HabOMed der Charité

Hiermit erkläre ich, dass

- weder früher noch gleichzeitig ein Habilitationsverfahren durchgeführt oder angemeldet wurde,
- die vorgelegte Habilitationsschrift ohne fremde Hilfe verfasst, die beschriebenen Ergebnisse selbst gewonnen sowie die verwendeten Hilfsmittel, die Zusammenarbeit mit anderen Wissenschaftlern/Wissenschaftlerinnen und mit technischen Hilfskräften sowie die verwendete Literatur vollständig in der Habilitationsschrift angegeben wurden,
- mir die geltende Habilitationsordnung bekannt ist.

Ich erkläre ferner, dass mir die Satzung der Charité – Universitätsmedizin Berlin zur Sicherung Guter Wissenschaftlicher Praxis bekannt ist und ich mich zur Einhaltung dieser Satzung verpflichte.

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