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Global teaching and training initiatives for emerging cohort studies

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Abstract A striking disparity exists across the globe, with essentially no large-scale longitudinal studies ongoing in regions that will be significantly affected by the oncoming non-communicable disease epidemic. The successful implementation of cohort studies in most low-resource research environments presents unique challenges that may be aided by coordinated training programs. Leaders of emerging cohort studies attending the First World Cohort Integration Workshop were surveyed about training priorities, unmet needs and potential cross-cohort solutions to these barriers through an electronic pre-workshop questionnaire and focus groups. Cohort studies representing India, Mexico, Nigeria, South Africa, Sweden, Tanzania and Uganda described similar training needs, including on-the-job training, data analysis software instruction, and database and bio-bank management. A lack of funding and protected time for training activities were commonly identified constraints. Proposed solutions include a collaborative cross-cohort teaching platform with web-based content and interactive teaching methods for a range of research personnel. An international network for research mentorship and idea exchange, and modifying the graduate thesis structure were also identified as key initiatives. Cross-cohort integrated educational initiatives will efficiently meet shared needs, catalyze the development of emerging cohorts, speed closure of the global disparity

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in cohort research, and may fortify scientific capacity development in low-resource settings.

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1. Introduction

Prospective cohort research is of fundamental importance in defining public health priorities and interventions. Its essential approach, defined by the study of complex diseases and risk factors simultaneously over an individual's lifetime, has proved crucial to the understanding of the etiology, natural history, and outcome of non-communicable diseases and has informed the design of prevention programs.

Recently, an urgent need to initiate prospective cohort studies in new populations has been identified [1,2]. In many low- and middle-income settings there is a current and rising epidemic of non-communicable diseases – including cardiovascular disease, cancer and metabolic diseases, such as diabetes and obesity – that is projected to increase dramatically in the coming years [3,4]. A striking disparity exists across the globe, with essentially no large-scale longitudinal studies ongoing in regions that will be significantly affected by the oncoming non-communicable disease epidemic [1]. The epidemiologic transition, driven by rapid economic development, in low- and middle-income countries is creating a unique mixture of risk factors and diseases, which scientists have not had the tools or opportunity to study ever before (Table 1). Additionally, human genomic studies

have an advanced understanding of disease etiology and catalyzed novel treatment strategies, but have rarely been implemented in large studies in low-income countries, which have diverse genetic groups [5,6].

These global disparities in cohort research can be resolved only if teaching and training initiatives are developed in parallel to meet the need for scientific expertise. Cohort studies in the most low-resource research environments present unique challenges, and their successful implementation will require significant teaching and training. The leaders of emerging cohort studies representing India, Mexico, Nigeria, South Africa, Sweden, Tanzania and Uganda who were attending the First World Cohort Integration Workshop about training priorities, unmet needs and potential cross-cohort solutions to these barriers through an electronic pre-workshop questionnaire and workshop focus groups were surveyed.

2. Methods

2.1. Cohort teaching and training needs assessment survey

In October 2010, 42 researchers from around the world gathered for the first World Cohort Integration Workshop to discuss training priorities and to

Table 1 Unique opportunities for cohort research in low- and middle-income countries.

Area	Opportunities for research
Epidemiologic transition	<ul style="list-style-type: none"> • Many low- and middle-income countries currently have a dual burden of both infectious and chronic conditions as they move through the epidemiologic transition, providing a unique opportunity to study infectious and chronic disease interactions • Rapid economic development results in contrasting lifestyles; for example, overweight and obesity occur alongside underweight and stunting, allowing the study of both in one environment
Risk factors	<ul style="list-style-type: none"> • Unique patterns of incidence and prevalence of chronic diseases such as hypertension, stroke, and cancer exist • Differing lifestyle, environmental, dietary and infectious risk factors have never been studied before • A better understanding of the exposure prevalence of these causal factors is needed
Genetic diversity	<ul style="list-style-type: none"> • Genetic susceptibility to infectious and chronic conditions varies considerably across population and ethnic groups. Scientific findings that are applicable to diverse populations are needed • Unparalleled opportunity to examine gene–gene and gene–environment interactions
Nested interventions	<ul style="list-style-type: none"> • Nested randomized interventions that are context-specific are needed • Multi-country intervention studies could provide insights relevant to high-income countries
Stimulate political will	<ul style="list-style-type: none"> • Demonstrating the prevalence of known risk factors such as smoking and alcohol use and the diseases they cause among low- and middle-income countries' populations could stimulate political will to tackle them aggressively • Long-term studies afford training opportunities to attenuate or reverse brain drain

identify possible cross-cohort collaborative educational initiatives. Cohort leaders represented Mexico (EsMaestra, Mexican Teachers' Cohort), India (Barshi Cohort), Sweden (LifeGene Sweden), Iceland (SAGA Cohort), and the United States, Nigeria, Tanzania, Uganda, and South Africa (Africa/Harvard School of Public Health Partnership for Cohort research and Training). The objective was to exchange ideas, foster collaborations, harmonize study design features to facilitate long-term pooling projects, and develop professional networks among scientists and managers of emerging cohort studies. The ultimate goal of establishing an early foundation for harmonized procedures, shared training programs, and sustained communication is to facilitate long-term exchanges of data, ideas and resources.

A brief pre-workshop online questionnaire was developed to query all conferees on the types of training currently offered and needed, the obstacles to participation in training programs, and to prioritize areas for collaborative training. During the workshop, a focus group of leaders of teaching and training initiatives convened to discuss training priorities, unmet needs and potential cross-cohort solutions to these barriers. The proceedings of this focus group and its recommendations were summarized in the narrative form.

2.2. Survey of numbers of students trained in cohort research programs

The principal investigators of 43 established chronic disease cohorts (National Cancer Institute Cohort Consortium, the Framingham Heart Study, and the Physician's Health Study) were contacted by e-mail and asked to estimate the number of pre-doctoral and post-doctoral students who had received training by participating in cohort-specific research.

3. Results

3.1. Survey results

Among the participants of the World Cohort Integration Workshop, on-the-job training was the most common instructional approach used in all four cohorts. Instruction in data analysis software, and database and biologic bank management was a top priority for all cohorts (Table 2a) along with training in scientific disciplines and in skills development, such as scientific writing. Three quarters of respondents reported that their research groups were constrained by a lack of funding and protected time for training activities (Table 2b), though all had training infrastructure and technology available at their institutions. Two key needs were short

courses in critical subject areas and an international network for research mentorship, problem-solving, and idea exchange (Table 2c).

Investigators representing 16 of the 43 established chronic disease cohorts contacted responded to an e-mail inquiry about the number of students who had received training using the cohort research program (Table 3). While long established cohorts have trained large numbers of students and fellows, it is noteworthy that even cohorts only recently enrolling participants support the training of substantial numbers of public health researchers.

3.2. Designing cross-cohort solutions to unmet training needs: focus group results

A subgroup of eight investigators with leadership roles in the teaching and training initiatives of emerging global cohorts assembled in a focus group at the World Cohort Integration Workshop to design cross-cohort solutions to barriers in training infrastructure. The following three recommendations were prioritized to promote efficient training environments that are integrated across cohorts and are sensitive to the constraints of low-resource environments: (1) integrated training initiatives shared across cohorts; (2) application of novel teaching methods; and (3) reform of the graduate thesis structure.

3.2.1. Integrated training initiatives

Given the similar training challenges and needs across all cohorts in low-, middle- and high-resource settings, and at all levels of staff, the focus group decided to launch three pioneering initiatives. The first was to establish an online portal for sharing operating manuals, protocols, and best practices in areas such as questionnaire development, recruitment, retention, database management, and the handling of biologic specimens. The second initiative aimed to establish a peer network across cohorts for technical assistance and problem-solving in specific domain areas, including cell phone technology use and data management. Both these initiatives have been established through an interactive web-based platform, which hosts materials and discussion boards. The third initiative was to establish a global cohort teaching initiative prioritizing short courses, including web-based content and interactive teaching methods, such as the Case Method, for a range of research personnel.

3.2.2. Novel teaching methods and technologies

Novel teaching methods and technologies will be required to ensure the sustainability of educational

Table 2 Training requirements by: (a) topic; (b) constraints; and (c) strategies reported by leaders of cohort studies in India, Mexico, Nigeria, South Africa, Sweden, Tanzania and Uganda.

	Number (%) N = 19
<i>(a) Topic</i>	
Scientific disciplines	
Epidemiology	8 (44)
Biostatistics	9 (50)
Nutrition	9 (50)
Genetics	11 (61)
Environmental health	5 (28)
Health behavior	9 (50)
Bioinformatics	11 (61)
Cohort management	
Study design	11 (61)
Recruitment and retention	11 (61)
Database management	13 (72)
Biologic bank management	15 (83)
Data Analysis Software (SAS, STATA, SPSS)	13 (72)
Skills	
Scientific writing	10 (56)
Strategies for Independent Research Development	10 (56)
Teamwork & Interpersonal Relationship development	10 (56)
Communication & Public Relations	11 (61)
<i>(b) Constraint</i>	
Lack of funding for training, tuition or travel	14 (77)
Lack of protected time to attend/organized training	13 (72)
Lack of instructors with expertise	12 (67)
Inadequate internet for distance learning	10 (56)
Inadequate computers/software	9 (50)
Inadequate textbooks or journal	7 (39)
Staff speak different language than training program	3 (17)
Other	3 (17)
<i>(c) Training strategy</i>	
Degree programs (Doctoral, Masters, Certificate)	13 (68)
Short courses	17 (90)
One-day workshops	8 (42)
Exchange programs with other institutions	16 (84)
International network for research mentorship & idea exchange	18 (95)
Advice as needed	12 (63)
Web conferencing	10 (53)

programs in low-resource settings, and cross-cohort integrated programs that bridge cultural, linguistic, or geographic divides. Engaging adult learners effectively will take advantage of their accumulated knowledge and work experience in order to enrich their learning experience through active and experiential approaches [7].

The Case Method is a pedagogical approach pioneered in the early 20th century that has been widely used in schools of business and economics to create an experiential learning environment based on real-world, multifaceted problems [8]. More recently, health professional schools have

adopted the Case Method [9–15], which differ from a traditional classroom in that the student assumes an active role in the learning process. The Case Method confronts the participant with a summarized actual problem halted at a point where decisions must be made, forcing the student to choose a course of action. Participants proceed through a multi-step process in which they first study each case independently, then meet in discussion groups to test their individual analyses against those of their peers, returning to convene with the entire class where the faculty member serves as a catalyst and facilitator of the discussion.

Table 3 Number and type of trainees reported by established cohort studies as of December 2010.

Cohort study	Year cohort enrollment began	Study population location	Description of trainees	Total number trained
Framingham heart study	1948	USA	Research fellows and statisticians	75–100
Harvard cohorts (Nurses' health study I & II, health professionals follow-up study)	1976, 1989	USA	100 Pre-doctoral, hundreds of Master's and post-doctoral	>300
NYU women's health study	1985	USA	7 Pre-doctoral, 2 post-doctoral	9
Multi-Ethnic Cohort Study of Diet and Cancer (MEC)	1993	USA	Master's, pre-doctoral, post-doctoral, and medical students/residents	>50
Agricultural health study	1993	USA	11 Master's, 10 pre-doctoral, 2 medical residency/fellowship, 18 post-doctoral	41
Black Women's Health Study (BWHS)	1995	USA	14 Pre-doctoral	14
Shanghai Women's Health Study (SWHS)	1996	China	Students and research fellows	>20
Cohort of Swedish men	1997	Sweden	2 Master's, 9 pre-doctoral, 4 post-doctoral	15
Vitamins and Lifestyle (VITAL) Study	2000	USA	2 Master's, four pre-doctoral, 12 post-doctoral	18
Shanghai Men's Health Study (SMHS)	2001	China	8 Post-doctoral	8
Millennium cohort	2001	USA	10 Master's, 3 pre-doctoral	13
Breakthrough generations study	2003	UK	1 pre-doctoral	1
Sister study	2003	USA	2 Pre-doctoral, 7 post-doctoral (laboratory and clinical), 2 research fellows	11
Golestan Cohort Study (GCS)	2004	Iran	14 Master's, 25 pre-doctoral, 13 post-doctoral, 30 post-medical degree fellowship	82
California Teachers Study (CTS)	2005	USA	8 Master's, 14 pre-doctoral, 12 post-doctoral	34

The Case Method offers an ideal format for programs to train cohort study staff in an array of subjects. A critical aspect of this method is the exchange of insights and experience among participants and faculty, ideally suited to draw upon the diverse knowledge and skills of a cohort study team. As such, Case Method approaches underscore the importance of teamwork and collaboration. Cultivating collaborative skills will be critical to the success of emerging cohorts that rely on the integration and cultivation of diverse scientific, administrative and political competencies. In addition, the Case Method challenges students to approach large-scale problems that require multidisciplinary solutions. The development of successful cohort studies—especially in low-resource environments—requires

not only scientific expertise, but also political, managerial, financial and social acumen. One priority is the development of a library of open-source global cases that tackle challenging topics in the development of cohort studies, such as participant tracing, bio-banking in low-resource environments, and validation of questionnaire data among participants with limited health and general literacy. Brief interviews with leading cohort researchers on focused topics could be developed into cases. Such a case library could serve as an invaluable instructional device for future generations of cohort leaders and staff across institutions.

Pairing modern educational methods with technological advances will begin to break down the barriers that have limited the opportunities for

students in low-resource settings and will facilitate integrated training programs across global cohorts. Collaboration through the construction of “communities of practice” is one exciting paradigm. A community of practice is defined as a group of people who share an interest, such as the application of cell phone technologies for data collection, and can exist in real life or online. By sharing information and experiences, group members learn from each other and assist in real-time problem-solving [16]. Furthermore, this model allows learning materials to evolve in response to changing interests and needs, and to be developed into a searchable reference.

Supercourse, a repository of thousands of lectures on global health produced at the WHO Collaborating Center University of Pittsburgh, provides a model for teaching that is becoming increasingly useful around the world [17]. By sharing lectures from prominent researchers in the field, Supercourse seeks to eliminate geographic and economic barriers in the learning process. Currently available, Supercourse lectures relevant to emerging cohorts of NCDs include methodological content, such as cohort study design, epidemiologic transitions, cancer and cardiovascular epidemiologic methods, mixed models for longitudinal data as well as administrative and logistical topics including construction of virtual science libraries, approaches to global information sharing and capacity development of professional public health teams. Emerging cohorts across the world could also contribute shared lectures to this model as they accumulate expertise in cohort development. In addition to Supercourse, Harvard University and the Massachusetts Institute of Technology (MIT) recently announced EdX (<http://www.edxonline.org>), a joint partnership between the two institutions to offer online classes to build a global community of online learners and to improve education for everyone.

Building sustainable statistical expertise necessary for the analysis of longitudinal data will be necessary to support emerging cohort studies. For example, proficiency in advanced statistical topics including survival analysis, handling repeated measures of exposures, approaches to missing data and loss-to-follow-up will be essential for the valid analysis of complicated longitudinal datasets that potentially include multiple recruitment sites. Short courses which include hands-on laboratory work with the analysis of actual longitudinal cohort data, such as training sets from established cohorts that investigate NCDs, would provide a strong added advantage. Such courses would ideally be team-taught by statisticians along with epidemiologists and data management experts in order to

foster integration of concepts from each discipline. Sustainable access to necessary software and computer processing equipment is a key hurdle in many low-middle income countries. The rapid expansion of R, a free software environment for statistical computing and graphics, and the donation of free or reduced-cost licenses for other programming packages from for-profit software providers could bridge this critical gap.

Communication technology can also be used to foster more active and experiential learning. By effectively utilizing state-of-the-art communications platforms, students and teachers will be able to interact in real-time across the globe. Short courses were identified as one of the most useful training strategies (Table 2c). Applying distance education technology for the administration of short courses could increase their efficiency owing to reduced travel costs and increased conveniences. In addition to videoconferencing technology, more basic, inexpensive internet-based communication platforms such as Skype and Webex would be useful to promote peer-to-peer networks and mentoring relationships on a global scale. Many of these new technologies carry limitations, including cost and high-bandwidth Internet access. In many places, however, these barriers are becoming less of an issue.

In addition to distance technologies, leaders of emerging cohorts of NCDs would benefit from externship opportunities with established cohort studies, such as the Framingham Heart Study and the Nurses’ Health Study, which have been running for decades. Investigators would have an opportunity to attend cohort-staff meetings, such as protocol and manuscript review panels, and meet with all tiers of study staff, including statistical programmers, recruitment and retention staff, and laboratory personnel, in order to collect feedback on their infrastructure. Externs could be encouraged to share their new knowledge with colleagues and partners by writing a report summarizing their externship experiences.

3.2.3. Call for reform of graduate thesis structure

Currently, in many low- and middle-income nations, master’s and doctoral degree requirements include submission of a thesis. While specific formats vary across universities, the thesis is often voluminous, with some universities expecting 300 pages or 100,000 words in length [18]. Until recently, many if not most universities have simply mandated the deposition of a hardbound copy of every thesis in the library, left copyright with the author, and have thereafter presided over stacks

of under-used volumes [19]. In Croatia, master's and doctoral theses are not made available to the scientific community, while in India only 30% of post-graduate theses ever get published [20,21]. These requirements are starkly incongruous with current requirements for peer-reviewed publications and present a further obstacle for dissemination of student research findings. When medical schools structure doctoral thesis requirements around peer-review publications, students have enjoyed a significantly higher profile in key authorship positions [22]. The professional advancement and international recognition of investigators leading emerging cohorts will be critical to ensure the sustainability of emerging cohort studies. It is therefore proposed that a transformation of the current thesis requirements be initiated and preparations be put in place to begin a more publication-ready format, to facilitate international dissemination of early cohort results and fortify the professional development of cohort staff and graduate students.

4. Discussion

Despite differences in available resources and cultural contexts across cohort studies represented, similar training needs were described, including on-the-job training, data analysis software instruction, and database and bio-bank management, as well as commonly identified constraints. These needs were described as applicable to all tiers of study staff, from senior scientists to consultants, core administrative staff, and public health practitioners. Proposed solutions were designed to be integrated across cohorts in order to maximize resources. Priority recommendations include developing a collaborative cross-cohort teaching platform with web-based content, an international network for research mentorship and idea exchange, as well as modifying the graduate thesis structure.

Globally coordinated training initiatives may impact science and society to counteract the oncoming chronic disease epidemic in much of the world. A prerequisite of this goal is the training of a cadre of public health researchers to reduce the global disparity in health education and research [23]. This cadre must cover a broad and growing range of competencies not limited to the traditional domains of epidemiology and biostatistics. They must also master organization of field-work in challenging settings, the development and management of biologic banks, and the use of cell phones and other novel technologies for tracking, retention, and monitoring of participants in large epidemiologic

studies. Understanding the role of the genome and its interaction with lifestyle and environment adds another layer of complexity. In order to achieve the ultimate goal of disease prevention, translation of knowledge to action, legislation, and public health policy requires prioritization and professionalism. The implementation of training programs can also be a key marker of short-term success, building confidence in the research endeavor among scientists, existing and potential funders, and study participants. Finally, cohort teaching initiatives are critical for scientific and societal capacity-building, with the potential to train generations of public health researchers, providing employment opportunities and generating knowledge that contributes to improvements in local, national and international human health.

The World Cohort Integration Workshop was driven by two goals. First, large prospective cohort studies intended to continue for decades offer an unsurpassable and sustainable infrastructure for providing scientific evidence for priority setting, and a training ground for generations of global public health workers. Indeed, existing large cohorts have become more informative and prolific as time goes by, with the unique ability to accommodate emerging hypotheses. In contrast, while case-control studies may require fewer resources to implement, they are transient, address only one phenotype per study, and may be hampered by low validity. Second, the waste of resources would be enormous if the same wheels are invented repeatedly around the globe when new large cohort studies are planned and implemented. Instead, an integrated effort would take advantage of a broader knowledge base and will likely result in better-designed and more efficient solutions. This advantage pertains but is not limited to organization of field-work, approaches for recruitment and retention, questionnaire development and validation, designing IT-infrastructure and biologic banks, use of diagnostic algorithms and uniform anthologies, as well as optimization of cell phone use in different phases of a longitudinal study.

It is not surprising to scientists and healthcare workers that a new multi-polar world requires a new multi-polar approach to knowledge if global public health is to be improved. Pivotal for such a transformation to take place is the possibility of securing funding for cross-global teaching and training programs. Regrettably, funding mechanisms are still lagging behind, not only in the actual funding available, but also in much of the design or the scope laid down by funding bodies. For instance, one limiting factor is often various geographic constraints that hamper the fostering of

collaborations across continents. This presents a challenge not only to this initiative, but also to teams of scientists from different countries that could combine their expertise in innovative approaches to questions that cannot be answered by individual countries, let alone individual research institutions.

New international funding mechanisms are needed to enhance cross-border funding. One of the important groups that could bring about change is the Heads of International Research Organizations (HIROs) network, which includes 17 different funding bodies for medical research from around the world. Another solution might come from non-traditional sources, such as individual donors, non-profit organizations or companies. One potential advantage for any of these groups is that they might not place constraints on how an international collaboration is managed. On the other hand, competition for philanthropic money is fierce, so any attempt to find support for a multi-national educational research program needs to be innovative, collaborative and interdisciplinary.

The World Cohort Integration Workshop revealed significant enthusiasm for personal networking, and harmonization of procedures that in the future could lead to collaboration and pooling of results across four continents on the globe. A second successful World Cohort Integration Workshop has built upon the foundation laid over a year ago to consolidate the enormous learning opportunity afforded by joint activities. The time seems ripe to overcome small-scale approaches to global health challenges. A collaborative spirit replaces competition and builds a strong scientific base for learning. Implementation of the training initiatives and recommendations outlined in this paper would be a natural starting point.

Conflict of interest

None declared.

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