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# Ten years of international collaboration in biomedical informatics and beyond: the AMAUTA program in Peru

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## ABSTRACT

Well-trained people are urgently needed to tackle global health challenges through information and communication technologies. In this report, AMAUTA, a joint international collaborative training program between the Universidad Peruana Cayetano Heredia and the University of Washington, which has been training Peruvian health professionals in biomedical and health informatics since 1999, is described. Four short-term courses have been organized in Lima, offering training to more than 200 graduate-level students. Long-term training to masters or doctorate level has been undertaken by eight students at the University of Washington. A combination of short-term and long-term strategies was found to be effective for enhancing institutional research and training enterprise. The AMAUTA program promoted the development and institution of informatics research and training capacity in Peru, and has resulted in a group of trained people playing important roles at universities, non-government offices, and the Ministry of Health in Peru. At present, the hub is being extended into Latin American countries, promoting South-to-South collaborations.

## INTRODUCTION

Information and communication technologies (ICT) could have an impact on healthcare delivery, public health, research and health-related activities for the benefit of both low- and high-income countries. In fact, the World Health Organization's executive board identified ICT as a priority eHealth action area for supporting human resources for health.<sup>1</sup> In addition, the use of ICT for the development of the health workforce, 'Human resources for health', is increasingly being recognized as a crucial element in improving health systems to achieve the Millennium Development Goals.<sup>2</sup>

Education and training programs for healthcare professionals need to prepare them not only for technical work, but also to act as enablers, mediators and advocates for health-based and population-based action in all sectors.<sup>3</sup> Biomedical informatics can play a key role in these educational programs, and well-trained biomedical informatics specialists are needed, particularly in developing countries.<sup>4,5</sup>

With the globalization of healthcare and health systems, international partnerships have been an important part of the biomedical informatics curriculum.<sup>6,7</sup> Moreover, universities have cooperated in joint projects to promote multidisciplinary

and international approaches in their educational programs, most of which come from developed countries.<sup>8,9</sup> However, in developing countries, some efforts have been made to develop and establish partnerships for training health professionals in biomedical informatics. The Informatics Training for Global Health Program<sup>10</sup> and AMIA's Global Partnership Program<sup>11</sup> are examples of such accomplishments, yet it still remains one of the greatest challenges.

Before 1999, training or research activities involving medical or health informatics were almost non-existent in Peru.<sup>12</sup> With the growth of ICT over the last decade, competent informatics training became a must.

In this article, we report on the approach, achievements and future work of an international collaborative training program in biomedical informatics in Peru. This case report not only illustrates the evolution of the program over time, but also describes some of the challenges and lessons learned from a model that could be applicable in other resource-constrained settings.

## CASE DESCRIPTION

Peru is a middle-income country in the Andean region with an annual per capita gross domestic product (GDP) of US\$8400, with only 4.4% of GDP devoted to the healthcare sector.<sup>13</sup> The Peruvian population is multicultural and multiethnic, and the main spoken language is Spanish.

Peru has experienced significant advances in the telecommunications sector. For example, the market for cell phones has been increasing since 1993, with major growth from about 200 000 sales in 1996 to 24.7 million sales by December 2009,<sup>14</sup> a penetration rate of 87.5%.

Internet access has been growing steadily as well. As of December 2009, internet penetration (the percentage of households that report having internet access) was 9.7%; however, 31.4% of people aged 6 and older access the internet at home, school, work or *cabinas públicas* (internet cafes).<sup>15</sup> *Cabinas públicas* serve the majority of internet users in Peru.<sup>15,16</sup>

In 1999, the AMAUTA Global Training in Health Informatics program (*amauta* is a Quechua word meaning a person of great wisdom, one who knows and teaches) was developed to train Peruvian healthcare professionals in the application of informatics to health. This collaborative program is an institutional partnership which involved Universidad Peruana Cayetano Heredia (UPCH),

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Universidad Nacional Mayor de San Marcos, and the University of Washington (UW), Seattle, Washington, USA, with the support of the Fogarty International Center (FIC)/National Institutes of Health (NIH). Universidad Nacional Mayor de San Marcos was a partner for the first 5 years of the training program and remains a collaborator since 2005. The current goals of the AMAUTA program include training of core professionals in biomedical and health informatics, and strengthening of library and health information resource capabilities and accessibility at UPCH.

The AMAUTA program collaboration has 'rolled out' in a phased fashion, including (1) short-term courses in Peru and (2) longer-term graduate-level training in biomedical informatics for the core UPCH faculty. In addition, the AMAUTA program has supported short-term training at UW in health informatics and library sciences. The first two activities are described more extensively as examples in the next section.

### METHODS

We will report on the evaluation of short-term courses, the methods of which were very similar and are described in detail elsewhere.<sup>17</sup> In brief, students completed a 30 minute before and after test. Each test was paper-based and consisted of multiple-choice questions. The questions were selected from an original pool developed from the subject matter to be covered by the course. Questions on the before and after tests were identical; however, the order of presentation of the individual items was randomly changed on the before test. The students were not allowed access to the examination outside the testing period to prevent unauthorized distribution of the questions. Descriptive statistics were used to summarize the course.

### EXAMPLES

#### Short-term courses in Peru

The AMAUTA program has focused on training Peruvians to strengthen the informatics workforce and building capacity at the institutional system level. Individual training has included both short-term and long-term courses. Short-term courses offered in Peru involve: (1) intensive 1–2-week introductory courses on biomedical and health informatics; (2) training of trainers—that is, training of UPCH faculty members to teach an introductory informatics course to their own students.

In general, the objectives of the introductory course were as follows: (1) to present state-of-the-art developments in medical informatics, public health informatics, and bioinformatics; (2) to increase the knowledge of participants in the application of recent information technology tools to medicine, public health, and biomedical investigation in Peru; (3) to enable participants to develop and strengthen collaborative studies both locally and internationally; (4) to present and summarize research projects on health informatics and bioinformatics being conducted by Peruvian fellows (present and past) of the program; (5) to improve the use of current informatics tools by participants to form new working hypotheses, and to carry out new collaborative research projects on global health.

During the 1999–2009 period, four short-term courses were organized in Lima in 2000, 2001, 2005, and 2008 (table 1). The first two covered topics in medical informatics and public health informatics.<sup>18</sup> The last two covered topics in both health informatics and bioinformatics.<sup>17 19</sup> Evaluations of these courses have been positive. As identified in table 1, from the before and after test scores, knowledge increased during the course. In addition, gains in knowledge were assessed immediately at the end of the 2005 course, which indicated that it is an effective

**Table 1** Participants in short-term courses organized by the AMAUTA program

Course year	No evaluated/total*	Pre-test mean score	Post-test mean score
2000	25/26	53	71
2001	30/30	48	67
2005 BIO	18/20	49.7	59.7
2005 MI	21/23	33.6	51.2
2008 BIO	39/45	64	82
2008 MI	50/58	47	54

\*No evaluated represents number of participants who completed both the before and after test, and total represents total number of participants.

MI, medical informatics; BIO, bioinformatics.

method of information dissemination.<sup>17</sup> In general, the overall acceptance of the courses was ranked as very good to excellent, and the usefulness of the courses was rated as very good. In a follow-up evaluation 6 months after the 2005 course, there was no decline in evaluation scores.<sup>17</sup>

#### Long-term training in Seattle

The long-term training program offered at UW has allowed key UPCH faculty members to be trained through certificate, masters, doctoral, post-doctoral, and post-masters training programs, enhancing the core informatics capacity at UPCH and other institutions in Peru.

Visiting scholars engaged in long-term training at UW are required to return to Peru and are generally guaranteed a position at UPCH or another Peruvian institution upon completion of their training to prevent migration of the skilled workforce from Peru (ie, 'brain drain'). Institutionalization of capacity is a key component of sustainable capacity building.<sup>20</sup> Most long-term trainees have returned to Peru and continue to be engaged in the public or private sector. Research implemented by trainees in Peru includes<sup>21</sup>: public health online courses; a computer-based support system to control congenital syphilis; a computer-assisted coding tool for the international classification of diseases for mortality data; a real-time surveillance system for adverse events using cell phones<sup>22</sup>; internet as a tool to access high-risk men who have sex with men;<sup>23</sup> and a grid implementation to diagnose mycobacterium tuberculosis using microscopic observation drug susceptibility (MODS) patterns.<sup>24</sup>

There are prospects for continuing growth—for example, UPCH has started planning and preparing the first graduate diploma program in biomedical informatics in Peru, led by former AMAUTA trainees.<sup>25</sup> Currently, the program is organizing the curriculum in close collaboration with UW and other collaborating institutions.

### DISCUSSION

There are many lessons to be learned from AMAUTA. Foremost, we have found that collaboration is a key component of the program. Secondly, we tailored and integrated training and research into our program to accommodate our local needs. The UW collaboration enhanced the ability of UPCH to strengthen its own portfolio of research projects leading to additional funding support.<sup>26</sup> Since 2000, the program has been successful in identifying internal and external resources and identifying ongoing funding from complementary sources (eg, Asia Pacific Economic Cooperation) for scholar support. In addition, one returning scholar successfully obtained a very competitive R01 grant as a principal investigator.<sup>27</sup> The UPCH has been successful in identifying additional funding sources to support informatics research and training, nationally and internationally (ie, the Peruvian National Council of Science and Technology,

UW, the Mobile Citizen Program—Inter-American Development Bank,<sup>28</sup> and the Department of Health of the Executive Yuan of Republic of China). Finally, the UPCH faculty in collaboration with the Ministry of Health have participated in the deployment of health information systems on a large scale.<sup>21 29 30</sup> Additionally, the UPCH biomedical informatics group has been very productive in publishing peer-reviewed articles related to biomedical informatics, particularly in the area of mobile health.<sup>21 31 32</sup>

There are important factors regarding leadership, management and future challenges and approaches that warrant further discussion.

### Leadership, management and expansion

A progressively enabling environment with strong and sustained leadership from UPCH authorities (eg, rector, vice-rector of research and deans) facilitated the implementation start-up of this program, and these authorities continue to give their support. We believe this support was important for the success of the program. There is now sufficient commitment and momentum among a much larger group of professionals to partner and begin national and international expansion. For example, in September 2008, the UPCH faculty collaborated in planning and teaching to support a public health informatics program at Mahidol University (Bangkok, Thailand), a good example of South-to-South collaboration. The UPCH faculty has also collaborated in a workshop on academic health informatics training and research programs in Africa. Substantial efforts should be made to develop global informatics training programs. One promising effort is the AMIA Global Biomedical and Health Informatics Fellowship Program, funded by the Bill & Melinda Gates Foundation, which seeks to develop scalable approaches to eHealth education and help address the growing need for a global informatics workforce and scholarly network.<sup>11</sup> One of the UPCH Peruvian faculty (WHC) is a member of the steering committee.

### Future challenges and approaches

One challenge is how to effectively expand capacities in biomedical informatics from the university and capital level to the rest of the country. Increasing adoption of distance education may become an efficient and effective way to provide health informatics training to health providers located in distant areas of Peru and beyond.

Attracting highly qualified Peruvians (especially those working in technology and development) to return from abroad to work in their home country is difficult. One idea to encourage researchers to return is to promote re-entry grants, which are funds to help researchers to re-establish themselves and find niches after some time in other countries. The UPCH has instituted a grant for PhD graduates returning to Peru to work at the university, which pays their salary for 1–2 years at a relatively high level compared with other university positions.<sup>33</sup> In exchange, they commit to working in research and looking for funding opportunities. Garcia and Curioso<sup>20</sup> have found this initiative to be very successful in transitioning these valuable researchers back to their home country. This strategy could be promoted in other Peruvian universities, creating a network of opportunities in the country.

Another challenge is how to grow in the Latin American region, promoting effective South-to-South collaboration in biomedical informatics training and research.<sup>34</sup> One current strategy is a center of excellence in biomedical informatics training and research at UPCH for the Latin American region. The center is called QUIPU: The Andean Global Health Infor-

matics Research and Training Center (*quipu* is a Quechua word that describes an ancient system used throughout the Andes by the Incas to record and distribute information), funded by the FIC/NIH,<sup>10</sup> and will expand, initially, from UPCH and the US Naval Medical Research Center Detachment in Peru, the Universidad del Cauca (Colombia), and UW.<sup>35</sup> This initiative aligns with the WHO eHealth initiative, which encourages the establishment of centers and networks of excellence for eHealth best practice, policy coordination, and technical support for healthcare delivery, service improvement, information to citizens, capacity building, and surveillance.<sup>1</sup>

In summary, the AMAUTA Global Informatics Research and Training program is an example of a successful collaboration for health informatics training in a developing country. The AMAUTA program has retained a high proportion of Peruvian biomedical informatics professionals in both the public and private sector. In addition, we have found that a combination of short-term and long-term strategies directed at both individuals and institutions have helped to develop local health research enterprise. The AMAUTA program has achieved considerable success in the development and institution of informatics research and training programs in Peru. Projects supported by this program are leading to the development of sustainable training opportunities for biomedical informatics in Peru and contributing to such efforts in other low- and middle-income countries. At present, through the QUIPU Center, we are extending our hub into other Latin American countries, promoting South-to-South collaborations.

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