UK Universities Global Health Research League Table

Methodology

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INTRODUCTION

This document provides a comprehensive overview of the methodology used by a team of researchers from Universities Allied for Essential Medicines UK (UAEM UK) and Medsin UK in evaluating universities for the "UK Universities Global Health Research League Table". In addition to presenting our detailed methodology for data collection and scoring, we also address quality control and data reliability considerations.

Why is this project needed?

Universities are major drivers of medical innovation. Between 1/4 and 1/3 of new medicines originate in academic labs[1], and universities have contributed to the development of one out of every four HIV/AIDS treatments.

There is huge potential for universities to leverage their investment in biomedical research to advance global health. The size and scope of this impact, however, depends on decisions about where to focus research and how to share new discoveries.

More than 1 billion people worldwide suffer from "neglected diseases" – illnesses rarely researched by the private sector because most of those affected are too poor to provide a market for new drugs[2]. Furthermore, 10 million people die each year simply because they can't get life-saving medicines that already exist – often because those treatments are just too expensive.

Universities can use their unique positions as public-interest, largely publicly-funded research institutions to address both challenges. By prioritizing research on global diseases neglected by for-profit R&D, they can pioneer new treatments that will benefit millions in the developing world. And by sharing their medical breakthroughs under open, non-exclusive licenses or licenses that promote lower prices in developing countries, universities can help poor patients worldwide access new, life-saving treatments.

Worldwide, some universities are already taking steps to address these issues, and this project is inspired by and built upon UAEM's work in producing the North American "University Global Health Impact Report Card" project, which measured these efforts and was undertaken in 2012-13. However, attempts to systematically measure UK universities' contributions in this vital area have been lacking. The UK Universities Global Health Research League Table intends to fill that gap.

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[1] Chatterjee, S.K., Rohrbaugh, M.L. NIH inventions translate into drugs and biologics with high public health impact (2014) Nature Biotechnology, 32 (1), pp. 5258; available from http://www.nature.com/nbt/journal/v32/n1/full/nbt.2785.html

[2] World Health Organization. Working to overcome the global impact of neglected tropical diseases: First WHO report on neglected tropical diseases (2010) Geneva: World Health Organization; available from http://whqlibdoc.who.int/publications/2010/9789241564090_eng.pdf

Project Aims

The purpose of this project is threefold:

Firstly, it aims to provide a reliable and comparable assessment of the top UK research-intensive universities, best placed to have impact through their research, in their commitment to global health research and equitable technology licensing.

Secondly, it aims to provide a platform upon which an open dialogue between research institutions and global health advocates can take place, which we hope may lead to improved global health outcomes.

Thirdly, it aims to be a baseline against which future changes in globally-relevant research and intellectual property management by universities can be measured. Future iterations will be necessary in order to measure these changes and enable the identification and promotion of best practice in this area of university activity.

Project Overview

The UK Universities Global Health Research League Table evaluates and ranks 25 top UK universities on their contributions to neglected global health research and efforts to improve access to medicines.

A project of UAEM UK and Medsin UK, the League Table uses both publicly-available and self-reported information to evaluate academic institutions on two key questions:

1. Are universities investing in innovative medical research that addresses the neglected health needs of low-income communities worldwide?
2. When universities license their medical breakthroughs for commercial development, are they doing so in socially responsible ways that ensure those treatments can reach developing world patients at affordable prices?

METHODOLOGY

Introductory notes on methodology

Selection of institutions

In order to meet the aim of investigating universities best placed to impact health globally, the project evaluated the 25 UK universities that received the highest amount of funding from the primary public funding agency in the UK, the Medical Research Council. The figures used to determine this were the latest available to us; those for the year 2010-2011[3]. For our purposes, a 'university' was defined as an institution receiving research funding that also provides teaching programmes for students, undergraduate or postgraduate.

Recruitment of researchers

In order to collect the data for this project, researchers were recruited by advertising through the internal networks available to UAEM UK and Medsin UK and also at several student-led, global health-oriented conferences throughout the UK. Respondents to the adverts were then assigned to a section of the study, to be supervised by the respective section leads (people responsible for the development of the methodology and data collection and analysis pertaining to their section). Volunteers were taken on as researchers after completion of training modules in how to collect the data relevant to their assigned questions. This was done through use of a training event held in London and an online training package devised by the section leads.

The 'questions' approach

The methodology of the project is based around the use of research 'questions'. Each section has several questions that aim to address the issues relevant to each section. The answer to each individual question is then determined through assessment of the evidence available, from publicly available or self-reported data. These answers are then scored according to criteria outlined in the section methodologies.

Selection and comparability of metrics

We acknowledge that there is still significant variation across the universities selected for evaluation (e.g. in levels of research funding, research/funding focus, specialist institutions). To account for this, we have selected evaluation criteria intended to minimize the impact of such variations.

Importantly, all metrics that analyze continuous variables account for variation in funding by normalizing the absolute number to the overall funding an institution receives. For example,

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[3] available at: http://www.mrc.ac.uk/research/funded-research/recipients-of-funding/

when evaluating a university's investment in neglected disease research, our metric is calculated by dividing a given institution's medical research funding devoted to neglected disease projects by their total medical research funding. This enabled us to adjust for confounding by institutional size and allowed for meaningful comparison performance across institutions.

For categorical metrics, we have developed pre-defined sets of discrete categories by which all universities can be uniformly evaluated, and for which performance is again likely to be independent of variations in university size, funding, capacity or resources.

Data quality and reliability considerations

A critical aspect of our methodology is that answers to our research questions have been generated through analysis of data obtained using two broad categories of data collection:

1. Data obtained by accessing publicly available sources, such as university websites, online grant databases, and search engines.
2. Data obtained through self-reporting by university officials in response to survey instruments designed and distributed by the co-ordinating committee.

For category 1, we addressed data quality and consistency through:

- Development of standardized operating procedures and standardized data entry forms, including uniform search terms to which all investigators were required to adhere.
- Use of quality control tests to ensure that investigators were obtaining the same results from the collection procedures, these are described in more detail later.
- Performance of the same data collection and search processes, where possible, by multiple individual investigators independently and concurrently to ensure consistency of data. Any discrepancies were moderated by section leads.

For category 2, we addressed data quality and consistency, including concerns about questionnaire non-response, through:

- Providing the same questionnaires to all institutions.
- Development of a standardized process for identifying and verifying contacts to receive questionnaires at each institution.
- Identifying the specific administrators at each university who we felt were most likely to have the data readily available for each of our respective three survey instruments; this included directors of technology licensing offices, deans of individual schools, and vice presidents for research.
- Using standardized scripts and communication strategies to deliver the survey instruments to all institutions and conduct consistent follow up via e-mail and phone; institutions were given at least 12 weeks to respond to the survey, and efforts to encourage response through emails and telephone calls were standardised and are described in Section I of the methodology.

- Sending, prior to public release of the Report Card, a pre-release to university presidents at all non-reporting institutions, providing a final chance to augment the response rate.
- Asking questions, where possible, in a manner such that the variable under question was measured categorically, rather than continuously; this was in an effort to maximize the likelihood of response from institutions.
- Using a standardized scoring of responses across all institutions.
- Measuring and reporting response rates both for the entire questionnaire and for individual questions.

General limitations - AT END

Section I: INNOVATION

The Innovation section is designed to investigate the first key question described in the project overview; namely, whether universities are investing in medical research addressing the neglected health needs of low-income communities worldwide. The section awards points to a university for the meeting of categorical criteria relating to each of our research questions. The data necessary to answer the questions was collected by searching funding and literature databases using predefined queries in an effort to capture as completely as possible the research efforts of each institution in the fields of neglected diseases and global health.

Scope and definitions

For the purposes of this project, "neglected diseases" (NDs) were defined as a set of diseases primarily affecting low- and lower middle-income countries. Our list of NDs and research areas was based on the criteria set by the G-FINDER 2011 survey on global ND innovation funding[4] and the World Health Organization's list of neglected tropical diseases[5]. The scope of the research areas included was further focused in terms of subject matter and application. Notably, this definition of ND includes HIV, tuberculosis, malaria, diarrheal diseases, meningitis, and pneumonia; however, for several of the diseases there are substantial restrictions to include only aspects or subsets of these diseases that are truly neglected. For example, we did not include all research on HIV - only research pertaining to paediatric HIV, HIV diagnosis, diagnostics, microbicides, and vaccines. The list of NDs used for this section can be found in Appendix 1.

In the absence of a universally accepted definition of global health, 'global health research' was defined for our purposes as a spectrum of health-related research primarily affecting low- and lower middle-income countries or those that had a global impact. Within our definition, low-income and lower middle-income were defined by WHO criteria as those countries with a 2012 gross national income (GNI) per capita of $1025 or less and those with a 2012 GNI per capita of $1036-$4085, respectively. This proxy definition has been used in a globally recognised report by the Global Forum for Health Research[6] and its use allowed us to focus our limited resources on the most neglected populations.

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[4] G-FINDER. Neglected disease research and development: is innovation under threat? page 19. Available at: http://www.policycures.org/downloads/g-finder_2011.pdf

[5] Available at: http://www.who.int/neglected_diseases/diseases/en/

[6] The scope of the relevant research areas within our proxy definition of 'global health' was based on the typology outlined in the document produced by the Global Forum for Health Research, 'Monitoring Financial Flows for Health Research 2008'. By using this definition, our scope of global health research thereby acknowledges, in addition to biomedical research, research into health policy and systems research, behavioural and social science and operational research.
Reference: Matlin SA, Burke MA, Monot JJ, Mathers C, Shibuya K. *Monitoring Financial Flows for Health Research 2008*. Global Forum for Health Research; available at http://www.isn.ethz.ch/Digital-Library/Publications/Detail/?ots591=0c54e3b3-1e9c-be1e-2c24-a6a8c7060233&lng=en&id=93435

Search strategy for funding and publications

The ND search query was constructed to encompass publications associated with the listed diseases by:

1. Including all permutations of common and scientific names for the diseases, and;

2. Pairing each disease identifier with an associated area of research (e.g. vaccines, diagnostics, etc.).

To calculate grant funding, we used publicly available data from five major medical research bodies in the UK to represent the 'total' medical research funding received by each university, these bodies were:

1. DFID[7]
2. European Commission[8]
3. Bill and Melinda Gates Foundation[9]
4. Gateway 2 Research (Research Councils UK)[10]
5. Wellcome Trust[11]

The number of publications from each university was obtained using searches on PubMed, a widely-used and comprehensive source for research publications. The 'index score' used to allocate points to each university is a percentage of total publications, in order to standardize for size of university and research capacity.

The study period for all publication searches used to generate index scores was 01/01/2011 to 31/12/2013. Data after this time period, although publically available from some organisations, was not available from all funders.

Scoring

In order to effectively compare investment and publication output in ND and global health research across institutions receiving varying amounts of total research funding, the 'index score' used to allocate points to each university is a percentage of total publications or total funding, enabling us to standardize for size of university and research capacity. Index values were skewed to normalise the data. Each institution was scored out of five points according to their index value within the normalised data.

In the Innovation section, all four questions have been weighted equally in the determination of the overall section grade.

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[7] http://r4d.dfid.gov.uk/Default.aspx
[8] http://cordis.europa.eu/projects/home_en.html
[9] http://www.gatesfoundation.org/How-We-Work/Quick-Links/Grants-Database#
[10] http://gtr.rcuk.ac.uk/
[11] http://www.wellcome.ac.uk/Managing-a-grant/Grants-awarded/Archive/index.htm

Quality Maximization Strategy

The primary data collection and categorisation was performed by at least two independent researchers for each question, each blinded to the selections of the others. Researchers were able to note when they were unsure of or disagreed with the categorisation recommended by regular online contact with a member of the expert committee. In the event of non-concordance in opinion between researchers, results were further discussed by the section leads to achieve consensus on their appropriate categorisation.

To eliminate variability in terms of data source and eliminate the risk of poor response rate for data directly received from university administrators, we generated our evaluation based on analysing publicly available sources. Use of PubMed as a single search engine aimed to avoid repetition of publications and thus potential over-reporting. A fixed start and end date eliminated any potential variability in results caused by searches conducted at different times.

QUESTION 1: What percentage of the overall medical research funding for each university is devoted to <u>neglected diseases</u>?

<u>Data collection</u>

Data was extracted from systematic reviews of public grant databases and funding disclosures from five major funders of UK biomedical research:

1. DFID
2. European Commission
3. Bill and Melinda Gates Foundation
4. Gateway 2 Research (Research Councils UK)
5. Wellcome Trust

For each institution, an index score was calculated based on total grant funding for research on neglected diseases (NDs) and the overall total grant funding received during the study period 01/01/2011 to 31/12/2013, obtained as an aggregate of all grants selected from the top 5 public grant databases. The index score was calculated using the following formula:

$$Index\ \% = \frac{grant\ funding\ for\ research\ on\ neglected\ diseases}{total\ grant\ funding\ received} \times 100$$

A database-specific methodology was used to extract the relevant projects for each institution. For the numerator, each database was filtered by institution and project start date and screened for grants relevant to ND research. Each study was categorised by two independent researchers as to whether the study was an ND study or not (see Quality Maximisation Strategy above).The ND search query text can be found in Appendix 2.

<u>Scoring criteria</u>

Index score	Points awarded
8 ≤ x	5
6 ≤ x < 8	4
4 ≤ x < 6	3
2 ≤ x < 4	2
0 ≤ x < 2	1

QUESTION 2: What percentage of the overall medical research funding for each university is devoted to <u>health in Low Income and Lower-Middle Income Countries</u>?

<u>Data collection</u>

Data was extracted from systematic reviews of public grant databases and funding disclosures from 5 major funders of UK biomedical research:

1. DFID

2. European Commission

3. Bill and Melinda Gates Foundation

4. Gateway 2 Research (Research Councils UK)

5. Wellcome Trust

For each institution, an index score was calculated based on total grant funding for research in health within low income and lower-middle income countries in 2011-2013 and the overall total grant funding received over the same period, obtained as an aggregate of all grants selected from the top five public grant databases. The score was calculated using the following formula:

$$Index \% = \frac{grant\ funding\ for\ health\ research\ in\ LICs\ and\ LMICs}{total\ grant\ funding\ received} \times 100$$

Studies were extracted from the 5 databases using university name and dates and were filtered based on whether they focussed on LICs or LMICs (Appendix 2) and whether they focussed on global health (Appendix 3) Each study was categorised by two independent researchers (see Quality Maximisation Strategy above).

<u>Scoring criteria</u>

Index score	Points awarded
8 ≤ x	5
6 ≤ x < 8	4
4 ≤ x < 6	3
2 ≤ x < 4	2
0 ≤ x < 2	1

QUESTION 3: What percentage of the university's total PubMed publications are focused on <u>neglected diseases</u>, including neglected aspects of HIV, TB and malaria?

<u>Data collection</u>

For each institution, we calculated an index score based on the total number of publications related to neglected diseases in 2011-2013 and the total number of PubMed publications over the same period. The score was calculated using the following formula:

$$Index~\% = \frac{total~number~of~PubMed~publications~related~to~NDs}{total~number~of~PubMed~publications} \times 100$$

To calculate the numerator, comprehensive searches were run to find studies focussing on neglected diseases and their associated areas of research. The search terms and limits used to extract relevant results are available in <u>Appendix1</u>.

<u>Scoring criteria</u>

Index score	Points awarded
2.0 ≤ x	5
1.5 ≤ x < 2.0	4
1.0 ≤ x < 1.5	3
0.5 ≤ x < 1.0	2
0 ≤ x < 0.5	1

QUESTION 4: What percentage of the university's total PubMed publications are focused on <u>health in Low-Income and Lower-Middle-Income Countries</u>?

For each institution, we calculated an index score based on the total number of publications related to health in Low-Income and Lower-Middle-Income Countries, or with a wider global impact, in 2011-2013 and the total number of PubMed publications over the same period. The index score was calculated using the following formula:

$$Index\ \% = \frac{number\ of\ PubMed\ publications\ relevant\ to\ health\ in\ LIC/LMICs}{total\ number\ of\ PubMed\ publications} \times 100$$

The search query used to extract relevant publications from PubMed for the numerator can be found in Appendix 2. Studies were then categorised using <u>Appendix 3</u>

<u>Scoring criteria</u>

Index score	Points awarded
3.2 ≤ x	5
2.4 ≤ x < 3.2	4
1.6 ≤ x < 2.4	3
0.8 ≤ x < 1.6	2
0 ≤ x < 0.8	1

LIMITATIONS OF THE INNOVATION SECTION

Technical limitations

- We used five large, publically-available databases to collect data on research projects carried out by universities. We acknowledge that a lot of global health and neglected disease research is funded by bodies outside of the ones assessed, some data of which is publicly available. However, the databases used represent the largest funders of infectious disease research[12]. All databases used highlighted an interest in research that focussed on unmet need in their strategic plans or mission statements. Thus, being unable to capture all funders, including charities and other smaller funders we prioritised these funders over those that focus on biomedical research in general. In future iterations of the project we hope to expand the number of databases used and investigate the roles of smaller charity and grant funding to the global health.
- Funding databases do not provide information on how funding is split between collaborating institutions, thus all funding was allocated to the lead organisations. While this excluded some very important studies, there was no way we could get this information within the given timeframe. We hope that this does not discourage institutions from collaborating on research.
- We only used PubMed to search publications to show the research output of institutions. (Questions 3 and 4). Thus studies not on PubMed would have been excluded from our results. We chose PubMed as it is large repository that is widely used by medical professionals and global health researchers across the world. We felt that using more than one database would lead to duplication of work.

Limitations in scope of assessment

- Global health is poorly defined worldwide. Due to the breath in scope of its definition, in the best interest of resource allocation and scientific rigour, global health was restricted to be defined as biomedical work specifically focussed on needs of the global society or more specifically low and lower-middle income countries. We respect that , in doing so, our analysis of innovation within global health is not fully comprehensive. Furthermore, we acknowledge that many non-infectious diseases such as heart disease have a significant impact on the global community. Whilst our search enquiry did not specifically extract these non-infectious diseases, we believe that our search terms in question 2 and 4 are adequately broad enough to screen for

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[12] Fitchett JR, Head MG, Cooke MK, Wurie FB, Atun R. Funding Infectious Disease Research: A Systematic Analysis of UK Research Investments by Funders 1997–2010. 2014. Funding Infectious Disease Research: A Systematic Analysis of UK Research Investments by Funders 1997–2010. PLoS ONE 9(8): e105722. doi: 10.1371/journal.pone.0105722

Research Investment in Global Health. http://researchinvestments.org/about-the-study/study-methodology/

all relevant diseases with an impact globally, in LICs or Lower-Middle-Income Countries.

- Within this section, research output of institutions was calculated on publication output and grant funding received. We respect that quantity of publications and size of grants does not linearly correlate to impact. However, one of the aims of the league table is to reward institutions to build a large community interested in global health issues.

- The dates selected for this section were 01/01/2011-31/12/2013 which does not account for the most up to date endeavors in global health and neglected diseases. However Data on funding in 2014 was not consistently available across all funding database. Furthermore setting a fixed timeframe allowed us to account for PubMed searchers performed by researchers at different times.

Section II: ACCESS

The Access section is designed to investigate the second key question described in the project overview; namely, whether universities are licensing their medical discoveries in socially responsible ways, ensuring that the benefits can reach the developing world at affordable prices. The section awards points to a university for the meeting of categorical criteria relating to each of our research questions, defined below. Data collection for the questions was achieved by searching publicly available records and also through the dissemination of a questionnaire to the technology transfer offices (TTOs), or equivalent, of each university.

Data collection overview

In order to gather self-reported data from universities, an online questionnaire was developed on SurveyMonkey®, and e-mailed to the TTO officials best suited to provide the data. TTOs were contacted a minimum of 4 times by email and two times by telephone over a 12-week period beginning July 6, 2014. For universities that did not respond by the end of the 12-week period, a request for the information requested in the original online survey was made under the Freedom of Information Act 2000 on October 1, 2014. Logs of communications with individual universities can be made available on request and a copy of the electronic survey is available in Appendix 4.

In the Freedom Of Information (FOI) request, with which organisations are legally required to comply, an invitation to complete the online survey was included and it was clearly stated that a response to the survey would remove the need for the provision of information through an FOI protocol. We used survey responses rather than FOI replies wherever possible, and information submitted in response to the FOI request was only used to increase, never to decrease, any points awarded for a given question. The text of the FOI request is available in Appendix 5.

It is important to note that the exact wording of the FOI request was slightly different to that of the survey. This was a compromise necessary to ensure that the language in the FOI request did not become a barrier to response. Information received in response was used to grade Questions 3 and 4 in cases where survey responses were not given. Multiple combinations of responses to questions in the FOI could be used to answer Questions 3 and 4. These were all included in the request to ensure the receipt of information that may be held by TTOs in a variety of formats. Specific details of how the answers to the FOI request were used are provided with the relevant question methodologies below.

Finally, to reflect the relative importance of each of the questions in the determination of the final access grade, the scores (out of a possible 5) awarded for each question were assigned a weighting using multipliers, which are written in bold beneath each research question in the methodology below.

Question 1: Has the university officially and publicly committed to licensing its medical discoveries in ways that promote access and affordability in developing countries?
Weighting multiplier = 2.5

Data collection

Publicly available information information was reviewed by researchers, including:

- Systematic search of University website and Google using search terms linking the university to access licensing.
    - Relevant search terms: University name; global access licensing; socially responsible licensing; equitable access licensing; access to medicines; university licensing; technology transfer.
- List of signatories to Stanford University's 'Nine Points to Consider in Licensing University Technology'[13].
- List of signatories to the 'Statement of Principles for the Equitable Dissemination of Medical Technologies'[14].

In addition to this, the TTO questionnaire included a request for any additional evidence supporting a public commitment to equitable technology licensing.

Scoring criteria

Strength of evidence to support 'yes' answer to Q1	Criteria	Points awarded
Strong	The university has publicly committed to detailed, specific access licensing strategies that prioritise generic production of	5

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[13] Available at: http://www.autm.net/Nine_Points_to_Consider1.htm
[14] Available at:
https://www.autm.net/source/Endorsement/endorsement.cfm?section=TechTransferResources

	university-researched medicines for developing countries	
...	The university has publicly committed to detailed, specific access licensing strategies that DO NOT prioritise enabling generic production of university-researched medicines for developing countries	4
...	The university has publicly committed to the general principle of global access licensing, but HAS NOT endorsed or disclosed specific strategies for promoting access through licensing	3
...	The university plans to make an endorsement of access licensing within the coming year	2
...	The university has made no public commitment to access licensing, but the TTO reports commitment to the general principle of access licensing.	1.5
Weak	The university has taken no official action and has no plans to do so	1

Question 2: Does the website of the university's technology transfer office OR the university's website make an effort to disclose, explain and promote access licensing commitments and practices?

Weighting multiplier = 0.5

Data collection

Both the university and university TTO (or equivalent) websites were reviewed independently by two researchers and points awarded according to scoring criteria. Where discrepancies arose, the researchers discussed findings with the section lead, who was responsible for awarding the final score.

Scoring criteria

Strength of evidence to support 'yes' answer to Q2	Criteria	Points awarded
Strong	The website provides BOTH the text of a specific, detailed access licensing document AND additional in-depth content related to access licensing	5
...	The website provides the full text of a detailed, specific access licensing document for the university OR offers in-depth explanations, case studies, license examples, press releases or other content focused on access licensing, but NOT both	4
...	The website references the university's endorsement, adoption or use of a specific, detailed access licensing policy, but does not post or link to the policy	3
...	The website offers brief, limited, and non-specific statements on access licensing	2

| Weak | The website makes no reference to promoting global access through socially responsible licensing | 1 |

Question 3: In the past year, what percentage of the university's health technology licenses were non-exclusive?
Weighting multiplier = 1

Data collection

The TTO questionnaire asked for a self-reported response to this question using the numerical percentage range in the scoring criteria below.

Responses to question 4 of the Freedom Of Information request (see Appendix 2) were used to assign a grade in this question for some universities if an answer was not provided through the online survey.

Scoring criteria

Criteria	Points awarded
At least 71% of health technology licences were non-exclusive	5
51-70% of health technology licences were non-exclusive	4
31-50% of health technology licences were non-exclusive	3
11-30% of health technology licences were non-exclusive	2
0-10% of health technology licences were non-exclusive	1
No response to question	1

Question 4: In the past year, for what percentage of all health technologies did the university seek patents in developing countries where they may restrict access?

Question 4 was split into two parts - A and B. Part A asks about patents in Upper-Middle Income countries (UMICs); specifically Brazil, Russia, India, China, and South Africa. Part B asks about patents in Lower-Middle- and Low Income countries (LMICs/LICs).

Data collection

The TTO questionnaire asked for a self-reported response to both parts of this question using the numerical percentage ranges in the scoring criteria below.

Responses to question 9 of the Freedom Of Information request (see Appendix 2) were used to assign a grade in this question for some universities if an answer was not provided through the online survey. Reported Patent Cooperation Treaty (PCT) applications that had not yet matured into national and/or regional applications were excluded from this calculation.

Scoring criteria - Part A (Upper middle income countries)
Weighting multiplier = 0.5

Criteria	Points awarded
UMIC patents sought for 0-20% of technologies	5
UMIC patents sought for 21-40% of technologies	4
UMIC patents sought for 41-60% of technologies	3
UMIC patents sought for 61-80% of technologies	2
UMIC patents sought for 81-100% of technologies	1
No response to question	1

Scoring criteria - Part B (Lower middle- and low income countries)

Weighting multiplier = 0.5

Criteria	Points awarded
LMIC/LIC patents sought for 0-20% of technologies	5
LMIC/LIC patents sought for 21-40% of technologies	4
LMIC/LIC patents sought for 41-60% of technologies	3
LMIC/LIC patents sought for 61-80% of technologies	2
LMIC/LIC patents sought for 81-100% of technologies	1
No response to question	1

Question 5: In the past year, what percentage of the university's exclusive licenses of health technologies included provisions to promote access to those technologies in developing countries?

Question 5 was split into two parts - A and B. Part A asked the research question as stated above. Part B asked what percentage of the provisions from Part A (if any) included Upper-Middle Income countries (specifically Brazil, Russia, India, China, and South Africa) in their scope.

Data collection

The TTO questionnaire asked for a self-reported response to both parts of this question using the numerical percentage ranges in the scoring criteria below.

We did not assess this question in our Freedom Of Information request. Where universities did not respond after multiple reminders, including a reminder in the cover letter for the FOI request, we awarded 1 point.

Scoring Criteria - Part A
Weighting multiplier = 1

Criteria	Points awarded
81-100% of health technology licences included provisions promoting access in developing countries	5
61-80% of health technology licences included provisions promoting access in developing countries	4
41-60% of health technology licences included provisions promoting access in developing countries	3
21-40% of health technology licences included provisions promoting access in developing countries	2
0-20% of health technology licences included provisions promoting access in developing countries	1
No response to question	1

Scoring Criteria - Part B

Weighting multiplier = 0.5

Criteria	Points awarded
81-100% of access provisions included UMICs	5
61-80% of access provisions included UMICs	4
41-60% of access provisions included UMICs	3
21-40% of access provisions included UMICs	2
0-20% of access provisions included UMICs	1
No response to question	1

Question 6: Does the university make an effort to promote and facilitate public-access publication by researchers?
Weighting multiplier = 0.8

<u>Data collection</u>

We used the definition of Open Access provided by the Budapest Open Access Initiative[15]. 'free access' (or 'public access') was taken to mean other cases where access is provided freely, but with limited re-use rights.

Publicly available information was reviewed by researchers, including:

- University websites: reviewed independently by two researchers.
- List of signatories to Compact for Open-Access Publishing Equity[16].
- List of institutions in the Registry of Open Access Repositories Mandatory Archiving Policies[17].

Points were then awarded according to the scoring criteria below.

<u>Scoring criteria</u>

Strength of evidence to support 'yes' answer to Q6	Criteria	Points awarded
Strong	The University has both an access fund for paying article processing fees and an institutional Open Access policy	5
...	The university has EITHER an Open Access fund for paying article processing fees OR an institutional Open Access policy, but NOT both	4
...	The website provides BOTH Open Access publishing guidelines for common research funding sources AND a description of Green and Gold Open Access	3
...	The website provides Open Access publishing guidelines for common research funding sources OR offers explanations of Green and Gold Open Access	2
Weak	The university website provides brief and limited statements regarding Open Access publishing.	1

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[15] Available at: http://www.budapestopenaccessinitiative.org/
[16] Availabla at: http://www.oacompact.org/signatories
[17] Available at: http://roarmap.eprints.org/

Question 7: What percentage of university research output is freely available online within one year of publication?
Weighting multiplier = 1.2

Data collection

For each university, PubMed[18] and PubMed Central[19] were searched for all university-affiliated abstracts and full-text articles using the following filters:

1. Publication type: journal article
2. Affiliation: University
3. Publication date: 1/5/2012 - 1/5/2013

The percentage was calculated using the following formula:

$$\% = \frac{number\ of\ full\ text\ articles\ in\ PubMed\ Central}{number\ of\ citations\ in\ PubMed} \times 100$$

Points were then awarded according to the scoring criteria below.

Scoring Criteria

Criteria	Points awarded
99-100% of output is freely available online within one year of publication	5
90-98% of output is freely available online within one year of publication	4
80-89% of output is freely available online within one year of publication	3
70-79% of output is freely available online within one year of publication	2
60-69% of output is freely available online within one year of publication	1

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[18] Accessible at: http://www.ncbi.nlm.nih.gov/pubmed
[19] Accessible at: http://www.ncbi.nlm.nih.gov/pmc/

QUESTION WEIGHTING

The table below provides a summary of the weighting for each question and overall points available to each university in the access section.

Question	Weighting multiplier	Points available
Q1	2.5	12.5
Q2	0.5	2.5
Q3	1	5
Q4A	0.5	2.5
Q4B	0.5	2.5
Q5A	1	5
Q5B	0.5	2.5
Q6	0.8	4
Q7	1.2	6
Total points available		**42.5**

LIMITATIONS OF THE ACCESS SECTION

Technical limitations

- Questions 2-5 rely in part on responses to surveys. Our survey, which can be seen in Appendix 4, captures only categorical data (ranges of percentages), so precise percentages cannot be reported for this section. As with any survey, we rely on respondents filling it in in good faith, and are unable to independently verify the data provided.
- Responses to requests made under the Freedom Of Information act 2000 were used in some cases to supplement data for Questions 2-4. In this case too, we are unable to independently verify responses. In addition to this, for technical purposes, the phrasing of the questions in the FOI request (which are given verbatim in Appendix 5) is different to the phrasing of the questions in the survey. The University of Cambridge refused to provide information under section 12(1) of the Act: "the cost of complying with the request would exceed the appropriate limit". This was the only case in which no response was provided either by survey or FOI.

- In Question 7, which measures the fraction of papers listed in PubMed that appear in PubMed Central, there are a number of slight differences in the types of literature that are included in PMC vs PubMed. Advance search functions are also slightly different. This means that the raw percentage values for 'percentage of university research output is freely available online' is not a precise value. These values are presented only to compare universities relative to each other.

Limitations in scope of assessment

- In the access section, we focus on areas where universities have a unique opportunity to influence access to health-related technologies and research. We make no attempt to assess aspects of 'access to medicines' such as rational use, supply chains, and sustainable funding in countries. We focus on what universities can do in terms of controlling how the health technologies they develop (such as medicines, vaccines, and diagnostics) are priced and distributed.
- In Question 5, which measures access provisions in exclusive licenses, we were not provided with the provisions themselves. These provisions can be various - with some provisions arguable more effective at promoting affordability in developing countries. We did not assess the type of provision.
- In scoring Question 6 there is no differentiation between scores given to stronger policies over weaker policies or related to the size of the Open Access fund.
- As part of this study we didn't utilise the Open Access subset of papers in PubMed central to measure Open Access output alongside free access output.

Overall Grading

Grades for each section (Innovation and Access) are determined by the total of a university's weighted scores for all questions in that subsection. For each subsection, a standard grading scale was developed that establishes the minimum number of aggregate weighted points required to receive a given grade. Overall grades are determined by a scale based on the sum of minimum weighted points needed in receive a given grade in all of the three subsections.

GENERAL LIMITATIONS

We appreciate that this methodology may not encompass a complete holistic overview of all global health research conducted at each institution. As with all ranking systems, our metrics will not capture all efforts made by each institution. However, we feel that restriction to the scope of our metrics is justified and necessary to ensure the rigour needed to enable us to validly compare across institutions.

It is also important to acknowledge that there are many other ways in which a university may impact on global health which this project was not able to assess, due to limited time and resources. To name a few:
- Global health research and education partnerships
- Global health education
- Dedicated centres / institutes
- Social justice work
- Scholarships and exchanges
- Institutional policies or investments with health impact e.g. tobacco, arms, fossil fuels
- Collaborations in which universities are contributing large amounts of resources to a project but are not the lead institution.

The above are issues which we hope to assess in future iterations of the project, and will require the development of additional metrics.

Appendix 1: Neglected Diseases search terms

Disease - common name:	Scientific name (organism):	Limit to Category (i.e. G-finder restrictions):	Suggested Search Terms:
HIV/AIDS	Human Immunodeficiency Virus Type-1 and Type-2	Vaccines + Diagnostics + Microbicides + Drugs (restricted to ONLY label extensions and reformulations for developing country use, e.g. paediatric or slow-release formulations; fixed dose combinations) + Basic Research (restricted to ONLY basic research related to preventive vaccines and microbicides)	"hiv AND paediatric" OR "HIV AND "fixed dose combination" OR "HIV AND "fixed-dose combination" OR "HIV AND fdc" OR "HIV AND microbicide" OR "HIV AND diagnostic" OR "HIV AND vaccine"
Malaria	(Plasmodium falciparum + Plasmodium vivax)	Basic Research + Drugs + Vaccines + Diagnostics + Vector Control	malaria OR plasmodium
Tuberculosis	(Mycobacterium tuberculosis)	Basic Research + Drugs + Vaccines + Diagnostics	tuberculosis OR TB OR "T.B." OR "mycobacterium tuberculosis" OR "M tuberculosis" OR "M. tuberculosis" OR "MTB" "
Helminthiases			
Roundworm	Ascariasis (Ascaris lumbricoides)	N/A	ascaris OR ascariasis OR "ascaris lumbricoides" OR" OR "a lumbricoides" OR "a. lumbricoid
Hookworm	(Ancylostoma duodenale + Necator americanus)	N/A	hookworm OR ancylostoma OR necator OR "Ancylostoma duodenale" OR "A duodenale" OR "A. duodenale" a" OR "Necator americanus" OR "N americanus" OR "N. americanus
Whipworm	Trichuriasis (Trichuris trichiura)	N/A	trichuris OR trichuriasis OR whipworm OR "Trichuris trichiura" OR "T trichiura" OR "T. trichiur"
Strongyloides	(Strongyloides stercoralis)	N/A	strongyloides OR strongyloidiasis
Elephantiasis	Lymphatic Filariasis (Wuchereria bancrofti + Brugia malayi + Brugia timori	N/A	elephantiasis OR "lymphatic filariasis" OR wuchereria OR brugia OR "wuchereria bancrofti" OR "w bancrofti" OR "w. bancrofti" OR "brugia malayi" OR "b malayi" OR "b. malayi" OR "brugia timori" OR "br timori" OR "b. timori"
River Blindness	Onchocerciasis (Onchocerca volvulus)	N/A	"river blindness" OR onchocerciasis OR onchocerca OR "onchocerca volvulus" OR "o volvulus" OR "o. volvulus" OR "robles disease" OR "robles"
Schistosomiasis (Bilharziasis)	(Schistosoma mansoni + Schistosoma haematobium +	N/A	schistosomiasis OR bilharzia OR bilharziasis OR schistosoma OR "cercariae" OR "Schistosoma

	Schistosoma japonicum + Schistosoma mekongi)		guineensis" OR "S guineensis" OR "S. guineensis" OR "Schistosoma intercalatum" OR "S intercalatum" OR "S. intercalatum" OR "Schistosoma mansoni" OR "S mansoni" OR "S. mansoni" OR "Schistosoma japonicum" OR "S japonicum" OR "S. japonicum" OR "Schistosoma mekongi" OR "S mekongi" OR "S. mekongi"
Tapeworm	(Taenia solium)	N/A	cysticercosis OR "taenia solium""taeniasis" OR "cysticercosis" OR "Taenia solium" OR "T solium" OR "Taenia saginata" OR "T. saginata" OR "Taenia asiatica" OR "T Asiatica" OR "T. asiatica" OR "beef tapeworm" OR "Asian tapeworm" OR "pork tapeworm" OR "tapeworm"
Echinococcosis	(*Echinococcus granulosus* + *E. multilocularis*)	N/A	"echinococcosis" OR "cystic echinococcosis" OR "polycystic echinococcosis" OR "hydatid disease" OR "echinococcus granulosus" OR "E granulosus" OR "echinococcus multilocularis" OR "E multilocularis" OR "E. multilocularis" OR "echinococcus" OR "echinococcal disease" OR "alveolar echinococcosis"
Foodborne Trematodes/ clonorchiasis/ opisthorchiasis/ fascioliasis/ paragonimiasis	*(Clonorchis* spp. + *Opisthorchis* spp. + *Fasciola* spp. + *Paragonimus* spp.)	N/A	"foodborne trematodiases" OR "trematodiases" OR "clonorchiasis" OR "chinese liver fluke disease" OR "chinese liver fluke" OR "clonorchis sinensis" OR "C sinensis" OR "C. sinensis" OR "fascioliasis" OR "Fasciola hepatica" OR "F hepatica" OR "F. hepatica" OR "Fasciola gigantica" OR "F gigantica" OR "F. gigantica" OR "Fasciola" OR "Opisthorchiasis" OR "Opisthorchis viverrini" OR "O viverrini" OR "O. viverrini" OR "Opisthorchis felineus" OR "O felineus" OR "O. felineus" OR "Paragonimiasis" OR "liver fluke" OR "lung fluke" OR "liver flukes" OR "lung flukes"
Dracunculiasis/ Guinea- Worm Disease	(Dracunculus medinensis)	N/A	"dracunculiasis" OR "guinea worm disease" OR "guinea-worm disease" OR "dracunculus medinensis" OR "d medinensis" OR "d. medinensis" OR "dracunculus"

Other Soil-transmitted Helminths		N/A	"soil transmitted helminthiases" OR "soil-transmitted helminths" OR "soil transmitted helminths"
Kinetoplastids			
Chagas' Disease	American trypanosomiasis (Trypanosoma cruzi)	N/A	chagas OR "american trypanosomiasis" OR "trypanosoma cruzi" OR "T. cruzi"OR "T cruzi"
African Sleeping Sickness	Human African Trypanosomiasis (Trypanosoma brucei)	N/A	"sleeping sickness" OR "african trypanosomiasis" OR "trypanosoma brucei" OR "T. brucei" OR "African lethargy" OR "Congo trypanosomiasis" OR "trypanosoma" OR "trypanosoma brucei rhodesiense" OR "trypanosoma brucei gambiense" OR "t b rhodesiense" OR "t b gambiense" OR "t.b. rhodesiense" OR "t.b. gambiense" OR "T brucei" OR "T. brucei"
Leishmaniasis (Kala-azar)	(Leishmania donovani)	N/A	leishmaniasis OR leishmania OR "kala-azar" OR "kala azar" OR "Phlebotominae" OR "Leishmania major" OR "L major" OR "L. major" OR "Leishmania infantum" OR "L infantum" OR "L. infantum" OR "Leishmania braziliensis" OR "L braziliensis" OR "L. braziliensis"
Diarrhoeal Diseases			
Viral Diarrhea	Rotavirus	Vaccines (restricted to ONLY developing country-specific R&D, including clinical trials, registration and Phase IV/pharmacovigilance studies in the target developing countries)	rotavirus AND vaccine
E. coli Diarrheal Disease	ETEC (Enterotoxigenic Escherichia coli) + EAggEC (Enteroaggregative Escherichia coli)	Vaccines + Diagnostics	ETEC OR "enterotoxigenic escherichia coli" OR EAggEC OR "enteroaggregative escherichia coli"
Cholera	(Vibrio cholerae)	Basic Research + Vaccines + Diagnostics + Drugs (restricted to ONLY drugs that target the pathogen, i.e. not supportive therapies)	cholera OR "vibrio cholerae" OR "V. cholerae" OR "V cholerae"
Shigellosis	(Shigella dysenteriae + Shigella flexneri + Shigella boydii + Shigella sonnei)	Basic Research + Vaccines + Diagnostics + Drugs (restricted to ONLY drugs that target the pathogen, i.e. not supportive therapies)	shigella OR shigellosis
Cryptosporidiosis	(Cryptosporidium parvum)	Basic Research + Drugs (restricted to ONLY drugs that target the pathogen, i.e. not supportive therapies) + Vaccines + Diagnostics	cryptosporidiosis OR cryptosporidium

Dengue (break-bone fever or hemorrhagic fever)	Dengue virus	N/A	dengue OR "Dengue Fever" OR "Dengue virus" OR "DENV" OR "DEN-1" OR "DEN-2" OR "DEN-3" OR "DEN-4"
Bacterial & Meningitis Infections			
Bacterial pneumonia	(Streptococcus pneumoniae)	Diagnostics + Vaccines (restricted to ONLY R&D on vaccines specifically for developing-country registration, i.e. must at a minimum: a) be designed for use in infants less than two years of age; and b) provide coverage against S. pneumoniae serotypes 1, 5, and 14)	"streptococcus pneumoniae" OR pneumonia
Bacterial meningitis	(Streptococcus pneumoniae + Neisseria meningitidis)	Diagnostics + Vaccines (restricted to ONLY R&D specifically for developing-country registration, i.e. must, at a minimum: a) provide coverage against N. meningitidis serotype A; b) be a conjugate vaccine; c) be designed for use in infants less than two years of age; and d) be designed to cost less than a dollar per dose)	meningitis AND"streptococcus pneumoniae" OR meningitis AND "neisseria meningitidis"
Salmonella Infections / Typhoid	NTS (Non-typhoidal salmonellosis, Salmonella enterica) + (Salmonella typhi) + (Salmonella paratyphi)	Basic Research + Drugs + Vaccines + Diagnostics	salmonella OR typhoid OR "s. paratyphi" OR "s. typhi" OR "s paratyphi" OR "s typhi" OR "typhoid fever" OR "salmonella typhi" OR "salmonella paratyphi" OR "Non-typhoidal Salmonellosis" OR "S. enterica" OR "Salmonella enterica"
Leprosy	(Mycobacterium leprae)	Basic Research + Drugs + Diagnostics	leprosy OR "mycobacterium leprae" OR "hansen's disease" OR "hansen s disease" OR "m leprae" OR "m. leprae" OR "mycobacterium lipomatosis" OR "m lipomatosis" OR "m. lipomatosis" OR "leprae"
Buruli Ulcer	(Mycobacterium ulcerans)	N/A	buruli OR "mycobacterium ulcerans"OR "Buruli ulcer" OR "M ulcerans" OR "M. ulcerans"
Trachoma	(Chlamydia trachomatis subtypes	Vaccines + Diagnostics	trachoma OR chlamydia OR "chlamydia trachomatis" OR "c trachomatis" OR "C. trachomatis" OR "trachomatis" OR "chlamydia AND blindness" OR "chlamydia AND keratoconjunctivitis"
Rheumatic Fever	(Streptococcus pyogenes)	Vaccines	"rheumatic fever" AND vaccine OR "rheumatic heart" AND vaccine

Yaws/ Endemic Syphilis/ Pinta	Yaws (*Treponema pallidum* subsp. *Pertenue*), Endemic syphilis (*T. pallidum* subs. *Endemicum*) and Pinta (*T carateum*)	N/A	"Yaws" OR "Treponema" OR "Endemic Treponematoses" OR "Treponematoses" OR "framboesia" OR "pian" OR "Treponema pallidum" OR "T pallidum" OR "T. pallidum" OR "Pertenue" OR "endemic syphilis" OR "bejel" OR "Endemicum" OR "Pinta" OR "Treponema carateum" OR "T carateum" OR "T. carateum"

Appendix 2: Health in Low-Income and Lower-Middle-Income countries search term

"global health" OR "global public health" OR "world health" OR "World Health Organization" OR "the WHO" OR "global governance" OR" health policy" OR "health system" OR "public health politics" OR "global health institute" OR "International medicine" OR "Population Health" OR "developing world" OR "developing country" OR "LMIC" OR "lower middle income country" OR "lower income countries" OR "lower income country" OR "middle income countries" OR "middle income country" OR "developing countries" OR "Global population" OR "Transnational" OR "West Africa" OR "SE Asia" OR "Southeast Asia" OR "Sub-Saharan Africa" OR "Latin America" OR "Afghanistan" OR "Gambia" OR "Myanmar" OR "Bangladesh" OR "Guinea" OR "Nepal" OR "Benin" OR "Bisau" OR "Niger" OR "Burkina Faso" OR "Haiti" OR "Rwanda" OR "Burundi" OR "Kenya" OR "Sierra Leone" OR "Cambodia" OR "Korea" OR "Somalia" OR "Central African Republic" OR "Kyrgyz Republic" OR "South Sudan" OR "Chad" OR "Liberia" OR "Tajikistan" OR "Comoros" OR "Madagascar" OR "Tanzania" OR "Congo" OR "DRC" OR "Malawi" OR "Togo" OR "Eritrea" OR "Mali" OR "Uganda" OR "Ethiopia" OR "Mozambique" OR "Zimbabwe" OR "Armenia" OR "India" OR "Samoa" OR "Bhutan" OR "Kiribati" OR "São Tomé and Principe" OR "Bolivia" OR "Kosovo" OR "Senegal" OR "Cameroon" OR "Lao PDR" OR "Solomon Islands" OR "Cabo Verde" OR "Lesotho" OR "Sri Lanka" OR "Congo " OR "Mauritania" OR "Sudan" OR "Côte d'Ivoire" OR "Micronesia" OR "Swaziland" OR "Djibouti" OR "Moldova" OR "Syria" OR "Egypt" OR "Mongolia" OR "Timor-Leste" OR "El Salvador" OR "Morocco" OR "Ukraine" OR "Georgia" OR "Nicaragua" OR "Uzbekistan" OR "Ghana" OR "Nigeria " OR "Vanuatu" OR "Guatemala" OR "Pakistan" OR "Vietnam" OR "Guyana" OR "Papua New Guinea" OR "Gaza" OR "Honduras" OR "Paraguay" OR "Yemen" OR "Indonesia" OR "Philippines" OR "Zambia"

Appendix 3: Global Health Categories

1. Research on "disease-related" prevention and treatment
1a.Basic research funded by public and private for-profit and not-for-profit sectors
1b. Other research carried out by pharmaceutical companies for development of products, etc.

2. Research on other "disease-related" prevention, treatment and care
2a. Health-care policies, programmes, systems and services
2b.Training of health-care workers
2c. Health-care human resources
2d. Scale-up of interventions
2e. Disease monitoring and surveillance
2f. Disease prevention and treatment:
2g. Exposures, risk factors for and determinants of ill-health and disease
2h. Specific diseases or conditions (biomedical and clinical research on type I, II & III diseases)
2i. Disease outcomes and impacts

3. Research on "health"
3a. Health planning
3b. Public health:

- The assessment and monitoring of the health of communities and populations at risk to identify health problems and priorities.
- The formulation of public policies designed to solve identified local and national health problems and priorities.
- To assure that all populations have access to appropriate and cost-effective care, including health promotion and disease prevention services.

3c. Safety, quality, availability, affordability, accessibility, inclusion of:
 Water, food, housing, sanitation or Natural environments [built or social]
3d. Health promotion
3e. Health education: Health knowledge, attitudes and practices
3f. Health research systems
3g. Health classifications systems, measures and indicators
3h. Health status: physical, mental, social, and spiritual well-being
3i. Health equity and social equality
3j. Social determinants of "health" including human rights, inclusion, participation and equality
3k. Safety, quality, accessibility, affordability, inclusiveness, efficiency, effectiveness,
impact on health of health policies, programmes, systems and services