Geography of Genetics and Genomics Research Funding in Africa

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ABSTRACT

An estimated U.S. $300 billion is spent each year on medical research. What proportion of this goes to genomics and genetics research in Africa? Until recently, this type of question was nearly impossible to answer. The World RePORT database, sponsored by the Heads of International Research Organizations (HIRO) and managed by the National Institutes of Health (NIH), provides a first attempt at answering questions on the distribution of research funding by geography and research organization. In this journal issue on the Human Heredity and Health in Africa (H3Africa), we explore the geography of biomedical research funding in the genomics field with special emphasis on Africa. Using World RePORT, we identified 185 research projects in genetics and genomics in Africa in 2015 with total funding exceeding U.S. $216 million. These numbers are likely incomplete and more efforts at collating data from funder organizations is needed. A comprehensive snapshot of funders' portfolios will be invaluable to research investigators and policy makers in the identification of research gaps and analysis of allocation priorities to facilitate evidence-based decision-making for public—research-funding organizations.

Global funding of health research is estimated at nearly U.S. $300 billion annually [1]. The impact of this research has been widely touted as essential for public health gains such as decreasing disease incidence and prevalence; increasing longevity and quality of life; spurring technological innovation; and serving as an engine for economic development [2]. For genetics and genomics research, the excitement around opportunities and prospects for gaining foundational understanding of health and disease has been described as unprecedented [3,4]. For example, the greater genetic diversity in African populations compared to other continental groups holds promise for the identification of rare genetic variations that may have diagnostic and therapeutic implications. In sub-Saharan Africa, these prospects have gained significant momentum over the last decade, beginning with the substantial investments made by the National Institutes of Health (NIH) and the Wellcome Trust in the funding for the landmark Human Heredity and Health in Africa (H3Africa) study [5-8].

Despite the remarkable progress made in genetics and human genome research, the magnitude, extent, and spectrum of genetics and genomics research in Africa and the rest of the world remain incompletely understood. For example, how much funding is there for genetics and genomics research worldwide? What types of genetics and genomics research studies are being funded in Africa? Until recently, these questions had been difficult to answer. No single source provides a snapshot of all active research across all organizations. A nascent effort as an open-access, interactive mapping database project highlighting biomedical research investments and partnerships from some of the world's largest funding organizations is now available at the World RePORT website (https://worldreport.nih.gov) managed by the NIH. This database includes data from the institutions that are part of the Heads of International Research Organizations group. In this article, we use World RePORT to explore the distribution of direct funding of genetics and genomics research in Africa by country and research organization.

METHODS

To demonstrate the feasibility and ease of use of World RePORT, we performed a simple data query using keywords, geographic location, and fiscal year of funding. The keywords selected were 'genetic' or 'genetics' or 'genomic' or 'genomics.' The geographic location used was 'Africa.' Because the beta version of World RePORT available only has complete data from fiscal year 2015, only projects funded in that year were included. The search query therefore retrieved all research projects supported by funding organizations in the database, at research organizations in Africa, in fiscal year 2015 that had at least 1 keyword in the project title or abstract. Logical search strings such as "OR" cannot be used currently in World RePORT, so keyword searches were done independently and then combined in Excel. Duplicates (projects found in both searches) were removed. Descriptive data are presented by country without any subnational analyses.

To ensure relevance of projects to genetics and genomics research, the initial results were manually reviewed and coded. There were 15 projects removed as false

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positives or only tangentially related to the subject. The precision of the combined searches is therefore 92.5%.

RESULTS

The keyword query retrieved 185 unique projects with a total funding of U.S. $216 million. Figure 1 shows the number of research organizations in each labeled country that received funding for genetics or genomics research in fiscal year 2015. Figure 2 shows the funding by major organization. NIH was the largest single funder at U.S. $110 million or 51% of all identified direct funding across 134 projects. NIH funding represented 74% of all funding in World RePORT in 2015. Wellcome Trust provided a total of U.S. $65 million in direct funding across 36 projects.

A key feature of World RePORT is how it tracks research collaborations. Many international research projects are supported through funds awarded to a single organization that then distributes part of the funds to the collaborators. For example, the project entitled "Young Africans' Changing Understanding of HIV/AIDS Risk" was funded by the NIH through an award to Emory University.

FIGURE 1. Map output from World RePORT showing the number of research organizations in each labeled country that received funding for genetics or genomics research in fiscal year 2015. A complete list of research organizations by country is provided in the appendix.

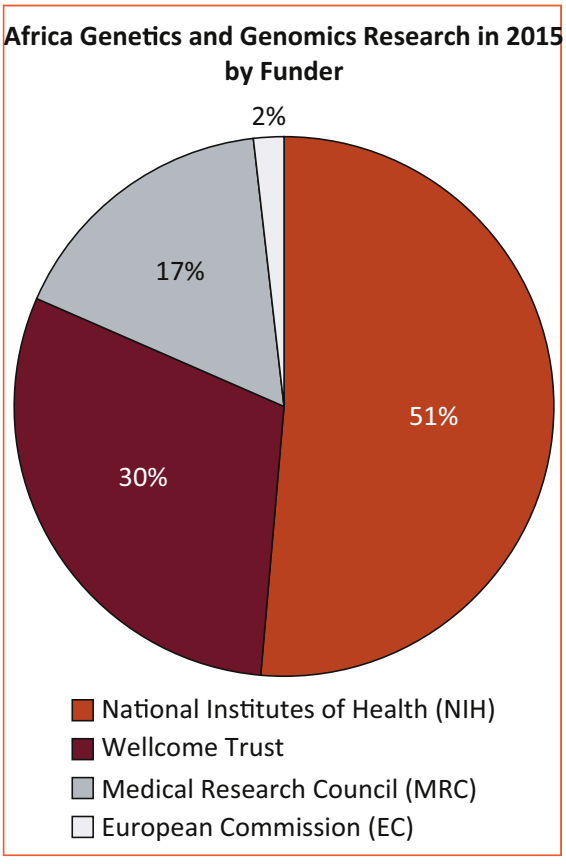

FIGURE 2. The proportion of funding for genetics and genomics research in Africa contributed by major research funders. Two research projects from the Swedish Research Council (SRC) and 2 from the Swedish International Development Cooperation Agency (SIDA) had missing budget data and were excluded from the funder analysis.

To manage the project, Emory University collaborated with organizations in Nigeria and Swaziland. In World RePORT, users can find the direct award to the primary award recipient or the collaborating entities. For purposes of this analysis, each collaborating entity is counted as 1 collaboration. Table 1 shows the number of such collaborations by funder organization. NIH had the most collaborations with 237 research organizations working on funded projects, and Wellcome Trust had 47 such research organizations. There were 134 research organizations in 28 African countries that had collaborations. The top 10 countries with the most number of collaborations are shown in Table 2, and Table 3 shows the top 10 research organizations with the most collaborations.

DISCUSSION

World RePORT is an open-access interactive mapping database of biomedical research projects, research

TABLE 1. The number of collaborations in genetics and genomics research in Africa by funder

Major Research Funder	Number of Collaborations
National Institutes of Health (NIH)	237
Wellcome Trust	47
Medical Research Council (MRC)	25
European Commission (EC)	6
Swedish Research Council (SRC)	5
Swedish International Development Cooperation Agency (SIDA)	1
Total	321

TABLE 3. Top 10 research institutes and universities with the most research collaborations

Research Organization	Collaborations
University of Cape Town	44
Makerere University	16
Medical Research Council Unit, the Gambia	10
Institute of Human Virology Nigeria	9
Stellenbosch University Tygerberg Campus	7
University of Yaounde	7
University of Kwazulu Natal	6
University of Bamako	6
Kenya Medical Research Institute (Kemri), Nairobi	6
University of Ibadan	5

institutions and their collaborators, and funding organizations and agencies that include some of the world's largest sources of biomedical research funding [9]. As a joint effort of members of Heads of International Research Organizations, it is designed to facilitate knowledge sharing and coordination in biomedical research. The project is led by the NIH and has more than 75,000 projects from its 16 public and private funding organizations, including the NIH, the Bill and Melinda Gates Foundation, Wellcome Trust, and the Medical Research Council [9]. Although it started in 2013 with an initial focus on research performed in sub-Saharan Africa using data supplied by member organizations, World RePORT has expanded its scope to include a global view of directly funded research grants data contributed by member organizations.

In this article, we have used World RePORT's simple data query to describe the geographic distribution of funding and research collaborations for genetic and genomic research in Africa. These findings can help identify research gaps and inform priority setting, especially for the creation of new research initiatives in alignment with the priorities of funding organizations as well as recipient institutions and countries. The availability of these data makes it relatively easier to identify underserved communities and/or scientific areas. Additionally, the ready availability of these data can help reduce or eliminate redundant or duplicative research studies. Knowing what questions are being examined in which areas could increase the spectrum and diversity of biomedical research themes. Importantly, these data may also facilitate an easier identification of potential local, national, and international research collaborations and strategic partnerships within and beyond Africa. Local expertise, especially in low-resource areas, is key to successful execution of research projects, yet it can be daunting to identify. Finally, the availability of World RePORT and similar resources and tools can facilitate objective monitoring and outcomes-based evaluations of biomedical research funding.

TABLE 2. Top 10 countries with the most research collaborations

Country	Number of Collaborations
South Africa	81
Kenya	31
Nigeria	29
Uganda	29
Mali	17
Cameroon	16
Ghana	13
Ethiopia	12
Tanzania	11
Gambia	10

Limitations

There are several limitations of this analysis. First, the data on World RePORT are incomplete. Some projects are missing abstract and funding data. Moreover, some organizations had not completed entry of their 2015 data at the time of this data analysis. Second, the search query was simple and thus the results may have had false negatives; however, this simplicity precluded nuanced data retrieval. For example, it is likely that relevant research projects were missed because they did not explicitly include the keyword of interest in the abstract or title. The manual coding ensured there were no false positives. Active use of World RePORT by research investigators and their identification of these and other limitations inherent in the beta version of the resource can help significantly improve its capabilities and accuracy in future versions.

CONCLUSIONS

The available data in World RePORT show that approximately U.S. $216 million was spent on 185 biomedical research projects in genetics and genomics in 28 African countries in 2015 by the major global funding organizations. Although this analysis was performed specifically for genetics and genomics research projects in Africa, there is general applicability of the analysis. As funding organizations increase the trend of aggregating project data into a

single database such as World RePORT, coordination of biomedical research efforts and secondary data analyses such as this will be improved. Importantly, World RePORT can help identify research gaps and inform priority setting in alignment with the mission and vision of funding organizations as well as recipient institutions and countries. The availability and improved analytic capabilities of resources such as the World RePORT can also facilitate objective monitoring and outcomes-based evaluations of biomedical research funding.

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