CANCER HEALTH DISPARITIES

Transforming Science, Service, and Society

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Management of the cancer burden in low- and lower-middle–income countries requires global partnerships between cancer-care mentors from high-income countries and community health workers familiar with the local circumstances.

The 2010 global status report on noncommunicable diseases (NCDs) from the World Health Organization (WHO; http://bit.ly/ZQkrnN) and the 2012 United Nations (UN) declaration (http://bit.ly/1saFmN4) focused attention on the growing global burdens of cardiovascular diseases, diabetes, cancers, and chronic respiratory diseases. The WHO noted that 80% of deaths occur in low- and lower-middle–income countries (LMICs), and mortality and morbidity have a disproportionate impact on people in low-resource settings. Because cancer requires life-or-death intervention, this "emperor of all maladies" (http://bit.ly/Zsec8F) has the attention of citizens in both resource-rich and resource-poor settings and thus can serve as a common focus on which to pilot new, highly collaborative approaches. Here, we discuss ways to address cancer health disparities globally.

From several perspectives—medical, health care systems, business, work force, economic, ethical—cancer is a growing global problem. Case burdens are increasing in LMICs and, by various measures, outcomes are worse than in high-income countries. Resources are limited, and thus potential for favorable impact is high. Although the WHO and UN reports have highlighted the problem, geopolitical conflicts, domestic political turmoil, and the global economic recession have drawn attention away from this "slow-motion disaster" (*1*). However, neglect invites future problems, because excessive cancer burdens contribute to social instability, increased migration, and intersocietal insecurity.

There are sufficient descriptive epidemiological and interventional data to allow focused and realistic statements for action (*2*). Case burdens will rise as the populations of LMICs age, and meeting the challenges will continue to be exacerbated by geographical movements of populations. In resource-rich countries, similar problems exist in rural underserved areas (for example, among American Indians) and merit attention. Addressing the growing burdens of cancer poses several broad challenges, including (i) health-system functionality and primary care medicine; (ii) human and individual rights issues; and (iii) governance and corruption (such as diverted and misspent funds). Health care systems and primary care medicine are disorganized, dysfunctional, inadequate in size, and underfunded; thus we need new business models (*3*, *4*). Easterly (*5*) has highlighted the consequences of ignoring issues such as racial, religious, and gender discrimination, violence against women, and poverty and other market-related ("equity") issues. Although well intended, attempts to apply the unaffordable systems and interventions used in high-income countries are widespread and often unsuccessful. Transparency and locale-specific solutions are necessary.

OPPORTUNITY IN DISGUISE

This seemingly overwhelming problem may also be seen as an opportunity to expand translation of biomedical and engineering sciences in the service of society. The breadth and scope of the issues grounded in circumstantial and societal differences challenge researchers and policy-makers to develop ways to widen the reach and impact of the fruits of scientific research. A greater presence of science in the lives of more global citizens will increase support locally and transform perceptions of what science can provide.

What is needed is a balance of "top-down" and "bottom-up" interventions rather than the historically dominant top-down, authoritarian approach. A social-entrepreneurial changemaker process facilitated by a dedicated mentoring network—with its broad capabilities, experiences, and perspectives—better meets human rights requirements, acknowledges local barriers to change, and is sensitive to the particular challenges of cancer research and therapy (Fig. 1).

A mentored health care system. As Bornstein and Davis have described in *Social Entrepreneurship* (http://bit.ly/1d4KaxA), mentors from the global scientific community work with local changemaker teams with members from various sectors (Fig. 2) to establish centers that—through local investment and commitment—design innovative, accountable, continually changing processes for tackling a broad spectrum of cancer-control problems. Such a mentored health care system begins with carefully considered national and international attention, investment, and action. The ultimate goal is to develop, implement, assess, modify, adapt, and extend solutions that are shown to work. Mature mentors know the importance of people-to-people connectivity and understand the challenges of changing complex systems.

The expertise solution requires capable people in both resource-poor and -rich countries willing to take on recalcitrant challenges. Given substantial cultural diversity, specific policies might work in some LMICs but not

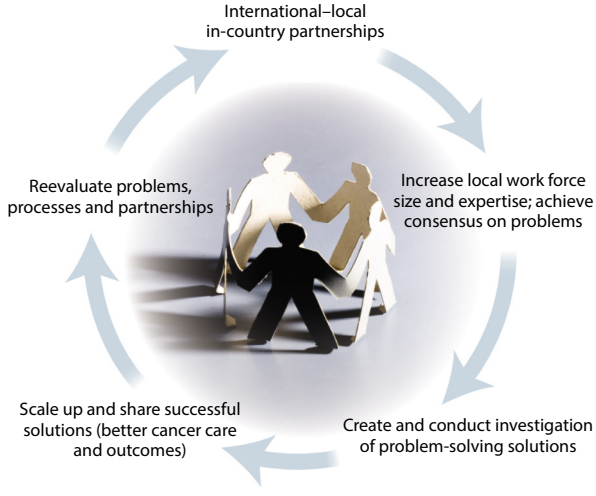

Fig. 1. Think globally, mentor locally. When carefully examined from local levels in-country, critical issues constitute a complex systems problem. Breaking this down by sectors makes potential intra- and transdisciplinary solutions definable. This translation requires ongoing systematic assessment with defined metrics and research in fields ranging from basic and translational biomedicine, engineering, implementation science, policy, and economics. Solutions must come from community participatory processes and mentors must serve not only as experts but also as facilitators and students of these processes. Educating and preparing mentors to act as social organizers is a necessary part of this model.

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Sector	Goals	The health care system	Tools and methods	Accomplishments
Expertise Resource-poor (LMICs) and resource-rich	Capability capacity; sustainable "in-country" cancer program	Underserved community; Mentor corps	Mentorship; New career path; Tap into wisdom of retirees	Transform health care value system; Catalytic innovation
Implementation science	Effective use of knowledge; New systems-solutions to hard problems	New health care models	Quality data bases; Appropriate metrics; Shared learning	Improvements are data driven; Shared solutions; New economic models
Technology	Best use of personnel; Remote outreach and improved access to care	At cancer center; Outreach, remote sites; Regional hospital as needed	Novel IT technology; Cell phone for remote outreach	Better health; New jobs; New markets
Research	Understand diseases; Targeted therapeutics and prevention	Research and continual improvement	Clinical epidemiology, translational and basic mechanistic research	New knowledge; Better prevention and treatment agents and strategies
Cancer and health (applicable to NCDs)	Expandable; Exportable models; Shared resources	Ultimate goal: Reduced cancer burden	Shared knowledge; Economic models that support more investment	Common ground; Diplomacy; Shared accomplishments

Fig. 2. Translating intention into action. As shown in the center panel, the ultimate goal of a reimagined health care system that reduces cancer burden in underserved areas (yellow box) relies on people—scientists, mentors, health care workers, and patients. The starting point for multisector and transdisciplinary innovation and improvements in cancer care is sustained in-country mentoring, and the resulting mentored health care system interacts with and offers opportunities and challenges for several sectors (shown in the surrounding columns). Appropriate expertise in a capable work force is an overarching requirement. Biomedical research produces new knowledge that can be translated into better treatments and prevention strategies. Implementation science will establish and use credible metrics that guide direction and investments. Economic benefit arises from a combination of better health plus the potential for new markets for goods and services—addressing the triple bottom line of profit and loss, social responsibility, and environmental responsibility (www.economist.com/node/14301663). Technology aids optimal deployment of the work force to (i) ensure appropriate delegation of tasks to the most cost-efficient expertise levels, (ii) bridge the distance between patients and care centers, and (iii) invent and develop diagnostics and therapeutics that remain functional within an unreliable infrastructure.

others. Sharing of ideas, study designs, and outcome data among an organized sustainable global network will facilitate the development of local solutions (*6*). But the building of a successful mentoring cadre will be possible only if mentorship efforts become part of a bona fide career path. Although the satisfaction gained from a vocation that adheres to one's personal values is a powerful motivator, sustainability of a biomedical vocational program requires that academic institutions, medical practices, and professional societies value mentorship and recognize that success can be measured by an individual's contributions to society as well as by the standard academic and financial metrics.

The mentoring model described by the International Cancer Expert Corps (ICEC, iceccancer.org) notes three sources of mentors: (i) Academia. A critical transformation is to create a career path for health care service to the underserved by providing an organizational and academic base in resource-rich centers of excellence for developing public health oncology expertise (*2*). We suggest enlarging the focus of global health programs from their current emphasis on the general training of medical students to include emphases on service and research that can be maintained throughout faculty careers similar to the laboratory, translational, and clinical research, teaching, and clinical care career options. The Consortium of Universities for Global Health (www.cugh.org) could be a venue for shaping a complete career path from undergraduate to senior mentors. Such an endeavor requires a modification of the current value and reward system by providing time and academic recognition for mentoring activities, possibly with an adjusted financial structure, to further emphasize social responsibility and service and encourage altruism throughout one's career (http://bmj.co/1s7Zz5M). Much mentoring can be done using teleconferencing, so this activity can fit within the routine clinical and academic schedules. A commitment of mentors for ~20% time is the initial goal, with the aim of matching in-kind and external financial support. (ii) Private practitioners. Experience in an academic–community outreach program, cooperative group cancer research, and initial efforts toward recruiting individuals for ICEC indicates that many people in private medical practices are eager to participate in academic-type activities and have the flexibility in time and compensation to do so. (iii) Senior mentors and retirees. Given that oncology professional societies are ~50 years old, there is a rapidly growing cohort of people with career-long experience who are transitioning from full-time to part-time work. Many are interested in finding new ways to use their expertise and experience as clinicians, teachers, and mentors. From our conversations with members of this group, much of their participation will be in the form of in-kind contributions of time that require limited support. At every level, participation requires a formal commitment similar to that of other career activities. The planned approach to solving the immediate work force and expertise problems is consistent with the public health and systems approach for global health care delivery described by Kim *et al.* (*7*) and an international service corps of health trainees described by Kerry *et al.* (*8*).

Will this mentoring model be successful in reversing the brain drain? We do know that energy, enthusiasm, and staying power come from being part of high-quality teams taking on challenging problems. Having world-renowned people mentoring and partnering with LMICs is an approach that we believe will attract people and investment. In *Turning the World Upside Down* (*6*), Crisp identified the need for a systematic approach and emphasized that there is much for the resource-rich

world to learn from resource-poor countries about cost-effective health care approaches. In *The Innovator's Prescription*, Christensen *et al.* (*3*) offer an approach to disruptive transformation of health care involving technology, a business model, and a value network. They further suggest that a disruptive business model for health care could be adapted for LMICs by having value-added businesses and facilitated networks as cost-effective solutions; these businesses and networks would remain connected to regional hospitals but would not replicate the general hospital model. Indeed, the skepticism and sense of the overwhelming nature of global health problems requires what Christensen calls catalytic innovation, which focuses on social change and recognizes that such solutions are often ignored or rejected by the status quo.

Technology advances provide critical resources for networking among mentors and local LMIC teams. Telemedicine enables the case discussions on which capability will be built and provides the backbone for data management at international standards through which credibility will be established. With credible data, LMICs can participate in the guideline and protocol-based management that will enable them to become part of the global research network. Cell phone–based technology is rapidly advancing to facilitate the linking of health care workers at remote locations and outreach centers to cancer programs and regional hospitals. Data management systems used by cooperative cancer research groups can be expanded or modified to enable the collection of metrics to evaluate and guide progress.

Because of its effectiveness in providing palliative and potentially curative treatment, radiation will be an important therapy in the advanced stages of cancer in LMICs. The International Atomic Energy Agency (IAEA) Directory of Radiotherapy Centers (http://bit.ly/1qcjdbt) tabulates a shortage of more than 5000 radiation units worldwide; so there is a substantial market poised to drive precompetitive cooperation in the engineering of equipment that can function under conditions encountered in challenging infrastructures. Biomedical research directed at deciphering the natural histories of human diseases should help to provide continually improving preventative and therapeutic interventions (see table S1 for a portfolio of potential projects). The success of tobacco control efforts in resource-rich countries indicates that we can aspire to affect cancer incidence and mortality in other populations.

In the LMIC centers, personnel will be mentored by international teams with a broad range of expertise to identify and then address—together with community cancer caregivers and health care activists—local issues and problems related to cancer care. There is a growing understanding that the long-term sustainability of development activities is critically enhanced by actively involving communities whose members promote self-reliance (*9*). It is essential to build on, work closely with, enhance, and not duplicate existing programs, including ongoing projects by universities and international agencies such as the Program for Action for Cancer Treatment of the IAEA (PACT, cancer.iaea.org) and the Union for International Cancer Control (UICC, www.uicc.org). So, the aim is this: Availability of effective treatments, including cure and palliation for every patient with cancer in the world, within the next two decades—a period suggested for "Global Health 2035" (www.globalhealth2035.org).

CAN WE AFFORD IT?

The mentoring model supports both mentors from resource-rich countries and local changemakers in resource-poor areas who are willing to stay in-country to help solve a major global health problem. We use the full-time equivalent (FTE) calculation and assume that the rate paid will be commensurate with local rates (an absolute maximum being the current NIH maximum FTE rate of ~$180,000) and that each participant will commit 20% time on average; therefore, ~$330,000 would support the salary, fringe benefits, and travel and overhead expenses for a maximum cost FTE. For $2,000,000, one can have 5 FTEs (25 experts) with an additional ~$300,000 to support organizational infrastructure shared among partner countries in an international collaborative. Assuming that academic medical centers would match support, medical practices and retirees would provide in-kind effort and largely require limited support for travel and infrastructure, and many FTEs are well below the maximum, it may be possible to support 50 to 100 people, working worldwide, for $2 million to $4 million per year. Industry might then see a viable market emerge in LMICs.

We are not suggesting a government-supported model but rather, broad sources of investment; however, to provide a sense of scale, the annual budget of the U.S. National Cancer Institute (NCI) is ~$5 billion, much of which supports researchers' salaries. Thus, the cost of the mentoring model (~$2 million to $4 million) is less than 0.1% of the NCI budget. Alberts *et al.* propose that leading-edge scientific research requires stability and predictability in investment and substantial changes in education, training, grant mechanisms, and career paths (*10*); so adding the mentorship dimension to address health issues of the underserved is timely, visible, and only a minor expense. Investing in both leading-edge science and service to the trailing-edge underserved populations can lessen disease burdens and accelerate advances in laboratory, social, and implementation sciences; bridge intercultural differences; forge lasting international partnerships; open new health care markets; create jobs in underserved communities; and put to better use the wisdom and expertise of resource-rich countries. With the ongoing rapid changes in the health care enterprise, firmly linking sustainable careers to mission and human service can transform global health.

SUPPLEMENTARY MATERIALS

www.sciencetranslationalmedicine.org/cgi/content/full/6/259/259fs42/DC1

Table S1. Portfolio of potential projects.

REFERENCES AND NOTES

1. L. Rosenbaum, D. Lamas, Facing a "slow-motion disaster"—The UN meeting on noncommunicable diseases. *N. Engl. J. Med.* **365**, 2345–2348 (2011).
2. R. R. Love, O. M. Ginsburg, C. N. Coleman, Public health oncology: A framework for progress in low- and middle-income countries. *Ann. Oncol.* **23**, 3040–3045 (2012).
3. C. M. Christiansen, J. H. Grossman, J. Hwang, *The Innovator's Prescription: A Disruption Solution for Health Care* (McGraw-Hill, New York, 2009).
4. M. Yunus, *Creating a World Without Poverty: Social Business and the Future of Capitalism* (Perseus Books Group, New York, 2007).
5. W. Easterly, *The Tyranny of Experts: Economists, Dictators, and the Forgotten Rights of the Poor* (Basic Books, New York, 2014).
6. N. Crisp, *Turning the World Upside Down* (CRC Press, Boca Raton, FL, 2010).
7. J. Y. Kim, P. Farmer, M. E. Porter, Redefining global healthcare delivery. *Lancet* **382**, 1060–1069 (2013).
8. V. B. Kerry, S. Auld, P. Farmer, An international service corps for health—An unconventional prescription for diplomacy. *N. Engl. J. Med.* **363**, 1199–1201 (2010).
9. R. A. Cash, A. Mushtaque, R. Chowdhury, G. B. Smith, F. Ahmed, Eds., *From One to Many: Scaling Up Health Programs in Low-Income Countries* (University Press, Bangladesh, 2011).
10. B. Alberts, M. W. Kirschner, S. Tilghman, H. Varmus, Rescuing US biomedical research from its systemic flaws. *Proc. Natl. Acad. Sci. U.S.A.* **111**, 5773–5777 (2014).

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