Evaluation of the SATELLIFE PDA Project, 2002

Testing the use of handheld computers for heathcare in Ghana, Uganda, and Kenya

Report published: 28 February 2003

For further information on this evaluation contact:

bridges.org
PO Box 4163, Durbanville 7550
Cape Town, South Africa
Tel: +27 (0) 21 970 1314
Fax: +27 (0) 21 970 1315
Email: evaluation@bridges.org
URL: www.bridges.org

This report is available at http://www.bridges.org/satellife/.

EXECUTIVE SUMMARY

Information and communications technology (ICT) can be used as a tool for collecting community health information to support decision-making; improving doctors' access to current medical information; linking healthcare professionals so they can share information and knowledge; and enhancing health administration, remote diagnostics, and distribution of medical supplies. One ICT that offers promise is handheld computers – also called personal digital assistants or PDAs – which are widely used in the medical profession in the developed world. But PDAs are a relatively new technology in Africa, and little work has been done before now to demonstrate their utility as a tool for healthcare in developing countries.

This evaluation looks at a project led by Massachusetts-based organization SATELLIFE, to test the use of PDAs in healthcare environments in Ghana, Uganda, and Kenya during December 2001-December 2002. The project put PDAs into the hands of physicians, medical students and community volunteers in different settings in order to demonstrate their viability and usefulness, especially for the collection of health data and dissemination of medical information. SATELLIFE worked in partnership with a number of ground level partners, including the American Red Cross; Makerere University Medical School in Kampala, Uganda; HealthNet Uganda; Moi University Faculty of Health Sciences in Eldoret, Kenya; and the Indiana University Kenya Program. The project received financial support from the Acumen Fund.

The PDA used was the *Handspring Visor Neo*, with a 33 MHz DragonBall VZ microprocessor from Motorola, a Palm operating system (Palm OS), and 8 MB of main memory. *Pendragon Forms* v*3.1* was the software program used to create the survey forms. Country-specific drug lists and treatment guidelines were obtained by SATELLIFE in hard copy or electronic formats and adapted to a PDA-accessible format. Medical texts were obtained from Skyscape.

SATELLIFE first put the handheld computers to use for field surveys, by linking this project to a widespread measles immunization campaign being conducted in Ghana by the American Red Cross in December 2001. The objective of the SATELLIFE-ARC joint effort was to use PDAs in a short-term survey intended to determine the efficacy of the measles immunization campaign outreach efforts and collect some baseline health information. The objectives of the Uganda phase were to test the use and usefulness of PDAs by medical practitioners to conduct an epidemiological survey on malaria, and access and use certain medical reference tools and texts. The objectives of the Kenya phase were to test the use and usefulness of PDAs by students to collect field survey information, and access and use certain medical reference tools and texts as part of their studies.

Bridges.org was engaged as an outside consultant to conduct an independent evaluation of the PDA trial. The overall objective for the bridges.org evaluation was to gauge the viability and usefulness of PDAs in healthcare settings in Uganda and Kenya, by looking at the technology itself, the content loaded on it, and the impact that the PDA had on the behavior of health professionals and the quality of care they delivered. This evaluation looked at two main questions:

⇒ Did PDAs prove to be an effective tool for physicians and medical students to collect health data and access medical information as part of their daily routine?
⇒ If not, why not?

This evaluation responded to the two questions above by considering the following 16 criteria that represent the determining factors of whether people have Real Access to technology:

(1) Physical access to technology.
(2) Availability and use of relevant content.
(3) Appropriateness of technology for data collection in this environment.
(4) Appropriateness of technology to local conditions.
(5) Affordability of technology and content.
(6) Training and skills required for effective technology use.
(7) Need for and availability of technical support.
(8) Integration of technology use into daily routines.
(9) Socio-cultural factors that affect technology use.
(10) Confidence in technology use in terms of privacy, security, or cybercrime.
(11) Public enthusiasm for technology use.
(12) The effects of the national legal and regulatory framework on technology use.
(13) Political will in government to enable widespread technology use throughout society.
(14) Impact of technology use on the community and larger society.
(15) Ideas and plans for future uses of the PDA.
(16) Key external challenges that may have limited technology use in this project.

The main finding of this evaluation is that the SATELLIFE project in Ghana, Uganda and Kenya has validated the use of handheld computers in healthcare environments in Africa. There were a number of valuable lessons gleaned from the project that can be applied to further deployment of PDAs in developing countries. A number of obstacles to technology use have also been identified, which will need to be overcome in order to promote the widespread adoption of the technology in this context. Finally, the project has served to open the door for a number of opportunities that are worthy of the attention of technology companies and content providers.

Key findings of the evaluation

⇒ Overall, the handheld computers proved to be a useful and viable technology in the healthcare environments in Ghana, Uganda and Kenya.
⇒ The handheld computers proved to be an effective tool for collection of health data.
⇒ The handheld computers proved to be an effective tool for information dissemination.
⇒ The medical reference materials available on the PDA helped the physicians and students improve their provision of healthcare.
⇒ The handheld computers proved to be an appropriate technology for use in the African context.
⇒ Handheld computers proved to be an inexpensive alternative to PCs in terms of computer power per dollar.
⇒ The handheld computers proved to be simple to use, and the technology was easily integrated into the daily routines of the healthcare professionals.
⇒ Handheld computers offer enormous potential to help bridge the digital divide.

Key lessons learned in this project

⇒ People require at least some basic training in order to use the handheld computer effectively overall.
⇒ More focused training is needed to train people how to use the handheld computer for data collection, not just for the technology users, but also for those who are managing the project.
⇒ The use of the handheld computer changes the way that a survey should be designed and conducted.

⇒ Technical support is critical.
⇒ Content must be locally relevant to have the greatest impact.
⇒ The power supply for the handheld computer must be appropriate to the situation: battery-powered units would only be the first choice in situations where a ready electricity supply is unavailable.
⇒ Synchronizing onto a central data system must be simple and convenient.

Challenges that must be overcome

⇒ Despite the affordability by comparison to PCs, the cost of the PDAs may still be too high for the average person in Africa.
⇒ More locally relevant content in electronic format is needed to foster the widespread use of handheld computers for healthcare in developing countries.
⇒ Repairs for handheld computers are currently not feasible in Africa.
⇒ Broader ICT infrastructure is needed to support the widespread use of handheld computers in Africa in the long-term.
⇒ Issues of privacy, data protection, and security will affect the widespread use of handheld computers in healthcare in Africa over the long-term.

Opportunities for the future that emerged from this project

⇒ There is clearly a market opportunity for handheld computers in African countries.
⇒ Linking the use of handheld computers with wireless capabilities would exponentially extend the utility of both technologies.
⇒ There is clearly a market opportunity for locally relevant medical content in electronic formats, which is targeted to the needs of African countries.
⇒ Partnering handheld computer initiatives with community access point initiatives offers an effective model that would be mutually beneficial for both efforts.
⇒ Linking handheld computer initiatives with alternative power development efforts, such as the investigation of solar panels and wind-up technologies, may offer innovative opportunities for solving the power supply problems.
⇒ Handheld computers offer enormous potential for improving service delivery in national Ministries of Health as well as international healthcare organizations and programs.
⇒ Handheld computers offer specific utility in rural healthcare settings.

Handheld computers could revolutionize technology access for the people of Africa. But none of this potential can be realized unless the technology companies and content providers rise to the occasion. This study should be a wake-up call to industry, a glimpse into the untapped markets where their attention would make a real difference to people's lives.

ACKNOWLEDGEMENTS

We would like to thank the doctors, medical students, and medical school administrators in Kampala, Uganda and Eldoret, Kenya who took time out of their busy schedules to provide information for this evaluation. We especially appreciate the input we received from Dean N.K. Sewankambo of the Makerere University Faculty of Medicine and Dean B.O. Khwa Otsyula of the Moi University Faculty of Health Sciences, who welcomed us to their institutions. We applaud their leadership as local champions for practical, relevant technology use. Finally, we would also like to acknowledge the invaluable contribution of Fred Kakaire and HealthNet Uganda who helped us to organize the on-site visits and interviews.

TABLE OF CONTENTS

1 INTRODUCTION

Healthcare is one of the leading issues affecting African development today. HIV/AIDS is devastating the continent, and that is only one aspect of the healthcare crisis. For example, malaria is by far the most lethal tropical parasitic disease, killing more people than any other communicable disease except tuberculosis (TB), and it is estimated to have cost Africa USD $100 billion over the last 30 years.[1] Yet malaria, TB, and other diseases can be managed if promptly diagnosed and adequately treated, and in many cases prevention methods are relatively cheap and simple. But lack of information on treatments and disease management is often an underlying issue that hinders effective patient care and prevention. Information and communications technology (ICT) can play an important role in combating disease and improving healthcare. ICT can be used as a tool for collecting community health information to support decision-making; improving doctors' access to current medical information; linking healthcare professionals so they can share information and knowledge; and enhancing health administration, remote diagnostics, and distribution of medical supplies.

But even though ICT can help, the solution to Africa's healthcare crisis is not as simple as installing computers in every hospital and clinic and linking them to the Internet. Infrastructure and hardware mean nothing if ICT is not used effectively because it is not appropriate to the real needs of healthcare professionals at ground level, there is no locally relevant content available, healthcare providers are not trained to use it, or they cannot afford to use it. One ICT that offers promise is handheld computers – also called personal digital assistants or PDAs – which are widely used in the medical profession in the developed world. But PDAs are a relatively new technology in Africa, and little work has been done before now to demonstrate their utility as a tool for healthcare in developing countries.

This evaluation looks at a project led by Massachusetts-based organization SATELLIFE, to test the use of PDAs in healthcare environments in three African countries. The project put PDAs into the hands of physicians, medical officers, and medical students in different settings in order to demonstrate their viability and usefulness, especially for the collection of health data and dissemination of medical information. The project was conducted in Ghana, Uganda, and Kenya during December 2001-December 2002. SATELLIFE worked in partnership with a number of ground level partners, including the American Red Cross; Makerere University Medical School in Kampala, Uganda; HealthNet Uganda; Moi University Faculty of Health Sciences in Eldoret, Kenya; and the Indiana University Kenya Program. The project received financial support from the Acumen Fund.

Bridges.org was engaged as an outside consultant to conduct an independent evaluation of the PDA trial.[2] The bridges.org evaluation focused on the aspects of the project implemented in Uganda and Kenya, and both qualitative and quantitative data was collected during site visits to Makerere and Moi Universities in October 2002. Project partners and participants were interviewed and participants were surveyed through the use of a questionnaire. However, the evaluation also took into consideration the findings from the Ghana PDA experiment as well as several mid-term evaluations on the Uganda and Kenya activities, which were reported by others. The overall objective for the bridges.org evaluation was to gauge the viability and usefulness of the PDAs in these healthcare settings, by looking at the technology itself, the content loaded on it, and the impact that the PDA had on the behavior of health professionals and the quality of care they delivered.

[1] According to Medilinks, see http://medilinks.org/HealthTopics/Diseases/Malaria/malariaupdate1.htm.
[2] For more information on bridges.org see Annex 16, and see also http://www.bridges.org.

This evaluation report presents the lessons learned in this project to inform decision-making about future uses of PDAs and other ICT for development. It is also intended to provide resource materials for planning and implementing future steps in the SATELLIFE project or related initiatives. The intended audience for this evaluation includes: the Acumen Fund and its investors, SATELLIFE and its staff members, project partners, project participants, future donors, technology companies, other research and development organizations, government bodies, and other non-governmental organizations (NGOs).

2 ABOUT THE SATELLIFE PDA PROJECT

2.1 Project overview

The goal of the SATELLIFE PDA Project was to demonstrate the viability of handheld computers for addressing the digital divide among health professionals working in Africa. The project intended to explore questions related to the selection and design of appropriate, affordable technology and locally relevant content for use in this environment, specifically targeted at assessing the usefulness of the PDA for (1) data collection and (2) information dissemination. Physicians, medical officers, and medical students tested the PDA in the context of their daily work environments in order to gain a perspective on the real issues that affect the adoption of technology.

The project was conducted in three phases. The Ghana phase was implemented during 8-14 December 2001 with a health survey using American Red Cross field volunteers. In January 2002, SATELLIFE held a meeting of project partners to finalize the project design and content for the Uganda and Kenya phases; the experiences and results from the Ghana phase served to inform the planning of next steps. The Uganda and Kenya phases ran roughly in parallel during February-December 2002. The Uganda project targeted practicing physicians, while the Kenya project aimed at medical students. For a complete timeline of activities, see Annex 1.

2.2 The institutions involved

United States

⇒ This project was inspired and led by *SATELLIFE*, a non-profit 501(c)(3) organization based in Massachusetts, USA. SATELLIFE's mission is to improve health in the world's poorest nations through the innovative use of ICT. It promotes the use of appropriate, affordable technologies to link health professionals in developing countries to each other and to reliable sources of information, including by using geostationary satellites, modem-to-modem telephone links, and the Internet. SATELLIFE advocates for affordable access to ICT, publishes health information, and administers online discussion groups. All of SATELLIFE's information services are free of charge. For more information on SATELLIFE see http://www.healthnet.org. Key actors involved in this project include:

- Holly Ladd, Executive Director
- Amy Galblum, PDA Project Manager
- Rebecca Riccio, Director of Programs
- Leela McCullough, Director of Information Services
- Balazs Kosaras Technical Director

"HealthNet" is the name of SATELLIFE's global communication network, which links healthcare workers around the world via e-mail. It has come to encompass SATELLIFE's information resources,

as well as the e-mail technology. With over 10,000 members worldwide, HealthNet is not just about technology or content, it is a network of people working together to build healthier communities. Since its inception, SATELLIFE has worked with ministries of health, medical schools, medical libraries, and other health facilities to build locally owned and managed HealthNet networks. Each HealthNet has evolved according to local needs. In some instances, HealthNet serves a single institution; in others, it extends throughout a region or country to serve a much larger community. The services provided by HealthNet partners vary. All of them provide free or low-cost email and Internet access to HealthNet Information Services, but they may also provide locally generated information resources, information technology (IT) training, electronic conferences, and Web-based services such as Web telephone and Web site hosting. SATELLIFE supports its HealthNet partners by providing hardware and software, technical training for systems operators, technical support, and consulting on program development and business planning. SATELLIFE worked with HealthNet Kenya to establish the first IT training center for health professionals in Africa.

⇒ The *Acumen Fund* (Acumen) funded the project. Acumen brings a new and unique approach to development aid, which focuses on the accountability of project proponents to investors. Acumen identifies high-impact social organizations (both for-profit and non-profit), connects them to philanthropists who want measurable social results for their investment, and measures the result of the impact. Each portfolio is structured around a focused theme – such as innovative health technologies – and contains a mix of organizations and strategies for tackling related social problems. Rustom Masalawala, health technologies portfolio manager, was in charge of this project for the Acumen Fund. For more information see http://www.acumenfund.org.

Ghana

⇒ The *American Red Cross* (ARC) was the local implementation partner that conducted the measles survey using the PDAs in Ghana. ARC is a humanitarian organization led by volunteers that carries out a number of international programs together with a global network of Red Cross, Red Crescent and equivalent societies, to improve basic living conditions of those in chronically deprived areas of the world and empower people with the skills they need to help themselves. As part of its primary health care programs, the ARC trains local health promoters, volunteers and caregivers to advocate and teach proper health practices such as breast-feeding, sanitation and the detection of early signs of disease in children. This network of health promoters, including youth/peer educators, is the critical community link for national and local health prevention programs such as vaccine campaigns, distribution of bed nets against malaria and HIV/AIDS awareness. The Measles Initiative is a long-term commitment to control measles deaths in Africa by vaccinating 200 million children, preventing 1.2 million deaths over five years. Leading this effort are the American Red Cross, United Nations Foundation, Centers for Disease Control and Prevention, World Health Organization, and United Nations Children's Fund. For more information see http://www.redcross.org. Key actors involved in this project included:

- Rose Donna, Business Operation Systems Department, American Red Cross
- Mark Grabowsky, Senior Technical Advisor, International Services, American Red Cross
- Marianne Patton, Manager of the Measles Initiative, American Red Cross
- Yaw Dankwa, Information Officer, Ghana Red Cross
- Enyunam Acolase, Ghana Red Cross

Uganda

⇒ The local implementation partners in Uganda were *Makerere University Medical School*, and *HealthNet Uganda*. Makerere University is located in Kampala, the capital of Uganda. With a student population of over 20,000, it ranks as one of the largest universities in East and Central

Africa. Makerere was first established in 1922 as a technical school; today it has twenty faculties offering day and evening classes as well as external study programs. The Medical School of Makerere University is located within Mulago Hospital. This teaching hospital has casualty services for undergraduate classes in medicine and surgery, clinical departments with consultative outpatient clinics, and diagnostic laboratories for hematology, clinical chemistry, and microbiology. The Medical School is made up of 19 departments and offers both undergraduate and postgraduate medical degrees. Facilities include The Albert Cook Library, containing the largest collection of medical literature in East Africa, research facilities, and a Rural Health Center. For more information see http://www.makerere.ac.ug/. Key actors involved in this project included:

- Professor N.K. Sewankambo, Dean of the Faculty of Medicine, Makerere University
- Paul Ekwaru, Data Analyst

⇒ *HealthNet Uganda* is located in the Medical School of Makerere University and serves a wide array of users, including medical faculty, doctors, researchers, students, and other health workers with low-cost email, Internet access, and other information services. There are currently about 60 sites connected to HealthNet Uganda, including the Mulago Hospital, which is the main referral and teaching hospital in Uganda. SATELLIFE played a founding role in HealthNet Uganda and continues to support its operations and services. HealthNet Uganda has also established a computer training center using a model and training materials developed by SATELLIFE. HealthNet Uganda has trained nearly 100 medical personnel in basic Internet tools. HealthNet Uganda also collaborates with the World Health Organization's Health InterNetwork at Makerere University to offer training and networking for health professionals. For more information see http://www.healthnet.org/hnuganda.php. Key actors involved in this project included:

- Fred Kakaire, Project Field Manager, SATELLIFE and HealthNet Uganda
- Ceasar Barole, Project Site Coordinator, HealthNet Uganda

Kenya

⇒ The local implementation partners in Kenya were the *Moi University Faculty of Health Sciences (Moi)* and the *Indiana University (IU) Kenya Program.* The Moi University Faculty of Health Sciences is located in Eldoret, Kenya, a town of 400,000 people. The Faculty currently runs three undergraduate and one postgraduate program, and has 24 departments. The mission of the Faculty of Health Sciences is to promote lifelong learning, research, and communication skills in addition to emphasizing the promotion of good health, disease prevention, and curative hospital based medicine. The Faculty emphasizes student-centered and problem-based learning with a focus on learning rather than teaching, and a community-oriented approach. The medical school was established in 1990 and it is located within the Moi Teaching and Referral Hospital complex. The complex has office accommodation for all the staff, and offers teaching facilities, a library, and a Skills Laboratory. The students work in the hospital and in urban and rural health centers, functioning in many ways as community public health workers. For more information see http://www.mu.ac.ke/fhealth/introduction.html. Key actors involved in this project included:

- Dr. B.O. Khwa Otsyula, Dean of the Faculty of Health Sciences, Moi University
- Dr. Joseph Rotich, Professor, Moi University
- John Bii, Network Administrator, Faculty of Health Sciences, Moi University

⇒ The *Indiana University Kenya Program* is a collaborative educational project and medical research consortium launched in 1990 and led by Indiana University. A number of other US medical schools participate in the Program, including Brown University. The goals include enhancement of medical education at US and Kenyan institutions, promotion of collegial relationships between American and

Kenyan medical doctors and students, and the development of health care leaders. The program focuses on training medical practitioners for rural settings and on HIV/AIDS treatment and prevention. Kenya Program participants work in the Moi Teaching and Referral Hospital in Eldoret, and in urban and rural health centers. Several full-time faculty members from the participating US institutions work on site to share with their Kenyan counterparts responsibilities for teaching, patient care and curriculum. Residents and students from the participating US institutions may choose to take an eight-week elective during which they are based in Eldoret. The partnership helps satisfy Moi University's need for additional academic instructors while also creating new professional opportunities for medical faculty, staff, and students. For more information see http://www.indiana.edu/~ird/cieda/moi.htm and http://medicine.iupui.edu/kenya/program.html. Key actors in this project include:

- Dr. Joe Mamlin, Director, Kenya Program, Indiana University (IU)
- Dr. Doug Shaffer, Research Coordinator, Kenya Program, Indiana University (IU)

⇒ Dr. Jane Carter of *Brown University* was the initial point of contact that introduced SATELLIFE to the IU Kenya Program and Moi University. Brown University also developed HIV/AIDS treatment guidelines specifically for this project.

2.3 The technology used

PDA hardware

The criteria used to select the PDA for the project were price, power source, power consumption, performance, features, screen quality, memory capacity, and operating system. Battery-powered units were selected because it was uncertain whether participants would have ready access to sources of electricity required for the use of rechargeable units. The project also intended to test battery-powered units with an eye toward future uses of PDAs in rural locations where electricity would be less accessible. Cost was a key criterion because of project budget limitations, and also in consideration of future use of technology in developing country environments.

⇒ The PDA used was the *Handspring Visor Neo*, with a 33 MHz DragonBall VZ microprocessor from Motorola, a Palm operating system (Palm OS), and 8 MB of main memory. It has a monochrome screen. It runs on two AAA alkaline batteries. It comes equipped with a stylus, a pointing device used for making screen selections and inputting data. For more information on Handspring see http://www.handspring.com or for more information on the Visor Neo see http://www.handspring.com/products/visorneo/index.jhtml?sub_nav_section=Overview&prod_cat_name=Neo.

Survey design software

The options for off-the-shelf software to design survey forms on a PC and collect survey data from the PDAs were limited. The criteria used to select the software were ease of use (especially for non-programmers), efficiency, and PC interface.

⇒ *Pendragon Forms* v*3.1* was the software program used to create the survey forms. It creates handheld data collection forms for any Palm OS device without requiring additional programming. It consists of three components. The Forms Manager is an Access 97/Access 200X database application (Microsoft Access is not required to use this program) that runs on a personal computer (PC), which includes a Form Designer and some simple tools for viewing, managing and exporting data. The Forms Conduit is a bridge between forms on the PC and forms on the handheld device, and it runs

during each data transfer synchronization process, or "hotsync". The Forms Runtime is a forms program on the handheld device. For more information, see http://www.pendragon-software.com/.

2.4 The medical reference materials used

Drug lists and treatment guidelines

SATELLIFE originally intended to employ a comprehensive drug database and treatment guidelines in this project that would be ready-to-use with PDAs. However, many of the ready-to-use materials identified were found to be inadequate or unfeasible largely because of their orientation toward the US and European drug markets, with little relevance to Africa. Therefore, certain content had to be compiled from other sources and adapted for use with the PDAs. In particular, country-specific drug lists and treatment guidelines were obtained by SATELLIFE in hard copy or electronic formats and adapted to a PDA-accessible format. The following content was made available on the PDAs used in Kenya and Uganda, as appropriate:

- World Health Organization (WHO) Model Essential Drug List[3]
- Country-specific drug list for Uganda[4]
- Country-specific drug list for Kenya
- Uganda Ministry of Health HIV/AIDS treatment guidelines[5]
- Uganda Ministry of Health Tuberculosis guidelines[6]
- Uganda Ministry of Health malaria treatment guidelines[7]
- Brown University HIV/AIDS treatment guidelines for Kenya
- World Health Organization TB treatment guidelines for Kenya
- Malaria treatment guidelines for Kenya

Medical textbook and reference materials

Medical texts were obtained from Skyscape, a publisher of medical reference books in the Palm OS and Pocket PC format. Skyscape gave a substantial discount on 80 copies of various reference titles and donated 80 copies, including:

⇒ *Griffith's 5-Minute Clinical Consult* (5MCC™) is a clinical reference tool for students and practitioners containing topic areas that are indexed with terms and medications so the information can be found quickly. (Published by Lippincott, Williams and Wilkins) (3.8MB)

⇒ *A-Z Drug Facts* is a drug guide with the latest US Food and Drug Administration approvals, indications, dosages, side effects, and patient care considerations as well as information on over 700 generic and 2,800 trade name drugs. (2.2MB)

⇒ *The Harriet Lane Handbook* is a reference guide for healthcare professionals who work with children containing a variety of topics including pediatric medications and dosing, fluid and electrolyte management, developmental milestones, and other pertinent topics relevant to Pediatrics. Chapters

[3] Essential drugs are those that satisfy the health care needs of the majority of the population of a country and should therefore be available at all times in adequate amounts and in the appropriate dosage forms.

[4] Country-specific essential drug lists take into consideration prevalent diseases, treatment facilities, training and experience of health personnel, financial resources, genetic factors and demographic factors.

[5] HIV/AIDS guidelines give practical advice for the medical management of HIV infection and other issues surrounding HIV infection.

[6] TB guidelines give practical advice to healthcare professionals and national TB programs in the effective management of TB.

[7] Malaria guidelines deal with the objectives of malaria treatment, the parasites and risk groups involved, and methods for the diagnosis and treatment of malaria.

on Psychiatry, Surgery, and Oncology, fully updated drug information with lactation and safety in pregnancy information, and full trade name and generic name drug index are also included. (2.0MB)

⇒ *5-Minute Pediatrics* is a reference tool covering over 500 pediatric clinical diagnosis and treatment topics divided into six categories including Database, Differential Diagnosis, Data Gathering, Physical Examination, Laboratory Aids, Emergency Care, Therapy, Follow Up, and Q&A. (2.0MB)

⇒ *Pocket OB/GYN* is a medical reference tool containing diagnostic guidelines, recommended tests, therapeutics, and dosage schedules. (0.3MB)

For more information about Skyscape, see http://www.skyscape.com/index/home.asp.

The units also contained MedCalc, a freeware program that has about 40 medical calculators, including a pregnancy calculator. In addition, SATELLIFE provided a list of websites where materials could be downloaded, see Annex 2.

2.5 Overview of implementation for the three project phases

This section generally describes how each of the project phases unfolded in Ghana, Uganda, and Kenya. For more information on implementation, see the three project updates issued by SATELLIFE on 6 March, 6 May, and 1 August 2002, as well as the calendar of key project events, which are attached as Annexes 3, 4, 5 and 1, respectively.

2.5.1 Ghana

SATELLIFE first put the handheld computers to use for field surveys, by linking this project to a widespread measles immunization campaign being conducted in Africa by the American Red Cross in December 2001. Normally, the Red Cross uses paper surveys to gather data, which is then manually entered into a database and analyzed to plan for follow-up campaigns. The objective of the SATELLIFE-ARC joint effort was to use PDAs in a short-term survey intended to determine the efficacy of the measles immunization campaign outreach efforts and collect some baseline health information.

SATELLIFE provided ARC with 30 PDAs. Following its approval by the Ghana Ministry of Health, the survey was loaded onto the PDAs by SATELLIFE. A user-satisfaction questionnaire to be completed by the PDA users at the end of the project was also included on the devices. The PDAs were then shipped to Ghana along with a SATELLIFE-developed training manual that explained the use of handheld computers in conducting a survey.

Thirty volunteers from the Central Region of the Ghana Red Cross were chosen to participate in the project based on their experience as Red Cross District Officers, Mothers Clubs leaders and long-term local volunteers. The volunteers received a stipend as an incentive for participation.

The volunteers were trained over a two-day period. They then used the PDAs to conduct an exit survey, questioning people as they left immunization sites about the occurrence of measles, the mortality rates seen, and the number of children not previously vaccinated. Information was collected during the three-day immunization campaign, at 67 locations over a wide geographical area.

Survey data was turned in at noon on the following day. A total of 2425 records were returned. Once invalid records were excluded the final database included 1900 records, for a completion rate of 78%. Analysis was completed promptly after the data was uploaded onto a computer, and then written up as a

complete report for the Ministry of Health within five hours. An expert data analyst oversaw training, data collation, and analysis. The entire process was completed within a seven-day period.

An additional volunteer was sent out with identical instructions to conduct a paper and pencil version of the survey. The 30 paper surveys completed by this volunteer took approximately 30 minutes to enter into a database. At that rate it would have taken over 40 hours to enter by hand the same number of surveys that were collected electronically using the PDAs.

For more information see the full SATELLIFE report on the Ghana phase of the PDA project, which is attached as Annex 6.

2.5.2 Uganda

Objectives and practicalities

The Uganda phase of the project took place in Kampala during March-December 2002. As noted above, it was implemented in cooperation with Makerere University Faculty of Medicine (Makerere). Professor N.K. Sewankambo, Dean of the Makerere Faculty of Medicine, acted as a main point of contact and local champion for the project. HealthNet Uganda, located at Makerere, acted as a local implementation partner and full-time SATELLIFE project field manager Fred Kakaire was based there to coordinate implementation at ground level. HealthNet Uganda site coordinator Ceasar Barole provided technical support and project assistance. Makerere received a stipend to cover the costs of its participation in the project.

The objectives of the Uganda phase were to test the use and usefulness of PDAs by medical practitioners to (1) conduct epidemiological surveys on malaria and TB, and (2) access and use certain medical reference tools and texts. SATELLIFE provided Makerere with 40 PDAs, 20 modems, and 20 back-up modules. A laptop computer was provided for uploading and downloading files and applications, and storing project information, along with synchronizing software and a "hotsync cradle" used for synchronizing the PDAs with a computer. The PDAs were shipped without content, which was added later; they were loaded with data collection application for conducting surveys (see Section 2.4 of this report). Each participant received a PDA that came equipped with either a back-up module or a modem. In exchange for participating in the project, each PDA user was granted ownership of the PDA (and extra hardware received) upon completion of the project. Makerere retained ownership of the laptop and cradles.

As agreed at the outset, local implementation responsibilities for Makerere and HealthNet Uganda included assisting with the recruitment and training of participants, maintaining a database of user information, facilitating deployment of equipment, facilitating collection of data from participants and uploading new material onto the PDAs, maintaining an inventory control system to track the PDAs and the laptop during the year, replacing batteries in the PDAs, trouble-shooting problems for the participants, and participating in all project evaluation activities. Makerere and HealthNet Uganda communicated regularly with SATELLIFE about issues that came up during project implementation and required modifications.

Participants

Participants were recruited from among actively practicing medical professionals in the larger, urban Kampala area. The key criteria for selecting participants were that they would be practicing physicians or medical officers, which treated malarial patients. Information was provided to eligible participants and the first to register were enrolled. Most were physicians or medical officers working in public, private-

for-profit or private-not-for-profit health care facilities including Mulago, Rubaga, Nsambya, Mengo, and Kampala International Hospitals, as well as Kampala City Council satellite health centers and clinics. Most were located in the environs of Makerere University where Internet access and technical support were available.

A total of 40 participants were initially recruited. Nine of the original participants subsequently dropped out of the project because they moved, their workload was too heavy for them to participate effectively, or they were ineligible because they did not meet the selection criteria. Others were later added to the group, and at the time of the evaluation in October 2002 there were a total of 37 PDA user participants active in the project. Only four participants were not practicing physicians or medical officers.

Training

An initial training session was held on 16 April 2002 to teach participants how to use a PDA for data collection, retrieval of information and equipment maintenance like changing batteries and trouble-shooting minor problems. The project objectives, methodology, and the role of participants were also explained to them. No formal training was provided in how to use the modem. Smaller or individual training sessions continued as needed to instruct those who could not attend the training or who joined the project later. A training manual was also provided. Fred Kakaire and Ceasar Barole were available at all times to provide technical support and trouble-shooting advice to participants throughout the project.

Health data collection

The Uganda phase was implemented in two parts. First, there was an initial period of data collection through patient interviews conducted by the project participants. An epidemiological survey on malaria was developed by SATELLIFE and loaded onto the PDAs before shipping (the text of the malaria survey is included as Annex 7). The doctors entered the survey information from each patient interview directly into the PDAs. It was intended that surveys on TB and HIV/AIDS would also be added, but at the time of the evaluation that had not been accomplished because SATELLIFE has been unable to identify an ongoing project to which such data collection would be meaningful. Since it is physician behavior in using the PDAs that was being studied, patient data was collected anonymously and therefore no consent was obtained from patients.

Data from the malaria surveys was periodically downloaded from the PDAs to a laptop computer. It had been planned that the participants would come to the HealthNet Uganda office once a week to synchronize the data from their PDAs, and some did so. Fred Kakaire also visited the participants on a regular schedule to collect survey data; he also provided technical support and supplemental training during these visits. Malaria survey data for a total of 1221 patients was submitted from participants as of October 2002. Makerere University data analyst Paul Ekwaru compiled the information collected in the malaria survey and drafted a report on the results.

Medical reference materials and tools

In mid-July 2002, the HealthNet Uganda team worked with the physicians to load the PDAs with relevant health reference materials. The physicians were given Uganda-specific treatment guidelines and drug lists, a medical calculator, and a choice of two titles from Skyscape, which together used up the available memory on the PDA. For more information on the content loaded on the PDAs and the Skyscape texts available to the physicians, see Section 2.4 of this report.

Other

SATELLIFE executive director Holly Ladd visited the site in June 2002, reviewed project progress with the local partners and helped them frame needed adjustments. In July, participants filled out a

questionnaire regarding their experience thus far. During August, SATELLIFE distributed packets to the PDA users to thank them for their participation in the project and to encourage their continued engagement. The packets included "hot tips for PDA users", a list of sites where they could download additional free applications for the PDA, information about SATELLIFE's other services, and a new stylus.

2.5.3 Kenya

Objectives and practicalities

The Kenya phase of the project took place in Eldoret, Kenya during February-December 2002. As referenced above, it was implemented in cooperation with Moi University Medical School (Moi) and the IU Kenya Program. Dr. B.O. Khwa Otsyula, Dean of the Moi Faculty of Health Sciences, acted as a key point of contact and local champion for the project. SATELLIFE's initial relationship with Moi was based on introductions made by Brown University Medical School contacts, through their participation in the IU Program. Moi staff members Dr. Joseph Rotich and John Bii worked together with IU Kenya Program director Dr. Joe Mamlin to handle local implementation. IU research coordinator Dr. Doug Shaffer joined the effort in September 2002. Fred Kakaire, the SATELLIFE field manager in Uganda also traveled frequently to Kenya and helped to coordinate implementation. Moi received a stipend to cover the costs of its participation in the project.

The objectives of the Kenya phase were to test the use and usefulness of PDAs by students to (1) collect field survey information, and (2) access and use certain medical reference tools and texts as part of their studies. SATELLIFE provided Moi University with 40 PDAs. The PDAs were delivered to Kenya in two shipments. The first 10 PDAs were sent without any information content, which was added later, but they were set up to use a Pendragon survey form. The additional 30 PDAs were sent with medical reference materials included as well. A laptop computer was provided for uploading and downloading files and applications, and storing project information, along with synchronizing software and a hotsync cradle. Back-up modules and modems for the PDAs were also made available, but for the most part they were not used in this project. Moi University retained ownership of all of the hardware upon completion of the project.

As agreed at the outset, local implementation responsibilities for Moi and the IU Kenya Program included assisting with the recruitment and training of participants, maintaining a database of user information, facilitating deployment of equipment, facilitating collection of data from participants and uploading new material onto the PDAs, maintaining an inventory control system to track the PDAs and the laptop during the year, replacing batteries in the PDAs, trouble-shooting problems for the participants, and participating in all project evaluation activities. Moi and the IU Kenya Program communicated regularly with SATELLIFE about issues that came up during project implementation and required modifications. The specifics of the project implementation were defined largely through email in late January and February 2002 between SATELLIFE and the IU Kenya Program director, Joseph Mamlin, who was on-site at Moi. SATELLIFE executive director Holly Ladd visited the site in June 2002, reviewed project progress with the local partners and helped them frame needed adjustments. Following mid-term evaluations of project implementation in July, a number of administrative changes were made to the project and implemented from the beginning of the new academic year in September. Moi and IU Kenya Program staff members offered a renewed commitment to project over-sight at that time.

Participants

The Kenya phase was implemented in four parts, which involved 2nd and 4th-year health science students, and two groups of 6th-year medical students, respectively.

Collection of health data

(1) During February-March 2002, students were to use the PDAs to collect data in field surveys as part of a 2nd-year Community Based Education and Service (COBES II) survey design class. There were about 50 medical students and 35 others (nursing and environmental health students). The students started in the classroom, planning and writing a survey on general public health issues. The PDAs arrived in Eldoret on 19 February 2002, and the survey was translated to a PDA format using Pendragon Forms. The students received a one-day training course in the use of the PDAs for conducting surveys. A total of 10 PDAs were given to 10 groups of approximately eight students each, who were to share the PDAs during a three-week period in the field. The various groups were dispersed in several rural villages throughout the region where they conducted the survey. The students were to use the PDAs by entering survey information from each interview directly into the PDAs; because they were sharing the PDAs, they would also use the PDAs in the evenings to enter data collected using paper during the day in order to speed up data processing at the end. Plans for downloading data from the PDAs to the laptop computer were not clearly set out with the students, but the intention was that Joseph Rotich would assist the students with technical support and downloading data during visits in the field. Otherwise, the students were to download the data to University computers for analysis upon their return to Eldoret.

(2) During May-July 2002, 4th-year Community Based Education and Service (COBES IV) students used the same 10 PDAs to collect data in a more advanced survey class. Each student designed their own health science survey, which again had to be translated into the Pendragon software for use with the PDAs. The sixty students in the COBES IV class balloted (or drew straws) to select the ten that would use the PDAs. The students conducted research at the Moi Teaching and Referral Hospital and in Eldoret Municipality on a variety of subjects ranging from smoking among adolescents to maternal mortality. When the students received the PDAs in early May, they were nearly finished with the survey aspects of their projects and were beginning the analysis phase, so the PDAs were intended to help them enter survey data and conduct analysis. Fred Kakaire helped the students translate the surveys into Pendragon Forms, download the surveys onto the PDAs, and trained the students during 5-6 May. The students conducted research at Moi Teaching and Research Hospital and Eldoret Municipality during May-June and the project was completed in July.

Use of medical reference materials and tools

(3) During April-July 2002, 6th-year medical students who were in clinical rotations used the PDAs to access medical information and reference materials. The 6th-year students go through five, eight-week rotations. A total of 30 PDAs were provided to students on Internal Medicine, Pediatrics and Obstetrics/Gynecology rotations. Following a delay in customs, the PDAs arrived at Moi in April just before the students started a two-week holiday. On 22 April, the students received a one-day training course to learn how to access information on the PDA, and they started using the PDAs midway through an eight-week rotation that ended on 26 May. At that time, the PDAs were loaded with relevant health reference materials (Kenyan treatment guidelines for HIV/AIDS, malaria, and TB, Essential Drug Databases from WHO and for Kenya, and a medical calculator; see also Section 2.4 of this report). The Skyscape reference materials were later transferred to Moi from SATELLIFE on 13 May and loaded onto the PDAs for use by the students during a second rotation of 27 May-21 July. Participants were required to synchronize the PDAs on a computer at the University computer lab once a week, so that the project could capture "hit" data on the number of times participants used the various applications.

(4) In September 2002, a second group of 6th-year medical students began using the PDAs to access medical information and reference materials as part of their clinical rotations. One of the 40 PDAs was broken; so 39 students received PDAs for use during the 9 September-3 November and 4 November-29 December rotations covered by this project. It is intended that this group of 6th-year students will keep

the PDAs throughout the remainder of the academic year until July 2003. The students are on five rotations: Internal Medicine, Surgery, Obstetrics/Gynecology, Psychiatry, and Pediatrics. No specifically relevant texts are available on the PDAs for the Surgery and Psychiatry rotations, but through the course of the year students will be able to use the texts that apply to the other topics.

Training

During each part, the students received training and training materials to instruct them on how to use the PDA for data collection or accessing information, as appropriate, as well as technical aspects like synchronizing data, back-up, and changing batteries. Training was offered in the form of a one-day initial training session, training manual, worksheet, and ongoing technical assistance. The worksheet consisted of simple exercises that gave the participants a chance to use the features of the PDA, so they could get comfortable with the PDA and find their way to the information it contained. The project objectives, methodology, and the role of participants were also explained to them. Fred Kakaire (and on one occasion Ceasar Barole) traveled from Uganda to conduct the training sessions. John Bii was available on-site to provide technical support and trouble-shooting advice to participants throughout the project.

3 EVALUATION OBJECTIVES AND METHODOLOGY

The overall objective for the bridges.org evaluation was to gauge the viability and usefulness of PDAs in healthcare settings in Uganda and Kenya, by looking at the technology itself, the content loaded on it, and the impact that the PDA had on the behavior of health professionals and the quality of care they delivered. This evaluation looked at two main questions:

⇒ Did PDAs prove to be an effective tool for physicians and medical students to collect health data and access medical information as part of their daily routine?

⇒ If not, why not?

It is impossible to gauge technology usefulness by merely looking at the strictly technical performance of the equipment; it is important to also consider how people use the technology and what affects their use. It is not really about the technology, it is about the people – the technology users. Bridges.org evaluated this project by using a concept it has coined as "Real Access = Real Impact". The idea is that, despite the potential benefits offered by ICT, computers and connections will mean nothing to people in developing countries if they do not *use* it effectively. People may have physical access to very useful technology, but they will not use it if it is not appropriate to their needs, if they cannot afford to use it, if technical support is unavailable, if it adds too much burden to their already busy day (or even if they just perceive that it will), or if there are laws that limit its use. So in order for ICT to have a Real Impact on ground level development, people in developing countries need to have more than just physical access to technology, they need to have Real Access. Even though the evaluation focused on the technology, it also took into consideration how the project itself was implemented on the ground to the extent that project implementation had an effect on the technology use.

This evaluation responded to the two questions above by considering the following 16 criteria that represent the determining factors of whether people have Real Access to technology:

(1) Physical access to technology.
(2) Availability and use of relevant content.
(3) Appropriateness of technology for data collection in this environment.
(4) Appropriateness of technology to local conditions.

(5) Affordability of technology and content.
(6) Training and skills required for effective technology use.
(7) Need for and availability of technical support.
(8) Integration of technology use into daily routines.
(9) Socio-cultural factors that affect technology use.
(10) Confidence in technology use in terms of privacy, security, or cybercrime.
(11) Public enthusiasm for technology use.
(12) The effects of the national legal and regulatory framework on technology use.
(13) Political will in government to enable widespread technology use throughout society.
(14) Impact of technology use on the community and larger society.
(15) Ideas and plans for future uses of the PDA.
(16) Key external challenges that may have limited technology use in this project.

3.1 Mid-term evaluations

SATELLIFE and its project partners have carried out a series of mid-term evaluations on this project, which were taken into consideration by bridges.org as part of this overall project evaluation. The source materials include:

⇒ SATELLIFE report on the December 2001 Ghana phase of the project; see Annex 6.

⇒ The 6 May 2002 evaluation report on the COBES II survey class that presents the findings of a post-use questionnaire (Kenya); see Annex 8.

⇒ The 8 August 2002 evaluation report on the COBES IV survey class that presents the findings of a post-use questionnaire (Kenya); see Annex 9.

⇒ The August 2002 evaluation report on the first 6th-year class to use the PDAs that presents the findings of a post-use questionnaire (Kenya); see Annex 10.

⇒ The August 2002 mid-term evaluation report on the Ugandan physicians progress with the PDAs that presents the findings of a questionnaire; see Annex 11.

A number of key lessons learned were gleaned from these evaluations, and SATELLIFE and its partners introduced a number of appropriate changes to overcome the identified challenges. For more information on the lessons learned and adjustments made, see the project updates included in Annexes 3, 4 and 5.

3.2 The bridges.org evaluation

The evaluation involved three groups of key stakeholders:

- *Project participants:* physicians, medical officers and students who used the PDAs;
- *Project partners:* representatives of Makerere University, HealthNet Uganda, Moi University, and the IU Kenya Program who were involved in project implementation; and
- *Project management:* SATELLIFE staff members and the Acumen portfolio manager in charge of this project.

The project evaluation combined quantitative and qualitative data collection. Information was collected from background documents and reports, site visits, unstructured interviews, and questionnaires.

⇒ *Background documents*: SATELLIFE provided extensive background documents on the project that explained the history and mechanics of implementation. Key source materials are included as Annexes to this report. General research on the use of handheld computers for healthcare (or anything else) in developing countries showed few examples and no conclusions.

⇒ *Site visits*. The bridges.org evaluator visited Kampala during 7-11 October and Eldoret during 15-18 October 2002 to observe and interview the partners and participants in their work environments. These visits helped to put the project into the context of the real-life conditions that the healthcare providers face in their daily work at the hospitals and clinics.

⇒ *Unstructured interviews*. In-depth interviews were conducted in Uganda and Kenya using an unstructured approach. The evaluator used initial guiding questions and core concepts to get the interview going, but the questions were mainly open and the conversation was allowed to move freely toward any direction of interest that came up. This method was used to explore broad topics and allow the participants to focus on the issues that mattered the most to them. Some of the guiding questions and core concepts used to spark discussion included:

- Previous experience with ICT?
- Thoughts on the training? Sufficient? How long did it take to master PDA? Graffiti?
- Thoughts on the PDA? Practical? Functional?
- How did you use it? Did it fit in your daily routine?
- How do you normally get information? Was the PDA content a replacement of or addition to textbooks? Thoughts on the content / reference materials?
- How did it work for conducting surveys?
- Did you use the PDA for other things? Personal use?
- Did you have any problems? Thoughts on technical support?
- Did you have any security concerns? Where did you keep the PDA?
- What is the best thing about the PDA? Greatest benefit?
- Would you recommend a PDA to your colleagues? Would you buy one with your own money? Would you buy an electronic textbook with your own money? If you had to choose, would you prefer to own a textbook in a hardcopy edition or in an electronic format?
- Other ways you could see this technology being used? In community and society? Healthcare? Other?
- Do you have any anecdotes that you can share that would highlight your experience or make a point about the technology use?

Interviews were carried out with 27 of the 37 participating physicians and medical officers in Uganda, and 27 of the 39 6th-year medical students who were currently using the PDAs in Kenya. Most of the interviews were conducted one-on-one, however some were conducted in small groups of two or three, and two interviews included as many as eight. Interviews with SATELLIFE and Acumen were conducted by telephone. A list of project partners and participants interviewed is included in Annex 12.

⇒ *Questionnaires*. Questionnaires that asked about the participants' experiences with the PDA and the project were also used to collect information. The questionnaires were designed with SATELLIFE's input, and were specifically intended to follow up on issues raised in the mid-term evaluations. The questionnaires focused on the effectiveness, relevance, and appropriateness of using handheld devices for information dissemination and survey collection in the healthcare setting. They aimed to assess whether using the PDAs led to changes in behavior such as the way participants prescribed

medications, accessed information, or interacted with patients. Both close and open-ended questions were included, giving participants a chance to comment in their own words on their use of the PDA.

The questionnaires were given to the project participants following the interviews, and everyone that was interviewed completed the questionnaire (again, 27 of 37 in Uganda, and 27 of 39 in Kenya). Sample questionnaires with a summary of the results are attached as Annexes 13 and 14; samples of participant comments are included after open-ended questions, and general comments are included at the end of the questionnaire.

3.3 Limitations of this evaluation

The qualitative information collected during the interviews could not be taken to represent the views of all project participants, although 73% and 69% of the total participants were interviewed in Uganda and Kenya, respectively, and the views gathered can be considered strongly indicative of trends. Because some of the interviews were conducted one-on-one and others were conducted in groups, there was a variation in the kind of information gathered. While one-on-one interviews tended to provide very in-depth coverage of certain issues that mattered the most to the particular participant, group interviews tended to be much more far-ranging and the participants talked among themselves, but comments by one often sparked ideas among the others so that group consensus about key points emerged.

4 RESULTS OF THE EVALUATION[8]

4.1 Physical access to technology

Measure	**Comments**
ICT access at national level[9]	Overall, ICT access is low in both Uganda and Kenya, however both governments are working to improve the situation. The current population of Uganda is approximately 24.7 million. There are 1.72 fixed line telephones per 100 people (as of 1999, there were only 57,200 fixed line telephones in the country, with a waiting list of more than 9,000 per year and an average waiting period of more than a year). Uganda has 322,700 mobile phone users (1.43 mobile phones per 100 people) with 83.5% of the total telephone subscribers in 2001 being mobile users. It has 0.31 computers per 100 people, and 60,000 Internet users. According to recent NUA surveys, around 90 percent of communication facilities in Uganda are concentrated in urban areas. Inter-city telecommunications traffic is carried by wire, microwave radio relay, and radiotelephone communication stations, with fixed and mobile cellular systems used for short-range traffic. International connections include two satellite earth stations (one Inmarsat and one Intelsat satellite) plus analogue links to Kenya and Tanzania. Kenya has a population of approximately 31.1 million. There are 2.96 fixed line telephones per 100 people with 50,074 main telephone lines in use. However as of 1998, 80,868 main lines have been installed (with a waiting list of about 120,600 over an average waiting period of 6.5 years). Kenya has an average of 600,000 mobile phone users (that is 1.92 mobile telephones per 100 people) with 68% of the total telephone subscribers being mobile users. It has 0.56 computers per 100 people, and 500,000 computer users. Like many under-developed countries, ICT infrastructure and access is largely biased towards urban areas in Kenya. For example, there are 7.11 telephones per 100 people in large cities, compared to 0.47 in the rest of the country. International connections include four Intelsat satellite earth stations.

[8] Unless specified, the results presented here focus on the October 2002 evaluation conducted by bridges.org in Uganda and Kenya. For example, where conclusions are drawn from the report of the Ghana stage, it is specified.

[9] Sources include: *CIA World Factbook*, 2002, http://www.odci.gov/cia/publications/factbook/geos/ke.html and http://www.odci.gov/cia/publications/factbook/geos/ug.html; *Basic Indicators Statistics Resource*, International Telecommunications Union (ITU), 2001, http://www.itu.int/ITU-D/ict/statistics/at_glance/basic01.pdf; *Cellular Subscribers Statistics Resource*, ITU, 2001, http://www.itu.int/ITU-D/ict/statistics/at_glance/cellular01.pdf; *Information Technology Statistics Resource*, ITU, 2001, http://www.itu.int/ITU-D/ict/statistics/at_glance/Internet01.pdf; United Nations Economic Commission for Africa (UNECA), http://www.uneca.org/AISI/NICI/kenya/kenyinfra.htm; *Ugandan Internet and mobile use soars*, NUA, 8 July 2002, http://www.nua.ie/surveys/index.cgi?f=VS&art_id=905358141&rel=true.

PDA access and use

PDAs are virtually unavailable in Uganda and Kenya. Obviously, this project put units into the hands of the participating healthcare professionals and students. However, only three of them had used PDAs before this study. The exceptions were Ugandan doctors who had previously worked in the United States and had the opportunity to purchase a PDA there. Participants in Uganda reported their use of the PDA during this study at an average of 4.25 hours per day and 9.38 hours per week, and in Kenya the figures were 2.10 hours per day and 12.08 hours per week (median two hours per day and 10 hours per week in both cases).

ICT access in healthcare environment

ICT access is also low overall in the healthcare environments of Uganda and Kenya, although it is clearly higher than the national average. All of the major hospitals and the medical schools visited used computers for administrative purposes, but only in limited ways. No data is available to confirm the assertion, but it seemed that most of the physicians and many of the students participating in this project owned a mobile telephone, but very few of them had a fixed line telephone, or their own PC in their home or office. However, virtually all participants were familiar with computers and most have regular access to computers. In Uganda, 74% of the participants that responded to the questionnaire used computers regularly for an average of 8.36 hours per week, and 63% used the Internet regularly for an average of 4.82 hours per week. In Kenya, 73% used computers for an average of 4.27 hours per week, and 52% had access to the Internet for an average of 1.05 hours per week (these numbers were higher among the second group of 6th-year students). The doctors and students have access to PCs with Internet connections in computer labs and/or at the library in the Universities. The HealthNet lab at Makerere had 25 computers and a broadband connection, and the Moi lab had 10 computers available to over 500 students, with modem dial-up connections.

While few small or rural clinics were visited as part of this evaluation, discussions with participants suggested that access to technology in rural healthcare settings is almost non-existent. This is consistent with national figures for ICT access.

For the participants in this study – and presumably also the future users of PDAs in developing countries – limited access to landline telephones and/or PCs affected their use of the PDA. For example, the project only used a few hotsync cradles and one laptop at each location, which were shared by the near 40 participants. Most did not have access to computer data storage other than in HealthNet Uganda and Moi University labs, and many complained that more hotsync cradles and back-up computers were needed. Moreover, backing up data would have been a hardship for them if they had not been able to use hard-drive storage space at the HealthNet and University labs. Some of the participants had access to modems for use with the PDA, but none of them had actually used a modem. Several said during interviews that they did not use the modem because they did not have a landline telephone. In Uganda, most of the participants used the back-up module effectively, and 88% who responded to the questionnaire reported that it was useful. Few of the participants in Kenya used the back-up module.

4.2 Availability and use of relevant content

Measure	Comments
Availability of locally relevant content in PDA format	Originally, the project planned to use "off-the-shelf" content for the PDAs, however that content proved not to be adequate or feasible in all cases, largely because it was too expensive or not relevant. Since PCs, PDAs and other technologies are not widely used in substantive applications in the healthcare field in Uganda or Kenya, it follows that no country-specific healthcare information was available which was also ready-to-use with a PDA. Drug database A comprehensive drug database was considered an important cornerstone for the information content on the PDAs, as drug information is often not readily available in Kenya and Uganda. There are several drug database applications available for the PDA that are available as freeware and shareware, including: ePocrates Rx, Dr. Drugs, and ePharmacopoeia, but none were deemed to be appropriate for use in Uganda and Kenya because they listed drugs that were not available, or with names and/or doses that were different from those recommended for the population. SATELLIFE decided to use the WHO Model Essential Drug List and the Uganda and Kenya country-specific drug lists. The WHO Essential Drug List was easy to access from the WHO website, but was not available in either a Word or Text version. The country specific drug lists for Kenya and Uganda were only available in hardcopy. Each of these three databases required somewhat different tactics for conversion into a format usable on the PDA. The WHO Model List was the most complex and involved several conversions from text to Excel to HTML. The list also had to be converted from a table into a vertical format to fit the width of the Visor screen. The Kenya list was scanned using optical character recognition (OCR) software, then converted to HTML, after which it was proofread to check for the OCR accuracy. The text from Uganda was retyped in Microsoft Word to capture it electronically, and then converted to HTML. Disease treatment guidelines The country-specific treatment guidelines also required a complicated conversion process to adapt them for use with the PDAs. The HIV/AIDS and TB guidelines for Uganda were obtained in hardcopy, typed out, and converted to HTML. The other guidelines were obtained in electronic formats and converted to HTML. Not all content was adaptable in its entirety, especially charts, graphs, and diagrams. Converting to the Palm OS involved numerous complicated steps. Content viewer Everything was converted to html browser format, so that the content would be accessible through an html browser loaded onto the PDAs (Pendragon freeware). This reduced the individual files and allowed for hypertext linking within the documents.

Medical textbooks

SATELLIFE included a comprehensive medical textbook on the PDA to address the paucity of medical information in Africa. Several PDA formatted texts were considered and *Harrison's Principles of Internal Medicine Companion Handbook* was deemed to be the best choice based on content and interface, also because it uses only 1.1MB of memory. However, the US$80 per copy for Harrison's was beyond the budget of the project, and permission to use the text at a reduced price could not be obtained from the publisher. The *5MCC w*as later selected as an alternative, and permission to use the text was quickly granted by Skyscape. *A-Z Drug Facts*, *The Harriet Lane Handbook*, *5-Minute Pediatrics*, and *Pocket OB/GYN* were also included on the PDAs. No text that specifically targeted tropical medicine was available for use with the PDA. However, other specialized texts were available; a list of materials available for download, which SATELLIFE provided to participants, is included here as Annex 2.

Other content

The MedCalc application was easily available as a freeware application. SATELLIFE had particularly intended to provide a pregnancy calculator, and was fortunate to find MedCalc that includes 40+ different medical calculators (including a pregnancy calculator).

For a complete description of the content challenges faced and solutions implemented in this project, see the 1 May 2002 report by SATELLIFE attached as Annex 14.

Use of content on PDA

In Uganda, participants reported their use of the PDA for accessing medical reference materials at a median of two hours per day and four hours per week, and in Kenya they reported three hours per day and 10 hours per week.

Ugandan participants did not use the Harriet Lane text, but Kenyans used all of the medical information provided on the PDA. All of the texts were rated as helpful in Uganda and Kenya. In both locations, the A to Z Drug Facts was the most popular reference tool. In Uganda, the 5MCC, malaria and HIV/AIDS treatment guidelines, MedCalc, and the drug lists were the most popular (listed in declining order). In Kenya, all the content was rated on a roughly equal basis. In both locations, the BMI calculator was the favorite calculator. A Uganda physician said that she used the calculator more than all of the other reference tools because it was "easier to use than normal scientific calculators and did all the functions very simply".

Quick consultations. One Ugandan physician raved about the 5-Minute Clinical Consultation: "One of the best pieces of support technology ever. You are there on your own, and there is no one to ask or a textbook to consult. This helps you think through things, and it leads you to the drugs you need." Another added that, "with many patients there are so many symptoms and variables, and you can't recognize a pattern. If you look at the PDA references, you can be more concrete. Up country, it is all about clinical judgment and there are no labs. The PDA tools can help you clarify things." He gave an example of one instance where he was treating an elderly man who had a heart problem and a variety of symptoms. He thought the problem might have been a tumor that was not identifying properly. But he used the consultation tool to check the features and compare, and he concluded that it was liver psoriasis.

Most participants did not have the facilities (Internet access, cradles, etc.) to enable them to download content onto the PDAs. Nonetheless, 18% of the participants who answered the questionnaire in Uganda downloaded other information onto their PDAs, and 22% in Kenya, including a virus scanner, Worldmate, and other programs.

Impact of content use

The participants in this study regularly used the medical reference materials provided on the PDAs, and they considered it a valuable tool. The content helped these physicians and students improve their provision of healthcare. In Uganda, only one participant did not think that using the medical reference materials on the PDA improved his ability to treat patients effectively. The comments participants made about how the PDA use helped them improve their treatment of patients were informative: "I was able to tell clearly the diagnostic treatment and explain prognosis"; the PDA gave "easy access to information which would have taken longer to acquire if I were to go for textbooks"; "quick access to information meant informed decisions"; and "correct dosages given and drug interactions known". In Kenya, 74% of the participants found the PDA to be useful on their rotations, and 78% felt that the use of the PDA to access information during patient consultations improved their ability to treat patients effectively. However, these figures are misleading, because all of the students that reported that the PDA was *not* helpful and that it did *not* improve their treatment were psychiatry and surgery students who did not have content on that PDA that was relevant for their specific rotation. (The relevant materials had not been sought out by SATELLIFE because originally the psychiatry and surgery students were not going to participate in the study.) So effectively, all of the students who had specifically relevant content on their PDA reported that it was useful during rotations and it helped them improve patient care.

Prior to this project, the majority of participants regularly consulted medical textbooks – either books that they personally owned or those they accessed at the library – seeking information on diagnosis, treatment, disease management, and drugs. The participants reported that the electronic reference materials on the PDA did not entirely replace textbooks (mostly because they did not have sufficient detail), but the electronic texts complemented other reference materials. However, participants said that after using the PDAs in the project they were most likely to look for medical information on the PDA. Other sources mentioned were Internet websites, medical journals, books, and colleagues.

Overall, the content on the PDA was used mostly for quick reference. In the interviews, the strongest message that came across was that the PDA content was as a time-saver. In Uganda, 96% said that they were able to find information quickly using the PDA, and 88% in Kenya. Both doctors and students reported that normally they would visit patients on the wards and then would often need to go back to check textbooks (such as in the library) to confirm treatment for patients. The PDA allowed them to make immediate diagnosis in many cases where previously they would have had to check elsewhere. Many of the participants previously carried a small booklet with drugs lists, but they marveled at having all of the information on hand with the PDA. Several participants mentioned that they had been aware that a medical text could be put on a CD and used on a computer, but they had not known that the same amount of information could be put on a PDA that they could have with them at any time.

Drug names and dosages. A Ugandan physician explained that many drugs are prescribed by their trade name and that they often come with a particular recommended dosage. But the recommended dosages can be different for the same drugs on the generic drug lists. For example, the A-Z might list a drug under its trade name with a recommended dosage of 250mg for an average weight person, but the Ugandan drug list might record the generic version of the same drug with a recommended dosage of 200mg for a slightly smaller "average" person. When doctors are inconsistent in their prescriptions, this can cause confusion for the pharmacist too. Using the PDA reference tools helped him learn the generic names so he could start from the basics with the dosages. He felt this would help him in the long-term. A Ugandan doctor recalled one instance when she was treating a pregnant woman for a skin infliction and she was not sure if they drug she wanted to prescribe – Griseofulvin – had contra-indications during pregnancy. A quick reference check on the PDA told her that the drug was okay to use.

Several participants said that one of the most important uses for the medical reference materials on the PDA was to calculate drug dosages, especially for children; they explained that getting the dosage right for children is often harder because they vary in size and weight, but it is also very important to get it correct because they are smaller and a high dosage can harm them. Other participants mentioned that they liked the PDAs because they could quickly check the side effects of a drug, which was especially useful when they were prescribing unfamiliar drugs. 42% in Kenya and 48% in Uganda said that they changed the drugs or dosages prescribed after using the content on the PDA. The comments they made about how the PDA helped them change their prescriptions were informative: "I was able to tailor dosages to particular patients"; "the readily available dosage regime made it easy to prescribe specific for age, e.g. cardine glycosida"; I was able to give more correct pediatric dosages than before"; and "it helped me confirm what I needed to get more information on".

In the interviews, many said that the treatment guidelines were difficult to navigate, but that the information was useful. In Uganda, 93% found the malaria treatment guidelines useful, in Kenya the figure was 84%; however most did not change their treatment of malaria as a result of having the guidelines on the PDA (only 28% in Uganda). The reason that treatment did not change was explained in their comments; for example one participant said "the information in the PDA is similar to

the one I already had, just made me more confident". Many said they used the guidelines more as a textbook to learn from than a reference tool for consultation. For example, looking through the disease summaries would "spark ideas" for them and remind them of things they had learned previously. However, Kenyan participants noted that the Kenya-specific TB guidelines provided on the PDA are not used at the Moi Hospital, which uses the Ministry of Health Guidelines. Participants explained that the treatment guidelines sometimes change regularly, and new versions are distributed in hardcopy from the Ministry. When the issue was discussed further, they concluded that if the Ministry would issue electronic versions, then guideline updates would be easier to distribute and convenient for doctors to integrate into practice.

The participants saw the content overall as a valuable tool, but were aware of the limitations. Many highlighted the fact that many of the drugs listed were not available in Uganda and Kenya. For example, some said that the A-Z was useful for theory but in practice was not helpful because it included drugs that had just been released on the market but which were not yet available locally, and many old drugs used locally were not included in the A-Z. Many participants also bemoaned the lack of specific guidelines for tropical medicine. However, most concluded that if the limitations of the PDA content can be overcome, the handheld device would be a very big step in enhancing practitioner knowledge of diagnosis, treatment, and patient management.

Speeding up patient care. A Kenyan student said, "What I'm used to is writing down something, then I go back to the books. With the PDA, I can make an immediate decision based on quick reference. It speeds up patient care."

During the interviews, many participants indicated that if given the choice, they would purchase an electronic book instead of a textbook.

4.3 Appropriateness and use of PDA for data collection in this environment

Measure	Comments
Use of PDA for data collection	Uganda The participants submitted from two to 154 surveys each. A total of 1221 surveys that could be used for data analysis were collected from the participants (some were discarded because they were incomplete). It was reported in earlier evaluations that the number of surveys completed was affected by the fact that the early months of the PDA project were not an active malaria season. All but one participant thought that PDAs were appropriate for collecting information (including 65% who said that it was "very appropriate") and the majority thought the electronic survey was easy to use. Several mentioned during the interviews that it took them a few days to "get the hang of it", and they thought that more training would have helped. The majority of the participants in Uganda felt that the information gathered in the survey was important, and all

but three (who did not answer the question) said that they wanted to see the report on the results of the survey.

There was no ready-to-use malaria survey available, so SATELLIFE had to create a survey for the Uganda phase and put it into a PDA format using Pendragon Forms. During the interviews, several of the participants complained that the survey was not well structured to fit the use of the PDA. In particular, they felt that there were too many open-ended questions that required them to write in answers, and they said this took them more time than it needed to (especially since many of them were not proficient with graffiti). Paul Ekwaru, the data analyst, also reported that the structure of the malaria survey had shortcomings, which affected the usefulness of the survey with the PDAs. He pointed out the importance of the survey being structured in such a way to elicit uniform answers – and the need for training the survey users to complete each of the fields in a standard way – in order for the computer to analyze all data input automatically. For example, the physicians often used different names or abbreviations for drugs, and they wrote the dosages in different ways. In these cases, the questions had to be entirely disregarded, since the data analysis could not be automated. Other questions were structured without standardized terms and that also made the data analysis more complicated than it needed to be, for example, when doctors chose among a number of variables in a field rather than choosing "yes" or "no" for each one.

The survey would have been more successful if the participating physicians had better understood the objectives for the study and what the data was to be used for. Several participants expressed frustration that they did not understand the objectives of the survey. They indicated that they only completed enough surveys to "meet their obligations" to the project and "do their part to prove that the technology is useful for this purpose". They said that they did not feel inspired to complete more surveys than necessary because they felt it was taking them away from patient care for something that they did not see the value of. They did not understand how the results would be used. Paul Ekwaru also indicated that it was difficult to analyze the data because he did not understand the objectives of the study.

Kenya

The evaluations of the COBES classes presented findings on use of the PDAs for data collection in Kenya. The COBES II students were generally not successful in conducting the field surveys using the PDAs. The PDAs were received at Moi just before the students went into the field, and there was not enough time to fully prepare them for using the PDA. The survey designed by the students for pen and paper questioning was ill suited to the Pendragon software requirements; consequently there was insufficient time to properly enter the survey into the Pendragon application and train the students to use the PDA. For example, graphs were used in the paper version, which could not be translated into Pendragon, and some of the questions were poorly worded for adaptation to the PDA. The students also reported concerns that the data was not entered accurately and the surveys were slower to conduct with the PDA than with paper and pen. The majority of the students did not use the PDAs, and those that did only used them to later input data they had actually collected on paper. Further, it was impractical to provide technical support to the students as they conducted surveys across the region, so they had little or no support for their PDA use in the field. For more information, see the 6 May 2002 COBES II survey evaluation, Annex 8.

The COBES IV students were also limited in their use of the PDA to conduct surveys. Again, the students received the PDAs after their class was underway, so the surveys were not designed with the forms software in mind. While the students had been trained to use the PDA, they were not proficient in using the survey software; many were frustrated that they did not know how to adjust their surveys once they had been loaded onto the PDA. Most of the students used the PDAs to enter data collected previously using a paper survey. The ten students conducted an average of 146 surveys or individual interviews (range of 47 to 384) for their projects; on average they entered 54 of those surveys into the PDA (range 0 to 210). For more information, see the 8 August 2002 COBES IV evaluation, attached as Annex 9.

The use of the PDAs for conducting surveys in the Ghana phase of the project is not recounted here, but the report on the Ghana activities with the Red Cross measles survey, which is attached to this report as Annex 6, is incorporated herein by reference.

Impact of PDA use for data collection

Despite some problems related to project implementation, the PDA proved to be useful and appropriate for collecting survey data in the field. Overall participants felt that the greatest success of the PDA for data collection is the ease with which many surveys can be completed, and the accuracy of the surveys with very little loss of survey material due to data entry error. Improving the speed and accuracy of healthcare data collection can be expected to have the follow-on effect of adding value to field study results for medical officials and healthcare practitioners, which would consequentially result in the improvement of healthcare planning and delivery overall. The report on the malaria data collected has just been finalized, and the project partners hope that the results will be found to have value for the researchers at Makerere.

Uganda

The limitations of the malaria survey were not due to a failing of the technology for conducting surveys, but they were an indication that survey design should be done carefully to adapt to the technology format. During the interviews, participants made it very clear that they were enthusiastic about the potential of this technology for improving the ways that surveys are done and the effectiveness of the results. Specifically, many of the participants that were interviewed indicated that they had participated in data collection for surveys before, using pen and paper. Of participants who answered the questionnaire, 83% found the PDA easy to use for surveys, and 96% preferred the use of the PDA to pen and paper. Several participants talked about the potential impact of PDAs on public health, for example where systems for regular reporting by doctors could mean that city and regional medical officials would be informed regularly of health statistics and they could identify patterns and respond to public health issues more quickly. One physician in Uganda bemoaned the fact that he did not have a PDA some months previously when he had done a survey on home-based management of fever for WHO and the Ministry of Health. Several participants said that they would have been more invested in the study outcomes and would have conducted more surveys if they had better understand the objectives and been part of the process to design the study.

The importance of survey design. One Ugandan physician who had done a lot of survey work in the field explained several of the specific problems with the structure of the malaria survey to illustrate why its use was limited with the PDA. He said, "you only get a deeper feeling for the questions when you design the survey yourself." He was enthusiastic about the potential of PDAs for data collection, but noted that survey design would have to change in a fundamental way in order to tap into the power of the PDA.

Kenya

The problems with using the PDAs in the survey classes seemed to be brought about by a tight and fixed class schedule that did not coincide with the availability of the PDAs, which limited training in the design and use of electronic surveys. Nonetheless, the feedback from the students indicated an enthusiasm for the technology overall, and they clearly saw the potential benefits that the PDA could offer for data collection in the field. During the interviews, the COBES professors also said that they were enthusiastic about the potential for the technology and they are looking forward to using the PDAs in their future survey classes, when they will have more time to plan. They also admitted that they needed to become proficient in the use of the technology themselves, so they would be better equipped to instruct and assist their students.

Ghana

The experiment with using the PDA for the measles survey was very successful. The PDAs performed well in the field, the volunteers had no problems using them, and the number of surveys conducted was significantly higher than what would have been done with paper alternatives. The quick production of the report demonstrated the revolutionary power of this tool. The survey used was a tested, standardized instrument used by the ARC previously, which speaks to the issue of survey construction.

4.4 Appropriateness of technology to local conditions

Measure	**Comments**
Power supply	A battery powered PDA was chosen for this project because of the possibility that participants in the field would not have access to electricity. The Visor ran on two AAA batteries that lasted for two or three weeks on average in this project, with daily use. In Kenya, the students were provided with batteries, but in Uganda, participants had to purchase their own batteries (sometimes the project partners supplied them as well). Participants reported that batteries were easy to obtain, but expensive (see "affordability", below). As it turned out, the participants had ready access to electricity most of the time and the majority said they would have

preferred a PDA with a chargeable power source, rather than batteries. Many participants complained that they had lost data because they were not aware that the batteries were about to die or batteries died unexpectedly (in these cases they had not used the back-up module successfully or did not have one – this was most likely due to the user's unfamiliarity with the technology).

Yet, while a chargeable unit would have worked in this project where the PDAs were primarily used in urban settings, discussions with participants suggested that a unit requiring an electricity source would not have worked in a rural environment. Many said that batteries would be more suited to a rural environment, and they would be particularly useful for fieldwork. Some participants liked batteries because they felt they could "go where ever they wanted" and were glad that it did not require an electricity supply.

Synchronization and back-up

Synchronization of forms with the Pendragon software was one of the more complicated aspects of the project. It was not the synchronization process itself that proved difficult (which was a fairly simple procedure using the hotsync cradles), it was the logistical arrangements required for participants to connect regularly with a central computer. In Uganda, synchronizing the PDAs with the laptop turned out to be an additional burden to the participants' already busy days. It had been planned that the participants would come to the HealthNet office to hotsync once a week and download all the survey information collected. However, the work schedules of the doctors did not allow time for this, so it was necessary for Fred Kakaire to visit each doctor and hotsync in the field. In the questionnaire responses, only one reported that it was difficult to synchronize data with the laptop. However, the interviews revealed that it was easy for the rest largely because most participants simply let Fred do the hotsync for them during his visit. Nonetheless, there were some participants in Uganda who did their own synchronization, and they all reported that it was a straightforward process using the hotsync cradle.

In Kenya, it was logistically difficult for someone to travel around to meet the COBES students in the field so they could download information from the PDA to the laptop. However, the second group of 6th-year students synchronized their PDAs every Friday using a hotsync cradle and desktop computer in the university computer lab that was set aside for this purpose, which made the process more convenient. John Bii monitored the process, and he said that overall the students came in to synchronize regularly and they experienced few problems with the process. Only one reported that it was difficult to synchronize data with the laptop.

Those that used the back-up module in Uganda found it to be very useful. Few in Kenya used the back-up module.

Memory capacity

Many participants complained that there was not enough memory space on the PDA to hold all the reference materials that they desired. Several of the medical references had high memory requirements, which taxed the resources available on the PDAs, and choices had to be made about which reference materials to put on PDA. The 5MCC used 3.8MB of memory out of the total 8MB available on the Handspring Visor Neo. However, the drug databases and treatment guidelines together

	constituted less than 1MB of memory, which proved to be a space-efficient resource. Completed surveys had to be downloaded regularly, or the PDA memory space would fill up. Adding a memory module to the PDA would solve the memory problem in the long-term, but it was beyond the budget of this project.
Operating system	In Uganda, 86% of participants who responded to questionnaires found the operating system easy to use overall, and 76% in Kenya.
Screen	Most participants said that the screen was sufficient, although a few mentioned that they would prefer a color screen. Some of the COBES students complained that the screen was too small for fieldwork.
Size and portability	Participants found the PDA to be a good size that was easy to carry around but big enough to use effectively. A few said they were fascinated by the size compared to the amount of work that it could do, and one described it as "a desktop in the hand". Many commented that it fit perfectly in their lab coat pocket.
Robustness	Overall, participants did not find the PDA to be too fragile. In Uganda, only 24% felt that the PDA was "somewhat fragile", and in Kenya it was 21%. Otherwise, the participants felt that overall it was "durable enough". A few participants mentioned that the PDA should have a leather cover to protect it (like the leather covers that are available for cellular telephones).
Security	In Uganda 79% of participants felt comfortable to carry the PDA in terms of security and only 81% were concerned about loss or theft of the PDA. In Kenya the figures were 81% and 55% respectively. Concerns about security ranged from "worry of theft and possibilities of breakage" to "can quietly slip out of a pocket". One Ugandan participant noted that insurance is completely unavailable for computer equipment and content, and he worried a lot about loss of this valuable technology and content.

4.5 Affordability of technology and content

Measure	**Comments**
Local economic realities	In Uganda 35% of the population lives below the poverty line. The GDP of the country is US$29 billion and the per capita income is US$1200. An average desktop computer costs approximately US$1000-1300, and a laptop computer ranges from US$1300 to $2200 (for modern, but not state-of-the-art hardware). There are no import duties or Value Added Taxes for computer equipment in Uganda.

In Kenya 50% of the population lives below the poverty line. The GDP of the country is US$31 billion and the per capita income is US$1000. An average desktop computer costs approximately US$1425 and a laptop costs approximately $2000, inclusive of 18% Value Added Tax.

Cost of owning the PDA

The Visor Neos purchased for this project cost US$187 each. It is difficult to find PDAs for sale in Uganda and Kenya, but the Internet allows for international purchases and delivery to any requested destination. One can either purchase the PDA directly from the producer (including Palm, Handspring and Dell), from trusted online retailers including Amazon.com,[10] or from online sites that provide comparative prices such as CNET shopper[11] and Pricegrabber.[12] Some portal sites provide links to all the product retailers as well as comparative prices and product descriptions, such as Pricing Central.[13]

PDA pricing is further dependent on the chosen model's level of sophistication. Prices vary from the affordable and basic models to expensive, high-end models. Simple models such as the Palm m105, that include 8Mb of memory, Palm operating software, Internet and email capabilities, begin at roughly US$99. The Palm Tungsten T with additional integrated wireless connectivity, blue-tooth enabled, color screen, rechargeable batteries and an expansion card slot retails at US$499. The range of models can be viewed at Pricing Central. Online purchasing would also require payment for shipping, tax, and customs duty. The first group of 6th-year students was asked how much they would be willing to spend to get their own PDA and answers ranged from US$6 to $102 (the average was $58).

Cost of running the PDA

In Uganda, the participants complained that the PDA went through batteries too quickly (approximately every two to three weeks) and that batteries were expensive, costing 3000-4000 Uganda Shillings (approximately US$1.75-$2.30). However, 81% said that they could afford to continue buying batteries for the PDA. Many suggested felt that a rechargeable unit that they could power with electricity would be cheaper to run.

After the project ends in Kenya, the students or the university will have to purchase the batteries for continued use of the PDA. Many of the students said that the cost of batteries would be a limiting factor in their ability to use the PDA in the future. Most of the participants used up a set of batteries within three weeks. Moi University staff members suspected that some of the students were removing the batteries from their penlights and using them for the PDAs (the University supplies batteries for the penlights, used to look into patient's eyes and ears, and the students were not supposed to use the penlight batteries for the PDAs). The University found it expensive to supply batteries to meet student needs for using the PDAs.

[10] See http://www.amazon.com/.
[11] See http://shopper.cnet.com/.
[12] See http://www.pricegrabber.com.
[13] See http://www.pricingcentral.com/computers/handhelds.htm.

Cost of applications

The majority of participants said that they would pay for additional medical texts to be placed on the PDA. The market price for the reference materials used in this project range from approximately US$35 to $65. Prices for similar reference materials range from US$30 to $100. During interviews, most participants said that if an electronic textbook cost the same as a hardcopy version, they would buy the electronic copy to use with the PDA. A few said that they would purchase the electronic version even if it cost more, because after using the PDA in the project they realized how simple and convenient it is to carry a text on a PDA. In Uganda, participants reported that they would be prepared to pay, on average, 25,900 Uganda Shillings (approximately US$15) for electronic medical texts (range was 5000 to 90,000 UGS = approximately US$3 to $52), and in Kenya the average amount was 2500 Kenya Shillings (US$32; the range was 200 to 5000 KES = approximately $2.50 to $65). The few who said they would not buy the electronic textbook tended to be those who were less proficient with the technology.

The reality of electronic textbooks in developing countries. The majority of participants said that after using the PDA they would prefer to buy an electronic textbook for the PDA rather than buy a hardcopy version. One notable exception was a Ugandan medical office who had used the PDA effectively and thought highly of it as a tool, but still said he would prefer to purchase a hardcopy of a book. His reasons were informative: he felt uncertain about content held on the PDA for security reasons. He did not have his own computer to back-up the application, and if the PDA got lost, stolen or broken he was not sure that he would be able to replace it. He said, "at least with a book you can touch it and take it with you. It is there."

4.6 Training and skills required for effective technology use

Measure	Comments
Skills required for using the PDA and applications	In Kenya and Uganda, even though the majority of participants had used computers, only a few of them had used a handheld device before and most required some basic training. Not all participants attended the initial training, and the one-on-one training they received varied significantly according to their needs. In Uganda, participants estimated that they received an average of 1.3 hours of training, and in Kenya it was 1.8 hours. Of the participants in Uganda, 98% found the PDA easy to use after training and some practice, and 85% in Kenya. In each location, 81% of the participants used the "graffiti" handwriting functions on the PDA. The physicians in Uganda reported a wide range in the time it took for them to learn graffiti, from a few hours to more than two months; the median was 3.5 days. The students in Kenya reported that it took them a few hours to a few days to learn graffiti, and the median was one day. During the interviews, it seemed that overall those who used graffiti the most had learned it quickly (in less than a day) and their proficiency improved with use.

Effectiveness of training

Most of the training was done by Fred Kakaire and Ceasar Barole, and with John Bii in Kenya. The ability of the trainers received high marks overall. Of the various kinds of training offered – an initial training session, training manual, a worksheet, and ongoing technical assistance – all were reported to be helpful. By the time of this evaluation, 92% of the participants in Uganda and 89% in Kenya reported that the PDA was easy to use.

Several participants used the manuals provided; they reported that the manuals were helpful overall but said they did not give enough detailed information on certain points. One Ugandan physician was very proud that she had solved her own technical problem using the manual (the PDA needed to be reset). However, a few participants reported that they had not received manuals. In Uganda, 44% of participants said that the ongoing technical assistance a useful training tool, and 15% in Kenya. Several participants in Uganda mentioned that they had to have the use of the back-up module demonstrated to them several times, but that eventually they understood it and then did not have any problems after that. Even though most reported in the questionnaire that the training was sufficient, several Ugandan physicians admitted that it took them as much as two or three weeks to master the PDA. They explained that in the beginning they did not use it every day, so they would quickly forget what they had learned and would have to be shown again. One participant raised a concern that the training did not cover upkeep of the machine, such as to teach people how to keep it clean and away from dust.

Dynamic groups. Training the users in groups of people that knew each other and worked together was overall a more successful mechanism for teaching them to use the PDAs, because the quick learners would be on hand to help the others when the project support staff were not around to do so. The group of young doctors at Mengo Hospital was a case in point: during the interview one of the doctors taught another how to use the infrared connection on the PDA to exchange information.

There were mixed reactions to the training by the first group of 6th-year students in Kenya, where a significant number of them felt that they did not receive sufficient training. However, this matter seemed to have been remedied in the second group where training was not reported to be a problem. Training of the COBES II students in Kenya was rushed and problematic, but this was more a matter of timing than capacity of trainers or trainees (again, see Annex 8 for the 6 May 2002 COBES II survey evaluation report).

The COBES classes illustrated that someone from the university must be thoroughly trained in the subtleties of the forms software in order for the survey application to be used successfully in a classroom setting. This would be less important where people are given the PDA already loaded with a "frozen" form, such as in Ghana, because there is no reason for the data collectors to adjust the survey in the field. But the COBES students were learning to design and conduct their own surveys using the PDA, and they did not have sufficient training or locally available technical support to fine-tune their data collection tool as needed.

4.7 Need for and availability of technical support

Measure	Comments
Reliability of technology	In Uganda, 66% of participants experienced some sort of technical problem, and 67% in Kenya. In 75% of cases in Uganda the problem could be fixed, either by the user or technical support, and 79% in Kenya. The problems included losing data after replacing batteries or letting batteries run flat, and the device "freezing" and needing to be reset. In the Ghana phase, there were no technological problems with the PDAs over the course of the three-day measles survey. The screens were broken on two of the PDAs and they could no longer be used. It was not possible to get the screens repaired in either Uganda or Kenya. The PDAs were taken to South Africa to attempt to have them repaired there, and they could not be repaired there either. The devices could only be repaired by the manufacturer and a Handspring International Repair office in London was contacted. The standard repair costs for replacing the damaged screens was US$137 excluding shipment to and from the UK. Upfront payment is usually required, which can be handled by credit card (individual customer) or bank transfer (corporate customer) and the repair would have taken two to three weeks. Getting a unit repaired would likely be financially impossible in Uganda and Kenya.
Technical support	The project required active technical support. In Uganda, Fred Kakaire spent a considerable amount of time visiting participants at their hospitals and clinics, to help them solve technical problems and to hotsync their PDAs with the laptop. HealthNet Uganda staff members realized that they needed to make an extra effort to get people engaged. They had expected people to call to ask for help, but it turned out that they had more success when they called to check in on the participants and answer questions as needed. In Kenya, John Bii was on-site at the University to help the students with the technical problems that arose. There were some technical support problems early on in the project, but by the time of this evaluation all participants reported that the technical support was very good overall. When participants had a problem with the PDA most were able to fix it or get it fixed. Four participants in each location said that they had problems that were not fixed, but these matters were likely due to the two broken PDAs and/or lost data due to battery problems. The HealthNet Uganda and Moi University staff members admitted that they struggled to provide technical support that went beyond the basics. For example, their inexperience with the forms software slowed things down with the COBES classes because they had to figure out some of the more advanced functions of the software. Specifically, the students needed to be able to modify the survey form once it was on the PDA, rather than having it "frozen", and this proved complicated (they eventually figured it out). Fred Kakaire also mentioned his frustration that he did not know how to fix one of the PDAs that was "running hot" and using up batteries very quickly.

4.8 Integration of technology use into daily routines

Measure	Comments
Usefulness of PDA in healthcare	In Uganda, where the same participants used the PDA for both accessing information and data collection, 67% of participants felt that the PDA was more helpful for accessing information than for data collection. The most common uses for the PDA that were reported by the participants were treatment, general knowledge, differential diagnosis, investigations, definitive diagnosis, and advice to other health practitioners. They indicated that having access to information on the PDA made them feel more confident in these activities. All of the Ugandan participants and all but one Kenyan said that they would have sought this information from another source if they did not have the PDA. At the same time, the majority of participants reported that after participating in this project they were more likely to look up medical information than they were prior to the project. The most common situations where the participants used the PDA were to look up information during and just after patient visits, to look up information at home, and when prescribing drugs. Other ways that the participants used the PDAs included: storing appointments, daily reminders, ward rounds and clinic scheduling, and calculation of dosages. A few of the participants indicated that the PDA stimulated them to read and think more about the kinds of diseases they saw every day. **A handy teaching tool.** A Ugandan physician explained how he used the PDA in a rural setting where he sometimes works. He supervises staff members in eight health facilities located across the region. He visits each rural clinic one or two times per month, to see the cases that the staff medical officers need help with, and also to teach them new things. He said that he frequently used the PDA to show them how to do new things and access information.
Time management	Time management is a critical issue for the doctors and students who participated in this study, many who see 80-100 patients a day. Ceasar Barole, the site manager at HealthNet Uganda, summed up the time management issue succinctly: "In a medical environment we are dealing with doctors who have a lot of work everyday. It was a big challenge to get these busy people to use a technology and adapt to it, use it every day and change the way they live and work." Many participants echoed this sentiment. They reported that adapting the technology into their work was sometimes a hurdle, but most said that once they had gotten used to using the PDA, especially to consult the medical reference materials, it saved them time. At the time of this evaluation, all participants said that they felt the PDA saved them time, and the overall average estimate was 10 hours per week saved.

Useful gadget. One participant said, "PDAs are very useful gadgets which can simplify one's daily tasks and many more people should be made aware of them".

On the other hand, many of the Ugandan doctors complained that the survey took up too much of their time. However when questioned on this point, all agreed that this was about the requirement to conduct the survey itself, and not a reflection on the technology use; using the PDA for surveys was seen as a more time effective way to collect data when they had to collect data. Some had to enter the data on paper after entry on the PDA as a requirement of the health facility where they work, which exacerbated the problem.

Outside of this project where the assistance of someone like Fred Kakaire would not be available, synchronizing the PDAs at a central location would not fit with the daily routines of the doctors. In Kenya, this issue did not arise; the students were required to hotsync once a week at the University computer lab, but it was conveniently located near their classes so this fit easily with their daily routines.

4.9 Socio-cultural factors that affect technology use

Measure	Comments
Doctor-patient interaction	In Uganda, 80% of participants reported that patients had no concerns about the use of PDAs, and 48% said that accessing information on the PDA during patient consultations had a positive impact on their interactions with the patients (33% said that it had neither a positive nor negative impact). In Kenya, 96% said patients had no concerns, and 38% said that there was a positive impact on interactions (58% said there was no impact). The majority of participants felt that patients perceived them to be more professional when they used the PDA. One participant reported that patients "were impressed that such a small device can have vital information". One doctor said that patients "were more interested in [his] advice and information" because he was using the PDA. Others said that patients "were impressed with the sophistication". One participant said that his use of the PDA in the presence of patients was "immaterial and didn't affect the interaction." However, a few participants mentioned things like "some [patients] thought I was just doing my own thing and ignoring them" and "some thought I was playing a game". In Uganda, patients questioned about half of the participants about the PDA, but only four in Kenya reported questions from patients. One participant said, "children wanted to know what it was all about". Few patients expressed concerns about the use of the PDA, however on participant remarked that there were, "no verbal complaints [from patients] but signs could show that they are impatient".

No technology anxiety. A Ugandan physician said, "the patients don't question it, they just appreciate that you are using it. They thought it was a tool for management, rather than something frightening. There was no technology anxiety."

During the interviews, several Ugandan doctors mentioned that they also had to explain the PDA to other doctors, especially because sometimes their colleagues thought they were playing a game. Once they showed others the information on the unit, they were pleasantly surprised and interested.

Limitations in technology use because of gender, race, religion, age or other factors

The only socio-cultural factor that was observed to have an effect on technology use in this project was age. Many participants interviewed spoke about how old people were afraid of new things and therefore they would not try to use technology because they do not want to look foolish in front of other people. The theme that technology was for the younger generation was repeated throughout the interviews.

The age factor had an interesting twist in Uganda, where there was a great variation in the age range of the participants. Throughout the interviews, the most enthusiastic participation was consistently seen among the youngest doctors who generally put the technology through its paces and tried every application. While the older doctors were also keen in using the technology for themselves, their priority seemed to be on the broader implications that technology could have for healthcare in their country: they seemed to be more interested in the long-term impact than in their own short-term use. Many of these older doctors had traveled abroad and seen ICT in practice in medical applications. They were frequently the champions for technology, encouraging (and even requiring) the younger interns to use their PDAs on their rounds. But they admitted that they did not themselves use the technology to its fullest potential. For example, during an interview of three senior Ugandan doctors they joked that they knew all of the things they needed to know and therefore had little reason to consult the reference materials on the PDA.

Another factor that was mentioned by two participants was the public perception that technology is for the elite. They highlighted the importance of demonstrating to normal people that technology can be for them too. They pointed out that it is especially important to find ways that technology can have relevant uses in everyday life, and they suggested that a public awareness campaign would help. They also recommended changing people's mindset by putting technology into schools and training programs in a large scale way. No other socio-cultural factors were mentioned or observed which were thought to affect the technology use in this project or would be likely to affect the broader use of PDAs in these countries. There was a fairly even mix of male and female participants, and there was no indication that any of them were encouraged or discouraged in their use of the PDA based on their gender.

4.10 Confidence in technology use in terms of privacy, security, or cybercrime

Measure	Comments
Concerns about what happens "behind the screen"	There was an overall awareness among the participants that as patient records migrate to electronic formats, using PDAs (or any electronic system for data collection and storage) would raise new issues around security patient privacy. Some doctors pointed out that now patient records are stored somewhere else (either in a paper or electronic file), which is the responsibility of the hospital or clinic. But with PDAs, the doctors might have the patient database right there with them. This was frequently raised as a potentially controversial issue where doctors might be walking around with confidential information on a PDA that could get lost or stolen. For example, John Bii, the system operator at Moi University, noted that when computers are used to store patient records, there is "a shift of responsibility from the record office to the system operator." He was very aware of the need for effective electronic security and authentication systems. However, few participants knew anything about electronic security and how patient data could be secured. During the interviews, only a few of the participants said that they used a password to protect the information on the PDA. However, once the point was raised, most quickly understood the security implications and the relationship to patient data. Several Ugandan physicians who carried patient information on the PDA immediately began using a password after the discussion. Participants felt that overall patients did not understand the privacy implications related to technology use in healthcare. However, many commented that given the sensitivities about HIV/AIDS and record keeping, that it was only a matter of time before these issues would arise.

4.11 Enthusiasm for technology use

Measure	Comments
Technology culture	In Uganda participants were a self-selected group who for the most part had experience with using ICT previously, and who were keen to try a new technology. Most of the participants involved displayed enthusiasm about the technology and its potential and were keen to talk about the project and its results in spite of their hectic schedules. Because the doctors knew they would get to keep the PDAs at the end of the project, they were very interested in learning how to use the PDAs for the maximum benefit. The Kenyan students were also enthusiastic about the technology, and appeared to pride themselves on being "tech savvy". Not surprisingly, the Kenyan students reported that they would have engaged on the project more if they had been able to

keep the PDA (which became the property of Moi University for use with future classes). And it is clear that the frequent hand-over of the PDAs did hinder the ability of each group to gain the maximum benefit from the PDA. Nonetheless, overall the students seemed to appreciate the opportunity to try out the technology, even if only for a short period, and the fact that they did not get to own the PDA seems to have had little impact on the outcomes of this project.

All participants said they would recommend the PDA to colleagues as an effective tool.

Technology culture in Uganda. Dean Sewankambo described the interest in technology among the people of Uganda: "People here like technology. They would buy (the PDAs) first and then figure out to use it later. The first thing that they will do is put in each other's addresses and phone numbers. But we have learned from this study that there are a lot of uses for this device."

Using the technology outside of the healthcare field

Participants were trained and encouraged to use the other features of the PDA and virtually all of them took advantage of the additional built-in options: 100% in Uganda and 81% in Kenya. The address book and calculator were most popular. Many also used the date book and to do list features for recording personal notes, tracking appointments, and daily reminders. A few noted that they liked the "city time lookup" feature, and many individuals installed games to play.

In Uganda, 81% of the participants who responded to the questionnaires thought of other ways to use the PDA in their practice of medicine, 75% thought of ways to use it in their workplace, and 84% identified other uses for the technology more generally. The figures for Kenya were 63%, 54% and 63%, respectively. Examples of the kinds of ideas that participants shared include "using it to communicate with a fellow health professional to make quick consultations, accessing the Internet and email, formatting my own forms for my surveys of interest"; "statistical formulae for epidemiological surveys"; and "wireless, mobile communication with other doctors at a distance, viewing medical images and storing them, communicating online". It should be noted that healthcare professionals in both countries, especially those in Uganda, regularly do medical surveys in the field, and several participants described their ideas for how they would use PDAs to streamline survey activities.

A spin-off of this project is that HealthNet Uganda has become interested in using the PDAs in other ways and fields. They are purposefully building their internal knowledge of PDAs to explore other applications for PDA use in Uganda.

Local champion

A local champion who is interested in driving change can play a critical role in any ground level project. Dean Sewankambo of Makerere University helped to spark ideas and make things happen in this project, but then he gave the opportunity to HealthNet Uganda to implement the change. Dean Sewankambo brought a balance between local and international views to the project: he was in touch with what is happening in the rest of the world, but also understands the realities of delivering change at the ground level. His inspiration and leadership moved this project forward, and he helped

to connect it with related initiatives at the Ministry of Health and elsewhere to ensure it made the greatest impact overall. Dean Otsyula of Moi University also championed this project in Kenya. He helped to bring the greatest benefit to society in the long-term by putting this technology into the hands of the widest range of students. He also helped to ensure continuity of PDA technology use at Moi by vesting the ownership of the units with the University so that other students can use them in future, as opposed to the 2002 students keeping the PDAs at the end of the project.

4.12 The effects of the national legal and regulatory framework on technology use

Measure	**Comments**
National ICT policy	The Government of Uganda has designated ICT as a priority policy area and called upon development partners to support its efforts to harness the ICT sector for national development. A National ICT Policy was published in July 2002 and is due to be tabled before cabinet for adoption.[14] The draft policy has three areas of focus: information as a resource for development, mechanisms of transmitting and accessing information, and ICT as an industry, including e-business, software development and manufacturing. The Ugandan wireless market and industry is emerging and fast growing; laws governing this area will also be covered by the ICT Policy. Kenya does not have an integrated national policy in this area. Instead, the Kenya National Council for Science and Technology is formulating and implementing sectoral policies, which aim to bring about increased use of ICT in the country.[15] Part of the process is directed at updating Internet and wireless service laws, including the proposed liberalization of wireless communications and Internet voice-data transmissions.[16] Kenya has no legislation dealing with privacy. The Kenyan Internet industry is newly emerging and there is little governing legislation.

[14] See http://www.undp.or.ug/documents/ictpolicy.pdf for a copy of the *National Information and Communications Policy*.
[15] For further details on the information technology landscape in Kenya see http://www.american.edu/initeb/dk1540a/Computing%20&%20Internet%20Diffusion.htm.
[16] *Who Needs Regulation*, Tom Mogusu, East African Standard Online Edition, 24 September 2002, http://www.eastandard.net/survey/IT/092002/features/it0010.htm.

Concerns about the effect of laws and regulations on technology use

This project was not designed to look at how the legal and regulatory framework might affect the use of the PDAs, nor was it intended to deal directly with issues of privacy laws governing electronic medical records. Nonetheless, many of the participants were sensitive to the implications that laws and regulations might have for their current and future use of the technology, and they were aware of the role that this project might play at the national level in terms of demonstrating how government policies can affect the ground level realities of technology use.

Many participants commented on the legal and regulatory implications for the development of new uses of technology, and they highlighted the need for patient privacy matters to be addressed effectively in any ICT-related legislation. The need for environmental laws to deal with proper disposal of batteries and used equipment was also mentioned.

In Uganda, Dean Sewankambo admitted that they had not given serious consideration to laws that would affect technology use, but recognized that privacy legislation could have a profound effect. He was aware that the Ugandan National Steering Committee on Telemedicine, a body that discusses policies and how to promote telemedicine, was addressing privacy matters in its deliberations. In Kenya, Moi staff members were aware of a policy paper that had been issued on the use of ICT and healthcare for improvement of health services to communities, which said that the use of ICT for healthcare should be encouraged. But they also knew that current laws did not apply specifically to electronic environments. Many indicated that confidentiality should be applied in the same way for hard copy and electronic patient records.

4.13 Political will in government to enable widespread technology use throughout society

Measure	**Comments**
Government support for technology use	In Uganda, the United Nations Development Program is working in partnership with local actors in an effort to promote and popularize the use of ICT and sensitize policy-makers and the private sector on the benefits of ICT use.[17] Both the local partners and many of the project participants have been involved in healthcare and development initiatives in their countries, which are led by government and/or international development agencies. Several participants spoke about the need for government to be involved in driving local initiatives to foster ground-level ICT use, such as this project. For example, several participants were aware that many of the hospitals and clinics are now getting funding to purchase computers. They suggested that the Ministries of Health should be encouraged to also direct funding toward the purchase of PDAs. They felt that PDAs offered a more effective use of public funds that would put more information into the hands of

[17] See http://www.undp.or.ug/ict.htm.

health professionals that need it, and in more efficient ways. They said that governments and NGOs should budget for the purchase of handheld computers as part of any technology expenditure.

Support for government policy-making

Dean Sewankambo of Makerere University noted that the Faculty of Medicine has been working with the Ugandan Ministry of Health as it sets its policies in this area. He has talked at length with the Ministry both about this project and the use of PDAs and other technologies in healthcare in Uganda. He highlighted the importance of keeping the Ministry informed of these activities to spark their interest in new technologies.

4.14 Impact of technology use on the community and larger society

Measure	Comments
Market issues	Many participants said that if companies would offer PDAs for sale in Uganda and Kenya, people would buy them. In Kenya, a number of students voiced complaints that they had learned what a useful tool the PDA could be, but after the project they would not be able to buy one because they were not available. They explained that they could not purchase PDAs from the Internet because they did not have a credit card for payment, and also they did not trust that the PDA would reach them through shipment.
Environmental impact	A number of participants mentioned concerns about battery disposal, because there were no mechanisms for disposing of toxic waste. Given the rate that participants used up a pair of batteries, the wide scale use of battery-charged PDAs might put a strain on the already fragile environment of Uganda and Kenya unless stringent disposal measures are followed.
Fostering catalytic change and bridging the digital divide	Many participants commented that their familiarity with the technology would make them conduits to drive change to bring about the spread of technology throughout their society. Several mentioned that they were disseminating knowledge about the PDAs by showing them to their colleagues, and that often their colleagues were "amazed". Overall, participants were very aware of the digital divide, and the potential role of this project to have a catalytic affect to promote the widespread use of technology. In Uganda, participants commented that doctors were good "first initiators" with technology, because they had a lot of contact with the public; people would see them using the PDA and want one for themselves. The potential impact on rural areas was also frequently mentioned, since doctors in rural areas “are the ones with the greatest need who might benefit most”. Several participants talked about the need to bring together people from various parts of the country to disseminate information about the PDA project and raise interest, and to discuss what else is possible with PDAs.

The role of PDAs in bridging the information gap. One Ugandan participant said, “Many of our health workers here (in Uganda) are isolated both physically and in terms of modern communication technologies. Physicians in remote hospitals often have to work without a functioning library, telephone or fax machine. If we can get the technology to them in these places, then we will bridge the information gap.”

4.15 Ideas and plans for future uses of PDAs

Measure	**Comments**
Looking to the future	The Ugandan doctors clearly intend to continue using the PDAs in their medical practice and beyond. Moi University intends to use the PDAs in future as part of the course offerings for its medical students.

Participants mentioned the following other information would be helpful to have on the PDA more medical reference texts, including tropical medicine, pediatrics, emergency drugs and public health. Other medical publications included "current systemic medical research and reviews", "information about HIV/AIDS counseling and testing", and "mother to child HIV transmission and prevention. Additional features thought useful would be spreadsheets, statistical data, and formulae.

No turning back. A Ugandan medical officer summed it up: "Already it is a beginning for mobile computing in healthcare here. This is a step forward that we have taken now, and we can't go back. Now I want more."

Several of the Ugandan participants spoke enthusiastically about their ideas for future uses of the PDAs. A few of them had worked in rural locations before, and they explained that the PDA would be very useful in that setting because no textbooks were available. One highlighted patient records as a critical future use for the PDA, because he said it would be extremely helpful on his rounds to have the patient records with him. A few said that they would like to use the PDA to communicate with other doctors, especially to ask for advice. Several highlighted the opportunities for using the PDAs with wireless connections in fieldwork, so that data can be sent from remote locations.

Several Ugandan participants had worked with the Ministry of Health and the regional health authorities, so they had a good understanding of the wider health policy issues. They spoke about the need to persuade local government to invest in PDAs, for research and other uses. They explained that many physicians and medical officers regularly send data to health officials for analysis and usually they have to summarize it. The PDA solves the data collection problem, but now a better way is needed to send the information quickly and easily for real time data analysis. Again, wireless solutions were suggested as one option that might help solve the problem.

Ministry of Health updates. In Uganda, the Ministry of Health provides regular updates on health information, normally by disseminating books and manuals. It can take months to get new materials published and distributed. Now the texts are beginning to be distributed on websites, which works well for those who have Internet access. But many physicians do not have regular access to a telephone line, let alone the Internet. But with a handheld computer, even someone who does not have a telephone line can pass by a HealthNet office and download information. Even doing this every few months would be useful, and it would be timelier than waiting for hardcopy publications to arrive.

One Ugandan participant pointed out that as he used the reference materials regularly, he would master them. He was concerned about having regular access to new materials to continue to challenge him and meet his needs for new content.

If PDAs are going to be put in people's hands in developing countries, thought also needs to be given to where they will have ready and affordable access to a larger hard drive where they can back-up and store applications and data. This would raise storage issues for any computer lab, which should be taken into consideration.

Uganda has a 65% literacy rate and Kenya has an 80.5% literacy rate, which will have an impact on future uses of technology.

4.16 Key external challenges that may have limited technology use in this project

Measure	**Comments**
Bureaucratic hurdles	The Ugandan Government required approval by an Institutional Review Board (IRB) before data collection could begin on the malaria survey. The process slowed down early project implementation. The shipment of PDAs was delayed by customs some 7-10 days, which caused the project to begin behind schedule and affected the use of the PDAs in Kenya.
Technology problems	In Uganda there were problems in testing the use of modems to hotsync via landline telephone, because the Windows 98 operating system that ran the database software on the laptop would not allow incoming data connections. In order to make this work, HealthNet Uganda would have had to upgrade its operating system to Windows 2000, which they could not afford to do at the time.

Project management

Project timelines that were not sensitive to local needs and constraints also affected the project. In Uganda, the malaria survey was affected by the fact that the majority of the data collection was done outside the malaria season. In Kenya, the timeframe and planning of the project did not coincide with the timing of the academic year at Moi University, and this limited the use of the technology in the Kenya-phase of the project. SATELLIFE had intended that the PDAs would be used in Kenya for both data collection and information dissemination throughout the life of the project, and the implementation partners had indicated that this was possible. However, once the project was launched it became clear that (1) the 6th-year students could not accommodate data collection into their studies, and (2) the COBES classes, which did do surveys, only ran during January-July. The project did not get off the ground quickly enough to effectively reach the 2002 COBES classes with PDAs, and the project ended before the 2003 COBES classes began. Moreover, the use of PDAs by 6th-year students for reference materials was interrupted because the first class that used the PDAs ended its academic year in July, and the PDAs passed to the next class of 6th-years in September for the 2002-03 academic year. Local implementation partners requested an extension of time on the project, at no additional cost, to better plan and execute the use of PDAs in the COBES survey classes. Since Moi gets to keep the PDAs for use after the end of this project, they can continue the project as they like.

The Kenyan partners felt that they were not adequately informed about the project's objectives and timelines. There was no clearly appointed principal investigator in Kenya, which caused confusion about who was ultimately in charge and there was uncertainty about roles and responsibilities of the participants in Kenya. The fact that there were no representatives from Moi University at the planning meeting in January together with the fact that there was no field manager on the ground in Eldoret exacerbated the problem.

Nonetheless, these project management issues are strictly project implementation matters; while they did effectively limit the use of the PDAs, it was clearly not a reflection on the usefulness of the technology itself. To the contrary, even where the students only had access to the PDAs for a short time, they showed significant enthusiasm and interest in using the technology as a tool in their studies and profession. However, the problems encountered did underline the limitations of the technology and the implied conditions for success in that effective local support is a crucial factor.

Overall project implementation

Interest-level of the participants was clearly *not* an external challenge that this project faced. All of the participants who completed a questionnaire reported that overall they had a positive experience in this project (except for the four who did not answer the question). The long distance between SATELLIFE and the implementing partners was a challenge faced in this project, especially where SATELLIFE was helping to trouble shoot technical problems with HealthNet in Uganda. But for the most part it worked out through the use of email and telephone.

5 MAIN FINDINGS, LESSONS LEARNED, CONSTRAINTS AND OPPORTUNITIES

The main finding of this evaluation is that the SATELLIFE project in Ghana, Uganda and Kenya has validated the use of handheld computers in healthcare environments in Africa. There were a number of valuable lessons gleaned from the project that can be applied to further deployment of PDAs in developing countries. A number of obstacles to technology use have also been identified, which will need to be overcome in order to promote the widespread adoption of the technology in this context. Finally, the project has served to open the door for a number of opportunities that are worthy of the attention of technology companies and content providers.

5.1 Key findings of the evaluation

⇒ *Overall, the handheld computers proved to be a useful and viable technology in the healthcare environments in Ghana, Uganda and Kenya.* Doctors, medical students, and health volunteers put the PDA to use in a range of applications and it consistently performed as an effective tool to help them in their jobs and their lives.

⇒ *The handheld computers proved to be an effective tool for collection of health data.* Surveys conducted with the PDAs were more time-efficient and accurate than pen-and-paper versions. The use of the PDAs for conducting surveys was affected by problems with project implementation, which reduced the opportunity for the technology to deliver on its full potential. But nonetheless, the technology benefits were still clearly demonstrated. Processing information collected in electronic form using the PDA can be quick and easy if the survey is structured effectively with data analysis in mind.

⇒ *The handheld computers proved to be an effective tool for information dissemination.* PDAs are more convenient to carry around than textbooks or papers, and consequently are more frequently consulted. Medical reference materials can be stored on the device for quick reference and as a learning tool.

⇒ *The medical reference materials available on the PDA helped the physicians and students improve their provision of healthcare.* The healthcare professionals used the medical content to confirm diagnoses, drug protocols and treatment guidelines.

⇒ *The handheld computers proved to be an appropriate technology for use in the African context.* The unit itself performed well within the context where it was used in terms of durability, screen, size, operating system and memory.

⇒ *Handheld computers proved to be an inexpensive alternative to PCs in terms of computer power per dollar.* In an environment where PCs are beyond the reach of most people, even healthcare professionals, the PDA offered a reasonably priced alternative that gave significant computing power for the price.

⇒ *The handheld computers proved to be simple to use, and the technology was easily integrated into the daily routines of the healthcare professionals.* The PDAs helped the healthcare professionals improve the way they do practical things that they need to do everyday, in a way that was simple and

added no additional burden to their already busy daily lives. In this way it brought concrete benefits to their lives.

⇒ *Handheld computers offer enormous potential to help bridge the digital divide.* Given ground level realities in Africa – where electricity, security, and cost are only a few of the factors that inhibit technology use – it is unrealistic to imagine that technology could be put in the hands of the general public if that means a PC in every home or office. But PDAs are a viable alternative that can be used for a variety of practical purposes throughout society, and they may represent a turning point in the way that the digital divide is approached across Africa and beyond.

5.2 Key lessons learned in this project

⇒ *People require at least some basic training in order to use the handheld computer effectively overall.* Even people who have some exposure to ICT needed training to use the PDA effectively. However, a little training goes a long way, especially if useful training materials are supplied so that users can learn on their own time. Even with only a few hours of training, many new users quickly became proficient with practice.

⇒ *More focused training is needed to teach people how to use the handheld computer for data collection, not just for the technology users, but also for those who are managing the project.* For conducting a survey where people will be working alone in the field, more time should be spent on training at the beginning. It is important for users to have some experience with the PDA so they can learn how to deal with the various issues that may arise, before they are sent to the field where technical support is not available. It takes longer to train people to use the PDA as a tool for surveys if they need to have the ability to adjust the form in the field; where they receive a "frozen" survey form simply for data collection, it is much less complicated.

⇒ *The use of the handheld computer changes the way that a survey should be designed and conducted.* It is not as simple as taking a paper-based form and question-by-question creating the electronic form – using the PDA requires a whole new way of thinking about surveys. The avoidance of open-ended questions, and standardization to elicit uniform responses is extremely important so that data analysis can be automated.

⇒ *Technical support is critical.* The need for effective technical support will have to be addressed in some way if widespread use of this technology is to be achieved. Any future implementation must take into account the human resources time needed to support the technology use, especially with new users and/or new technologies. Moreover, the technical support team needs to be thoroughly trained in all aspects of the PDA so they can be well equipped to deal with whatever matters arise.

⇒ *Content must be locally relevant to have the greatest impact.* All of the medical reference materials that were offered on the PDA were used, and all were considered useful overall. But it was clear nonetheless that the greatest interest among the healthcare professionals was for content that was locally relevant to them. Specifically, they sought tropical medicine guidelines and information on drugs that were locally available to them.

⇒ *The power supply for the handheld computer must be appropriate to the situation: battery-powered units would only be the first choice in situations where a ready electricity supply is unavailable.* Batteries are too expensive to the average person in a developing country, and that makes battery-

powered units inappropriate except in cases where electricity is not available, such as rural locations. Otherwise, rechargeable units are preferred.

⇒ *Synchronizing onto a central data system must be simple and convenient.* If PDAs are going to be put in people's hands in developing countries, they will need to have access to a laptop or desktop where they can back-up and store applications and data on a larger hard drive.

5.3 Challenges that must be overcome

⇒ *Despite the affordability by comparison to PCs, the cost of the PDAs may still be too high for the average person in Africa.* The biggest challenge for the technology is whether average people in developing countries will be able to afford PDAs.

⇒ *More locally relevant content in electronic format is needed to foster the widespread use of handheld computers for healthcare in developing countries.* The efforts required to ready the essential drug lists and treatment guidelines for use with the PDAs underscores the need for a comprehensive database and regular healthcare updates that can be accessible through a variety of technologies.

⇒ *Repairs for handheld computers are currently not feasible in Africa.* The fact that no PDA repair outlets could be found in Uganda and Kenya and that repairs via London were prohibitively expensive does not bode well for the future use of PDAs in Africa. Technical support will need to include repair facilities to deal with the problems that can arise when accidents happen.

⇒ *Broader ICT infrastructure is needed to support the widespread use of handheld computers in Africa in the long-term.* For PDAs to be used to their maximum potential, the surrounding ICT environment will need to be in place, including telephone lines or wireless connections to enable data transfer by modem, and public connectivity and facilities that allow storage of data.

⇒ *Issues of privacy, data protection, and security will affect the widespread use of handheld computers in healthcare in Africa over the long-term.* With the increased migration of patient records to electronic formats, existing legislation will need to be reformed and supplemented with more specific legislation to deal with the issues that will arise. For example, especially sensitive areas will relate to blood transfusions and the non-public disclosure of HIV status. Enforceable legal mechanisms will be needed to protect patient data.

5.4 Opportunities for the future that emerged from this project

⇒ *There is clearly a market opportunity for handheld computers in African countries.* There is a significant potential market for affordable handheld technology in the developing world, where there is little ICT infrastructure and a lack of conventional ICT such as PCs. The high uptake of cellular telephones in countries such as Uganda, Kenya and South Africa is an indication that people in developing countries are willing to spend money on technologies that prove to be really useful and relevant to them. The industry should produce a cheaper PDA that is targeted to poorer markets.

⇒ *Linking the use of handheld computers with wireless capabilities would exponentially extend the utility of both technologies.* Connecting a PDA to another computer via wireless technology would allow remote data transfer for synchronization, back-up, and downloading of information. And it would bring an element of computing power to wireless technology, adding further dimensions to what wireless offers. Given the increasing focus on telecommunications liberalization and the

growing wireless markets in many African countries, this is a powerful combination with real potential.

⇒ *There is clearly a market opportunity for locally relevant medical content in electronic formats, which is targeted to the needs of African countries.* People are willing to buy electronic textbooks and reference materials, but they demand locally relevant content that will serve their needs. In particular, there is a demand for tropical medicine texts that are suitable for use with the PDA.

⇒ *Partnering handheld computer initiatives with community access point initiatives offers an effective model that would be mutually beneficial for both efforts.* Community access points that provide PCs and Internet connectivity would be a source of training, technical support, and storage space to augment PDA initiatives. PDAs offer community access efforts a way to extend the usefulness of technology to people who cannot afford their own computer yet do not have the time to use computers regularly at a public access point.

⇒ *Linking handheld computer initiatives with alternative power development efforts, such as the investigation of solar panels and wind-up technologies, may offer innovative opportunities for solving the power supply problems.*

⇒ *Handheld computers offer enormous potential for improving service delivery in national Ministries of Health as well as international healthcare organizations and programs.* Ministries of Health should consider direct funding toward the purchase of PDAs for use across the healthcare community in their countries. The use of PDAs would expedite the regular update of treatment guidelines and drug protocols, and health warnings and disease patterns could also be circulated among healthcare workers faster and more cost-efficiently. The technology would also be appropriate for the activities of international health and welfare organizations such as WHO, UNDP, and UNESCO.

⇒ *Handheld computers offer specific utility in rural healthcare settings.* In rural settings, medical professionals often work in isolation and have few resources available to them. PDAs coupled with wireless technology offer a great potential for empowering healthcare workers with regularly updated reference materials and connections to specialists for advice and consultation. PDAs and digital cameras could be used for basic telemedicine functions as well.

6 CONCLUDING REMARKS

As hospitals, clinics, and Ministries of Health across Africa face the devastating effects of HIV/AIDS, TB, malaria and other diseases, they are also stretching their budgets to get the most out of their health management efforts at the local, regional and national levels. At the same time, there has been a public debate about the digital divide and whether African countries could afford to concern themselves with technology when there were more critical and immediate matters at hand. But healthcare and technology is no longer an either/or equation: the reality is that technology must be integrated into the solutions for Africa's health crises.

But this is not just about healthcare and technology. Africa's leaders understand that an investment in technology infrastructure will enable them to tap into the power of ICT for broader socio-economic development. For example, the New Partnership for African Development (NEPAD), an initiative of

African Heads of State to eradicate poverty and bring African into the global economy, has highlighted bridging the digital divide as a focus area. ICT is seen as a factor that will affect many of the other activities because of its broad role in development and crosscutting impact on all aspects of human life. African leaders have seen that using ICT to improve healthcare delivery will serve to increase productivity because people will be healthier, and it will help disseminate technology throughout the population. It follows that it will help stabilize the countries of Africa and contribute to their economic growth.

SATELLIFE has demonstrated that ICT can improve healthcare in a real way through the use of handheld computers. This project proved that PDAs are highly appropriate in an African setting. It showed that handhelds could be used for dissemination of important medical information that would equip health care workers to make better judgment calls. It also illustrated the potential of PDAs to be used for surveys that quickly provide a wealth of accurate data to healthcare departments, to aid disease management; inform budget planning; and address a desperate need for spatial healthcare information in African countries. This adaptable and user-friendly technology brought computing power into the hands of people who previously did not imagine the possibilities for how the technology could be used. Although healthcare workers had almost no previous exposure to PDAs, they quickly took to the technology and came up with various other uses for the devices. Their suggestions hinted at the many other potential ways that PDAs could be employed for in an African healthcare setting and it would serve healthcare department well to take note of their suggestions. And now the door is open for the Africans to take it to the next step by using this technology to fulfill their local needs in local ways.

Handheld computers could revolutionize technology access for the people of Africa. But none of this potential can be realized unless the technology companies and content providers rise to the occasion. The interest in PDAs is likely to be high, but cost would be the main obstacle to implementation in Africa. If the cost of the technologies could be driven down, a whole new market could be created modeled on the example of cellular telephones, which brought unprecedented telecommunications access to millions across the continent. This study should be a wake-up call to industry, a glimpse into the untapped markets where their attention would make a real difference to people's lives.

For more information on SATELLIFE and the PDA Project contact:

SATELLIFE
30 California Street
Watertown, MA USA 02472
Tel: +1 617 926 9400
Fax: +1 617 926 1212
Email: info@healthnet.org
URL: www.healthnet.org

Annex 1. Timeline of project activities

PDA PROJECT
CALENDAR OF EVENTS

DATE	EVENT
November 19, 2001	Acumen approval of funding
Phase I: GHANA	
December 8-9, 2001	Training of Red Cross volunteers
December 10-13, 2001	Assessment
December 14, 2001	Data turned in, report written
Partners Kick-off Meeting	
January 11-12, 2002	Meeting of partners: Newton, Massachusetts
Phase II: KENYA and UGANDA	
February 8, 2002	First 10 PDAs and laptops sent to Moi with IU courier
February 11-23, 2002	COBES II students write survey
February 21-22, 2002	Fred at Moi for training of COBES II students and survey loaded by Fred onto Visors
Feb. 25- March 15, 2002	COBES II students in field
March 6, 2002	Ship date for 70 PDAs to Uganda
March 18, 2002	Shipment released from customs
March 18, 2002	New rotation begins for 6th-year students at Moi
March 28, 2002	Fred's trip to Moi cancelled since 2 week vacation begins
April 16, 2002	First training in Uganda – 25 physicians
April 22, 2002	Training of 6th-year medical students at Moi by Fred and Ceasar
May 3, 2002	Meeting in Hudson with Skyscape
May 5-6, 2002	Fred makes trip to Moi to translate COBES IV surveys
May 13, 2002	'COBES II evaluation' and 'Content' reports sent out
May 22, 2002	Skyscape content courier to Kenya
May 27 (to July 21), 2002	New rotation begins for 6th-year students at Moi
June 10, 2002	Skyscape titles loading completed at Moi
June 11-21, 2002	Holly makes trip to project sites
July 1, 2002	Report on Pre-use Questionnaires draft completed
July 23, 2002	Fred travels to Moi to wrap up academic year, COBES IV done
July 27, 2002	Skyscape unlock codes downloading completed
August 6, 2002	"Encouragement packets" sent out to Ugandan participants
August 21, 2002	All packets distributed to Ugandan participants
August 27, 2002	Fred travels to Moi to plan for new academic year
September 5, 2002	Fred travels to Moi for training of 6th-year students
Sept 9 (to Nov 3), 2002	New rotation begins for 6th-year students at Moi
mid September 2002	TB survey completed and distributed to ~ 5 PDA users in Ug.
October 7-18, 2002	Bridges.org in Uganda, then Kenya for on-site evaluation Fred to Moi with evaluation team
October 30, 2002	Fred travels to Moi for final training session
Nov 4 (to Dec 29), 2002	New rotation begins for 6th-year students at Moi
January 8, 2002	Bridges.org report submitted to SATELLIFE

Other Events and Milestones (publicity and reports)	
March 6, 2002	First Project update sent to all partners
April 15, 2002	IICT/InfoDev Story on Ghana project submitted
April 18, 2002	Stockholm Challenge story submitted on Ghana project
April 22, 2002	Ghana project write-up completed/sent to Acumen
	PDA project added to SATELLIFE web page
April 28, 2002	IICT/InfoDev finalist (subsequently not chosen as winner)
May 6, 2002	Second project update sent to all partners
May 13, 2002	Reports sent on COBES II and Content Challenges
June 15, 2002	Stockholm Challenge finalist
July 25, 2002	Handspring web site “success story” appears on PDA Project
August 1, 2002	Third PDA project update sent to all partners
August 22, 2002	INASP newsletter article submitted (accepted for publication)
October 10, 2002	Stockholm Challenge winner!! Message to supporters and widespread publicity announcements sent out.
October 22, 2002	Digital Partners' Social Enterprise Laboratory award to HealthNet Uganda for mentoring process designed to lead to the develop a business plan on furthering PDA use in Uganda

Annex 2. Hot tips for PDA users, and list of additional reference materials for download

HOT TIPS FOR PDA USERS

The PDA is a user-friendly device. If you spend time 'tapping around' on your PDA you will learn quickly. The following HOT TIPS may make this little computer more useful.

1. You can PRACTICE YOUR GRAFFITI to become faster and more accurate
If you want practice using the writing system called Graffiti, open the main menu and tap the Graffiti icon. Tap 'try it!' and the PDA will take you through a series of steps to give you practice using Graffiti. You will get very fast with Graffiti if you use it frequently.

2. Your can OPEN FEATURES ON YOUR PDA without going through the main menu
You can use the silver buttons with icon pictures on them at the bottom of the PDA for to both switch on and gain instant access to your Datebook, the Address Book, your To Do List or the Memo Pad. This is a convenient way to get into the PDA instead of going through the main menu.

3. You can CATEGORIZE THE ADDRESSES IN YOUR DATEBOOK to make them easier to find
Enter a new contact in your Address Book by tapping new, and using the Graffiti system or the built in keyboard. You can put your entries into categories after they are entered or as you enter them.

- You will notice at the upper right corner of the screen where you are writing in your contact information, there is a box that says 'unfiled'. Tap that box and a list of categories will appear.
- Tap a category such as business, friend, and the contact will be filed there.
- If you want a new category, tap edit categories and you can add or delete from the list.
- If you have a contact you have already entered and want to assign a category for them, tap the name, tap edit, tap details, tap the arrow next to category and choose from the list.

Later you can see all the names in one of your categories by tapping that upper right hand corner to choose the category you want.

You can VIEW YOUR DATEBOOK IN DIFFERENT FORMATS – by day, by week, by year, or the entire list of entries
You can view your Datebook in a one day at a time version, a week at a time, a month at a time, a whole year, or a list of all items you have entered.

- To get to each of these views, open the Datebook, and you will see a row of six small boxes on the lower left corner of the screen. Tap each box in turn to see what the options look like. They are all useful in different ways.
- If you would like the Datebook to open every time with one of these views, such as the week view you can do that. Open the Datebook, then tap the preferences icon in the lower left corner of the Graffiti screen (a rectangle with an arrow beside it). This will open an options screen. Tap preferences. In 'initial view', tap the box you like.

You can NOTATE YOUR DATEBOOK entries to manage your calendar more effectively

- Appointments: For an appointment:
  tap the day you need
  tap the time

write in the event you want to schedule using the graffiti system or the on board keyboard.

- All Day Event: You may want to enter an event that has no specific time in a day, such as a national holiday. Tap the day and just begin writing and your note will appear at the top of the screen with no time attached.
- Floating Event: A 'floating event' is an item that you should do on a specific day but if it is not done, you want it to appear every day after that until you delete it.
  tap the day
  tap new
  tap floating event
  write in your floating event and it will move from day to day.
  Should you wish to delete it:
  tap on the event
  tap details
  tap delete.
- To Do: If you want a "to do" item to appear on your calendar (and it will appear on your to do list as well):
  open your calendar and select a date
  tap new
  tap to do
  write your task.

ADDITIONAL CONTENT FOR THE PDA

You can download "Freeware" and other applications onto your PDA

To download these you will need to use a cradle (available at the HealthNet office) to get them (for free) from the web. Remember the PDA has only 8MB of memory available for all applications. To find out how much memory you have left on your PDA, tap the preferences icon on the bottom left corner of your preferences screen (rectangle with an arrow beside it), then tap 'info' in the drop down box that appears. The available memory notation will be at the top of your screen.

ABX (An antibiotic guide)
Version 2.0 is the latest available one available at http://hopkins-abxguide.org. It uses 2.5MB of memory. It is possible in ABX to search by antibiotic, by pathogen, or by diagnosis.

EPOCRATES (Medicine formulary)
The newest version is ePocrates Rx Formulary 5.5 available at www.epocrates.com. It uses 1.7MB of memory. Also available is ePocrates ID (infectious disease treatment recommendations). It uses 450K of memory. It is possible to launch instantly from ePocrates ID to Rx Formulary and back. Weekly upgrades are available on the web.

EPI TOOL v. 1.03 (statistical calculator)
A tool for performing basic statistical analysis of exposure and outcomes on the handheld computer from Johns Hopkins University. Available at www.hopkins-heic.org/features/mobile.htm

Other sites to look at:
(Note: these sites have a few items that are "freeware" and some that are "shareware" which means you can try it out for a trial period. Most, but not all, of the software applications from these sites cost money.)

www.fphandheld.com – Has suggestions for medical software for the PDA including a few with no cost.

www.healthypalmpilot.com – More suggestions including a few free ones.

www.ddhsoftware.com/handbase_info.html – This is a "relational" database program for the PDA (cost is US $24.99), uses 195KB memory and has over 1,000 free templates with a variety of medical applications.

Annex 3. Project update, March 2002

RE: PROJECT UPDATE
March 6, 2002

Our PDA Project is moving along, almost on schedule in spite of several challenges since our meeting in January. In fact, most of the SATELLIFE staff is downstairs at this moment packing up 70 Neo Visors for their trip to Africa. Ten units went over to Moi University last month so that the medical students there could take them out on their field assignments to conduct surveys. Much as happened on all fronts since our meeting and I'll try to bring you up to speed with the highlights.

1. Project Management. Amy Galblum has been on board at SATELLIFE since the middle of January and has taken over most of the daily operation of the project on our side. Fred Karakul, having completed his studies has been fully engaged on the project in Africa since February. Fred has been actively gathering treatment guidelines and interfacing with the Uganda MOH. Contracts have been signed with Brown and Moi Universities for their participation and we are in the final pen strokes with the agreement for Makerere and HealthNet Uganda. We spent a great deal of time with people involved with the Moi project, refining and defining the elements of the project there.

2. Content Presentation. Since we met in January we began the effort to develop a more appropriate drug list for each of the countries where the project is happening. This took considerably more time and effort than expected. Starting with WHO we learned that there is no electronic master list of essential drugs and no country specific list or formulary. So we had to build both. We ended up converting the WHO list from their web site into a database and hand entered the formularies for Kenya and Uganda from material that was mailed in hard copy to us. We also ended up having to convert much of the other content, i.e. the guidelines, which required disassembling tables and charts and reformatting that material into text. We finally decided, after reviewing countless application options, to load the units with an html browser (freeware from www.pendragonsoftware.com) and to convert everything into that format for the PDAs. This reduced the individual files and allowed for hypertext linking within the documents. (Balazs, Lance, Sarah, and Arlene get kudos for all the work to convert the files).

3. Initial Content. While we had hoped to include Harrison's Companion as the text offering, we were unable to secure permission from the publisher or a reduced price from the $80 per copy. We are still working with McGraw-Hill but have made a decision to send the units out without a text and to add something as soon as possible.

The units for Moi contain the following:
- Med Calculator, a program (freeware) that has about 40 calculators including a pregnancy calculator
- HIV/AIDS treatment guidelines developed by Brown University specifically for this project
- WHO TB guidelines
- Kenya MOH Malaria treatment guidelines
-WHO essential drug list
- Kenya essential drug list

The ten units sent over in February have Pendragon Forms and several individual forms for local data collection.

The units for Uganda have been preloaded with a Malaria survey developed specifically for this project.

After much effort searching we determined that the MOH was no longer using a Malaria survey so our original intention to parallel that effort had to be set aside. You may recall that we decided to use the units for a couple of months just to survey and to collect data on current practice in the Kampala health district, and then load the reference material to see if we could see changes in behavior once the information was available.

4. Other Hurdles. We still have to get through the IRB process in Uganda and are focusing at this point only on the Malaria survey. We expect to add additional surveys later in the project and will likewise need IRB approval. This could delay us a little longer but we are hopeful that since the survey work is now disconnected from the MOH we will only need the approval of the Makerere IRB. We'll know more next week.

We are shipping everything to Fred in Uganda, with the expectation that we will have an easier time with customs there. Fred will hand deliver the units to Moi. Fred traveled to Moi in February to meet with the team there, train the students to use the first ten units and to get a better understanding of that environment.

5. Next Steps. Once FedEx takes the boxes this afternoon our focus will shift to the analysis of the data collected in the Ghana study. Mark and Rose provided us with a great report in December; our focus will be on the user experience with the equipment. We are continuing to talk with Vikram and the folks at MIT about the data collection software. While we have been distracted by the need to get the units out on time, we will now have some time to think through the limitations that Mark and Rose noted with the Pendragon Forms program. Our efforts to pull together the essential drug list have underscored the need for a comprehensive database that can be accessible through a variety of technologies. We have begun conversations with Management Sciences for Health about how to approach and fund a larger project that would combine a host of currently available resources. We'll keep you posted as those discussions take shape. Fred will now be in the driver's seat on the project training the users in both Kenya and Uganda, troubleshooting and keeping us all posted on the progress of the roll out.

I had the opportunity to join Mark and Rose for their internal presentation of this project to the information system working group at Red Cross national headquarters. There was a good deal of excitement about the potential for other fieldwork using the handhelds. I also met with a representative of the UN Foundation (one of the principle funders of the measles campaign) to encourage expanding the use of the handhelds - possibly in the June campaign in Kenya. We hope to continue to build on our work with the Red Cross in this and other program areas.

6. Access to Content. We would like to offer the project partners access to the same content that we have loaded on the PDAs for the field. Please understand, however that this material must not be distributed beyond our group without SATELLIFE's knowledge and permission. While we feel good about the quality of the content we want to get feedback on it from the test groups before it is shared - and we also want to respect the effort that has gone in to the development of the material. So if you would like copies of the files to load on your own palm OS handheld, and accept these limitations on distribution, send me an e-mail and I will send you the requested file(s).

If you don't have a palm OS unit, Handspring recently dropped the price of the Neo (ouch!) to $169.00.

Great work everybody!!
Holly

Annex 4. Project update, May 2002

PDA Project Update
May 6, 2002

We last sent out a general update on the PDA Project on the day that the PDAs were shipped to Uganda & Kenya in early March. It's time to let you know what has been happening since then, so here are the highlights.

Uganda: 40 physicians have been recruited through Makerere University in Kenya and trained to use the PDAs by Fred Kakaire. These physicians will initially be using the PDAs to conduct a malaria survey that was loaded onto the PDAs before they were shipped. Since the PDAs arrived in Uganda an additional survey on telemedicine has been added as part of an IDRC funded project that Nelson Sewankambo is running. We are working on an HIV/AIDS and a TB survey to be loaded on later, and information content will be hot synched onto the PDAs in June.

Kenya: At Moi Faculty of Health Sciences in Kenya, the second year students completed their self-designed community health survey in March. They had planned to use 10 PDAs in 10 different rural village sites in western Kenya for the survey. Their survey was not as successful as we had anticipated. However, we consider the PDA Project to be a dynamic process where we are able to apply what we learn as we move through each phase so we have carefully considered the pitfalls and will put the lessons learned to use. We believe the major problems were related to TIME i.e. the rush we had in getting the PDAs to Kenya and then translating the student survey to the PDA and the short time for training.

At Moi, thirty sixth-year medical students have been trained to use the PDAs for accessing information content and are now using them as they go through their rotations in pediatrics, internal medicine, and ob/gyn. We are continuing our negotiations to add more content to the PDAs.

Content: Our discussions with the publisher of the textbook that participants at our Kickoff Meeting in January liked has not been fruitful, so the PDAs were shipped with content that did not include a standard textbook. Consequently, we shifted our search to an alternative, and are currently talking to a company here in the Boston area about other titles we could get at a reduced cost. We are also revisiting the ideas of what kind of drug database will be most useful. The ability for us to upgrade the content mid-stream is another evidence of the dynamic nature of the PDA Project.

Publicity/contacts: As Rebecca has informed you, we were chosen as finalists for the PDA Project/Ghana story we submitted to the ICT Stories Competition sponsored by the World Bank's infoDev initiative and the International Institute for Communication and Development (IICD). We also submitted our story to the Stockholm Challenge. We hope you have taken the time to look at our new PDA Project web site at http://pda.healthnet.org/ to which we recently added some photos that Fred took of the training session at Moi. In addition we have been in contact with several organizations about the use of PDAs in collaborative projects, and others who may help further our work with handheld computers.

That's it for now! We will keep you informed as we go here.

Best regards,
Amy

Annex 5. Project update, August 2002

PDA Project Update
August 1, 2002

It has been a few months since the last general update for the PDA Project and I want to take a moment to give you all a progress report.

1. We worked hard to find a good reference text at an affordable price to add to the content that is included on the PDAs in Kenya and in Ghana. We were greatly pleased to obtain a significant donation to the project from Skyscape, a Massachusetts, USA company (http://www.skyscape.com) that publishes medical reference books in the Palm OS and Pocket PC format. Skyscape gave us a substantial discount on 80 copies of various reference titles and donated 80 copies. Titles include Griffith's 5-Minute Clinical Consult, A To Z Drug Facts, The Harriet Lane Handbook, Pocket OB/GYN, and 5 Minute Pediatrics. Each unit has been equipped with two of the above books.

2. In Uganda, physicians have been conducting surveys on malaria since they received their PDAs. The survey data has been regularly hot synced - primarily through visits from our field manager and field coordinator to the physicians' work sites. After conducting the malaria survey for 2 months, in July the content components (treatment guidelines for HIV/AIDS, malaria, and TB, Essential Drug Databases from WHO and Uganda, a medical calculator, and Skyscape references) were added to each of the PDAs. At that same time, participants filled out a questionnaire regarding their experience thus far.
We are sending out packets this month to all our PDA users in Uganda as a gesture from SATELLIFE to thank them for their participation in the project and to encourage their engagement as we go forward. Packets include "hot tips for PDA users", various sites where they can download additional free applications for the PDA, information about SATELLIFE's other services and a new stylus.

3. The 6th-year medical student PDA users at Moi Faculty of Health Sciences in Kenya have wrapped up the 2001-02 academic year and turned in their PDAs. We start in September with a new group of 6th-year students who will be trained on all the basics of using a PDA to access the available content. Ten 4th year students completed individual survey projects using the PDAs to collect data. We are using the August break in the Moi academic calendar to regroup and focus on using what we have learned to structure the remainder of the project.

4. On the publicity front, we are thrilled to have the PDA project named as a finalist in the 2002 Stockholm Challenge where winners will be announced in October. And the PDA project has been written up as a "success story" on the Handspring web site which you can take a look at by going to www.handspring.com/company/successstories.jhtml.

5. Holly traveled to both Uganda and Kenya in June to visit the PDA project sites and brought back pictures, stories and impressions. She was also able to participate in a Red Cross measles immunization campaign in Kenya. The 30 PDAs that were used in Ghana in December, were used again by Kenyan RC volunteers to conduct a similar survey. Though this was not part of the scope of the PDA project it was a gratifying follow up.

So we look forward to the remaining months of our fieldwork and will keep you informed as we go.
Best regards, Amy

Annex 6. SATELLIFE report on Ghana phase of project, December 2001

HEALTH INFORMATION PROJECT
PHASE ONE: GHANA

INTRODUCTION

SATELLIFE: the Vision

The strategy of using technology and information to provide solutions to health problems in Africa and other developing regions led to SATELLIFE's latest endeavor, working with handheld computers. Also called personal digital assistants or PDAs, SATELLIFE envisioned the use of these small but powerful tools in two major capacities: as survey tools and to carry information. Ultimately a variety of public health applications could benefit from this relatively new technology.

In order to test the concept of using the PDA to conduct surveys SATELLIFE approached the International Services section of the American Red Cross (ARC) in the summer of 2001, seeking to get involved with their ongoing Measles Initiative aimed at vaccination of at risk children across Africa. The Red Cross typically runs measles immunization campaigns lasting from a few days to a few weeks that are designed to vaccinate every child under the age of 15 in a targeted region. Although assessment surveys can be a helpful element in immunization campaigns, they are not always conducted because they are time-consuming, plagued with errors in data collection and transcription, expensive, and inevitably followed by delays in the receipt of a final report. A measles immunization campaign in progress would create an excellent opportunity to conduct a public health survey to demonstrate the feasibility and usefulness of using relatively inexpensive handheld computer technology in the conditions found in Africa.

The survey would be specifically targeted to mothers and other caregivers gathered at immunization sites during an immunization event planned for the Cape Coast region of Ghana in December 2001. It was hypothesized that a survey could be done quickly and accurately and with a large sample size. Results of the assessment would be reported to the ARC, the Ghana Red Cross, and the local Ministry of Health in a timely manner that would facilitate planning for future measles and other public health efforts.

Funding

Negotiations to fund the plan began in early summer of 2001 with Acumen Fund, a new 501(c)3 public charity incubated by the Rockefeller Foundation in partnership with the Cisco Foundation and individual philanthropists from the technology and investment communities. Details of the agreement between SATELLIFE and Acumen, including arrangements for the second phase of the project in Kenya and Uganda, were worked out during the summer and fall months with a final agreement reached for funding the project in mid-November.

METHODS

Hardware and Software

After a careful examination of the available options the Handspring Visor Neo was the PDA model chosen for the Health Information Project. Consideration was made for use of the PDA to conduct surveys such as the one in Ghana, and for access of stored content information as it would be used in the

second phase of the project. Using only one unit throughout was an absolute necessity in order to avoid confusion and to allow a thorough evaluation.

The overriding consideration in the choice of a handheld computer was cost. It was necessary both for the overall project budget and with consideration for future use of handheld computer technology in the developing world that the unit chosen be one that was on the lower end of the cost scale while meeting the needs outlined for users. A unit with a cost of $200 or less was considered workable and the Visor Neo was priced at $199 per unit at the time of the purchase for the project.

Beyond price, further considerations that emerged were power source, screen quality, memory capacity, and operating system. The power source of the units chosen was paramount. Battery powered units were deemed a necessity over units powered by recharging with electricity because of the variable access users might have to a source of electricity. There were no Windows Pocket PCs that used batteries, and in fact only three units in the designated price range that did: Palm 100, Palm 7, and the Handspring Visors. The wireless technology included with the Palm 7 was thought to be an unneeded and awkward feature; moreover the Visor has a larger screen size and superior readability.

In order to store sufficient content, 8MB of memory was deemed the minimum acceptable. The Palm Operating System was the default operation mode due to other considerations but was a superior choice since there is an overwhelmingly larger supply of off the shelf software available for Palm than any other system on the market.

Available software on which to write surveys was limited. Two applications were examined, Satellite Forms and Pendragon 3.1 Forms. Pendragon was chosen for ease of use for a non-programmer and because in construction of a survey it offered better PC interface.

Development of the Survey

The focus of the survey in Ghana in conjunction with the measles campaign underwent several incarnations. It was originally intended to be a door to door survey that would determine the measure of immunization coverage and a query of why caretakers did or did not avail themselves of the opportunity to vaccinate their children. A determination that it would be more productive to conduct the survey at the immunization sites provided the opportunity to do a broader assessment of health issues rather than confining questions to barriers encountered getting to the campaign. This was a fundamental alteration but changed the survey from a post-campaign study and limited the ability to compare it to other previously conducted post-immunization outreach studies.

Development of the survey questions was put on hold through the fall until funding was secured from Acumen, which considerably shortened the amount of time available. Approval was anticipated for August, delayed through September and was finalized in mid-November.

In mid-November, SATELLIFE and the Red Cross collaborated to construct a survey that would be targeted to caregivers at immunization sites and largely focused on maternal and child health. Since the successful outcome of any survey depends on the formation of solid questions that are interpreted by interviewees in the manner anticipated by question writers, effort was made to pre-test the survey. A paper version was sent to Tanzania and pre-tested at the end of November.

Due to the shortened time frame the Ghana Ministry of Health (MOH), a partner in the immunization campaign, did not have the time required to approve the maternal and child health questions. A series of questions about TB, HIV/AIDS, measles, and malaria was quickly developed. However, at the final

deadline the MOH asked that the survey be circumscribed and limited their approval to 14 questions related to measles and the Red Cross outreach efforts for the campaign.

The survey was programmed by SATELLIFE into Pendragon Forms 3.1 and loaded onto the PDAs before they were sent to Ghana. The final survey included the MOH approved questions and a transition question asking interviewees if they would be willing to answer questions in an expanded survey. There were 13 additional questions asked about TB, HIV/AIDS, measles and malaria. At this point, there was no time to pre-test the final questions.

In addition to the caretaker survey, a short user-satisfaction survey was loaded onto the PDAs for the volunteers to fill out after they returned from the field. Questions included topics such as problems encountered, ease of use and comparison to a paper-based survey. SATELLIFE also developed a training manual that was sent with the PDAs that focused entirely on the use of the handheld computers in doing a survey.

In Country

Thirty Ghanaian Red Cross volunteers were selected for PDA training based on their experience as Red Cross District Officers, Mother's Club leaders and long term local volunteers. Though considered volunteers they were paid a stipend for the time they spent with the assessment. The surveyors were trained by ARC personnel over a two-day period on December 8-9 as noted in the ARC report on the project (www.redcross.org/measlesinitiative/ghana4.asp). The technology caused no trouble for the volunteers though some of them had never before used a computer and most indicated they had never used this kind of device. They spent the first hour of training learning how to use the handheld computer and the remaining time discussing the survey and maneuvering through it on the PDA. By interviewing each other the volunteers practiced using the survey. Finally they went over the logistics of where and when to conduct the survey, handling of the PDAs, and returning data. One additional volunteer was sent out with the identical instructions to conduct a paper and pencil version of the survey.

Surveyors spread out throughout the region conducting assessments over the course of three days, December 10-13. The data from 29 surveyors were turned into the ARC project leaders at noon on the day following the immunization campaign. (One volunteer had an appointment and turned in data late). The stored data from over 2,400 surveys was transferred from the PDAs to a database in a laptop computer using the synchronizing software and cradle supplied with the PDA. Transferring the data into the database required approximately thirty seconds and no errors were encountered during the process. The transfer also erased all of the assessment results from the PDAs.

Analysis was completed promptly after the data was hot synched into a computer using EpiInfo 6 software. Questions were analyzed using frequencies and ranges and a complete report was delivered to the Ministry of Health by the end of the day.

RESULTS

The major goal of the first phase of the Health Information Project in Ghana was to test the use of the handheld computers to do surveys in the field in Africa. The results, gleaned from both the user satisfaction survey of PDA surveyors, and from the measles survey of caregivers can be considered a success specifically on three fronts.

Individuals who were not familiar with computer technology were easily trained and deployed to collect data. They completed 2,425 surveys at 67 locations in the targeted region including 41 urban and 26 rural sites. They averaged 28 surveys per person per day.

The PDAs were utilized in the field with no disruption from elements such as dust, dirt, and sunlight nor was loss reported due to security or breakage.

Data was downloaded from the units rapidly and with no error enabling rapid analysis and prompt reporting to the local Ministry of Health. The 30 paper surveys took approximately 30 minutes to enter into a data base, at a rate that would have taken over 40 hours to enter the PDA surveys by hand.

User Satisfaction Survey

The user satisfaction survey revealed overall very positive results. The assessors consisted of 21 males and 7 female volunteers. Their ages ranged from 18-59 (median=40). All had completed either O level at school or had a certificate of training in any field.

The user satisfaction survey revealed overall very positive results. The assessors consisted of 21 males and 7 female volunteers. Their ages ranged from 18-59 (median=40). All had completed either O level at school or had a certificate of training in any field. Below are some of the results:

All thirty of the volunteers liked using the PDA and all but one (97%) would do it again.

Nearly all (87%) of the volunteers thought they had received adequate training, though 63% reported that they were either a little or very nervous at first about using it.

When asked how easy it was to conduct the survey with the PDA, 70% reported that on a scale of 1 – 5 it rated a 4 or 5 (a score of 1 was very hard, 5 was very easy).

All were able to keep the screen clean, and 87% reported no problem with reading the screen outdoors with an adequately sized screen and letters large enough to read.

Reported problems were: 7 (23%) lost their place in the survey, 3 (10%) noted sore eyes, and 3 (10%) found the survey too confusing to follow.

Measles Survey

A record in the measles survey was considered valid if it contained a response to the first and last questions and at least 11 of the other 13 question fields contained responses. Once invalid records were excluded from the 2,425 returned records, the final database contained 1900 records for a completion rate of 78%. Some of the results of the measles survey are as follows:

45.5% had at least one child who had measles in the past

45% reported knowing of a child in their community who had died of measles

16.8% reported that one of their children had died of measles.

19.7% of the children who were brought in for immunization had not been previously vaccinated against measles.

Further measles survey results revealed information on the Red Cross Social Mobilization effort including the finding that 50% of respondents reported that they first heard of the campaign through a Red Cross Volunteer. A full report of the Red Cross Ghana measles survey is available on their web site at http://www.redcross.org/ measlesinitiative/ghana.asp. Additional data from the expanded survey has not been analyzed.

DISCUSSION and LESSONS LEARNED

This first phase of the Health Information project demonstrated the feasibility of using handheld computers for rapid assessments by community members with no previous training. The number of surveys derived was large and perhaps beyond what could have been considered workable without the rapid data entry made possible with the PDA synchronization feature.

For the Red Cross and others providing care, the project was a good demonstration that exit interviews are an appropriate method for studies assessing client's reporting perception and knowledge of services received. They may be particularly useful in busy sites – such as at vaccination posts during mass campaigns.

The wording of questions in the survey was not easy to modify once it was loaded onto the PDAs with Pendragon Forms 3.1 software. This was a particular problem since the survey used was not pre-tested. Adequate time for planning of surveys is clearly necessary in any assessment and here includes allowance of time to format written questions for the PDA. A positive feature regarding the difficulty of changing the survey is that individual surveyors should not be able to make changes to any survey in the field. Surveyors were nearly all satisfied with the amount of training received but ARC trainers judged the training time could be reduced. They suggested an assessment could be conducted with one day of training, two days of field work and one day of report writing. Trainers also reported concern that surveyors had access to the built-in features on the PDA which could result in confusion or error. Handheld computers might be a technology that is especially accessible to women since the PDAs are small and thus not tied to centers that women could have difficulty reaching. In view of that hypothesis it was thought that the gender of the Red Cross surveyors would be predominantly women especially since major recruitment was done in Mother's Clubs. However, when the stipend was added as an incentive for participation, a greater number of male surveyors turned out.

Efforts could be made to improve the percentage of usable surveys over that which resulted from this assessment. The percentage of usable records that came from the Ghana measles survey was lower than might be expected. In the measles survey it was possible to push the "Forward" (and "Back") button and skip answering the question. This was done to allow maximum flexibility. The surveyors may also have been confused by the addition of a last-minute change in the order of answering questions. Many surveyors used the flexibility of skipping around. With a paper/pencil survey a rate of approximately 5% incomplete surveys could be anticipated with records lost due to problems such as illegible answers, spoiled surveys, lost surveys, or too many choices selected. All of these problems could be eliminated by the PDA. An acceptable unusable survey rate for PDA might be less than 2%. To reach that number the "forward" and "back" button should be removed and error checking instituted on each question (so there must be a valid response before moving on).

Future analysis should be done to determine cost effectiveness for using handheld computer technology to conduct surveys. By way of comparison, the American Red Cross estimates that approximately $20,000 was saved on the cost of personnel and computers that would have been required to enter data and analyze this large sample size and double-date data entry over a regular survey. The feasibility of wireless technology to collect data that would be of value for health as well as in other fields, such as agriculture and environmental health should continue to be explored.

This first phase of the Health Information Project is a step towards the goal of the creation of a hand-held device that is tailor-made for specific needs in the rural African environment -- low cost, more memory in the OS and longer battery life.

Annex 7. SATELLIFE malaria survey – Uganda

MALARIA QUESTIONNAIRE

Is patient age five or older? (Y/N)

Enter age in years for child or person five or older: (Number entry)

Enter age in months for child younger than five: (Number entry)

Patient sex: (M/F)

If female, is patient pregnant: (Y/N)

Which of the following symptoms are presenting?

Fever (consider last 48 hours)
Loss of appetite
Nausea
Vomiting
Weakness
Cough
Headache
Joint pain
Muscle ache
Not able to sit upright
Not able to stand
Other_____

Temperature (in degrees centigrade): (Number entry)

Has patient taken any malaria medication in last 48 hours? (Y/N)
If yes what_____

Has patient had a positive lab test for malaria? (Y/N/Not done)

Are any of the following danger signs present?

None
Convulsions/fits within 2 days
Not able to drink or breastfeed
Vomiting everything
Drowsiness, lethargy or unconscious
Fast breathing
Very pale lips or palms
Sunken in eyes (dehydration)

Are any of the following other diseases present?

None
Meningitis
Otitis media
Tonsillitis
Abscess
Skin sepsis
Measles
Other virus with rashes
Respiratory infection
Urinary infection
Other_____

Was a referral made for this patient to a higher level of treatment? (Y/N)
Where? _____

Was any anti-malarial medication prescribed? (Y/N)
What? _____
Dosage? _____

Was any antipyretic medication given? (Y/N)
What? _____
Dosage? _____

Which of the following additional measures have been done with this visit?

Sponge with tepid water
Mosquito net given
Oral Fluids
Health education on malaria prevention
Health education on proper use of malaria medication
Health education – other topics
Other_____

Annex 8. COBES II survey evaluation – Kenya, May 2002

PDA Project
COBES II Survey - Evaluation
May 6, 2002

Introduction
The second phase of the PDA project in Kenya is a collaborative effort between SATELLIFE and Moi University Faculty of Health Sciences in Eldoret. The medical school, established in 1990, has collaborated with Indiana University since it was established in 1990 and has an IU faculty member on site in a full-time position. Students at the medical school work in the Moi Teaching and Referral Hospital in Eldoret, a town of 400,000 people, and in urban and rural health centers.

Preparation and Planning
The specifics of the design for the PDA Project in Kenya were defined largely through e-mail in late January and February 2002 between SATELLIFE and the IU faculty representative, Joe Mamlin, who is currently on site at Moi. No representative from Moi was able to attend the Partnership Kick-off Meeting for the PDA Project that was held in mid-January. While it was clear that the PDA users would be medical students at Moi, the details of the project including which students would be using the PDAs and what kinds of surveys would be done was undeveloped.

The early goal was to identify which students would use the content applications and who would conduct surveys. Discussion revealed that the 6th-year students, who are largely involved in the attendance of patients, had no survey obligations. These students (thirty in various rotations) would benefit most from the content applications. However, the 2nd, 3rd, 4th and 5th year students all developed and conducted surveys as part of their curriculum entitled Community Based Education and Service (COBES), a problem solving approach to health. Plans were made to use the remaining 10 PDAs assigned to Moi for the COBES projects. The COBES II students (2nd year) were planning a large survey in February/March. Indeed the COBES II project appeared to be an excellent opportunity to test the PDAs in the field in a rural situation.

The following specific points were articulated about COBES II as part of the Memorandum of Understanding between SATELLIFE and Moi:

The COBES II class consists of a group of 2nd year medical students combined with nursing and environmental health students, in a unit that they conduct on doing field research. There are about 50 medical students and about 35 others (split between nursing and environmental health students). Each year the COBES II students sit down as a class and work through a curriculum that is designed to help them prepare a survey instrument. The COBES II instrument for the 2002 class is to be specifically directed at HIV. Each student uses the same single survey that the class developed. Once the survey is finalized, they break into groups and go to nine or ten rural areas with about 8 or 9 students going to each of the 9 or 10 sites. The ten villages targeted for the survey has the highest incidence of HIV in Kenya. Students spend about 3 weeks collecting data and conclude the COBES II project with a week in which they analyze their data and prepare a report.

Timing presented an immediate problem between SATELLIFE and the COBES II project. The students were committed to an inflexible schedule that commenced on February 11 when they sat down as a class

to begin development of their survey. They were to head out to the villages on February 25 and remain in the field for three weeks until March 16. SATELLIFE was confronted with the challenge of getting the PDAs to Moi, getting their survey loaded onto the PDAs in the Pendragon software, and training the students to use the PDAs for the survey, all before the students left for the field. Though the timing was tight SATELLIFE determined that it was possible to meet the requirements to get PDAs prepared for COBES II.

Ten PDAs and the laptop computer for Moi were sent by 'courier' with a staff person who was traveling from Indiana University to Kenya on February 15. These initial 10 PDAs were not loaded with any information content but were set up to use a Pendragon survey form. The PDA package arrived at Moi on February 19. The students completed work on the details of their survey instrument during that week, and on Thursday, February 21 the Africa PDA Project Manager, Fred Kakaire, traveled to Moi. The task of Mr. Kakaire was to work with the students on conversion of the survey from the paper to the PDA format and to train students on use of the units.

The Survey

The survey tool developed by the COBES II students included 65 questions. Content covered areas including demographic information, sanitation (type of house, ventilation, waste), water supply, nutrition, maternal and child health/family planning, health and disease, health service utilization, health education, sexuality and sexually transmitted infections, and pest and vector control. Three questions concerned HIV/AIDS.

The format needed for conversion of the survey to the PDA using Pendragon forms was very specific. Questions could be written to input answers in a formats that included yes/no or other dual answers, multiple choice with one answer or multiple answers accepted, numeric answers, date/time, or written answers. Faculty members were aware of the general design we needed for the survey to work well. However, some of the questions on the COBES II paper survey the students prepared were written as tables such as:

Name	Sex	Age/date of birth	Relationship to household head	Main occupation	Marital status

Though Fred Kakaire had trained to write surveys with Pendragon in the weeks previous to the Moi COBES II orientation, elements in the survey such as the above graph made the translation to the PDA complicated. Other problems with the translation to the PDA included:

Inability to write in an answer where the choice was "other". Though it is possible with Pendragon to write in answers, the COBES II survey on the PDA was not set up to do this.

Lists that would have been helpful were not included for example in answer to a question like, "Do you have special diets for the sick?" The COBES II survey in paper format also did not give this choice. Poorly worded questions such as, "What was weaning diet?" where it is not clear if this refers to the diet of the mother or child.

Areas where a question could be skipped for instance if a person answered "no", and the next question said, "If you answered yes to the previous question…," were not skipped.

Multiple choice questions had incomplete lists with no provision for writing in additional choices.

Students were not adept at skipping questions that were irrelevant in individual interviews.

Several people including Fred Kakaire, Dr. Fabian Esamai, Head of Pediatrics and Chairman of COBES, and Dr. Joseph Rotich, a PhD in Biostatistics and the Moi's major resource in informatics, all helped in designing and redesigning the survey for conversation to the Pendragon format. In the process of translation from the paper to the PDA format, three overlapping questionnaires were developed.

Training

Fred Kakaire arrived at Moi around 2:00pm on Thursday and got to work immediately. By Friday at 10:00am the survey forms were not ready to load on the PDAs, so the three group leaders (Fred, and two Moi designated personnel) demonstrated the devices to the students using the Ghana Measles Survey Form. There were close to 90 students involved in the PDA training, all very enthusiastic to test them out. In the middle of a demo Fred noted that just after he told them to handle the device carefully, "One stylus dropped to the hard floor but did not break much to the amusement of the students whom I had cautioned to handle the devices with extreme care!" The training session lasted about three hours. The Faculty (staff) was independently briefed about SATELLIFE and the PDA Project, and the units were demonstrated to them as well. They too expressed excitement about their use. Many of them expressed an interest in owning their own PDA through an agreed upon arrangement where they would pay for them. The interest of staff and others may be reflected in the PDA Project where it is ascertained whether health workers will use the tools as part of their daily routine in the treatment or collection of data from patients and other health/medical services consumers.

Preparation for the field wrapped up quickly. The conversion of the survey to the PDA format was finally completed late on Friday evening, the 10 PDAs were loaded and were ready for use. They were given out on Sunday before the students left for the rural communities. Each PDA was to be allocated to a group leader of approximately five people. Since the batteries that came with the PDAs were nearly drained, they were given to the students replaced with the new batteries. Each PDA was accompanied with an extra pair of batteries.

In the Field

There was only one PDA for use by groups of 8 or 9 students, so groups had to work out systems for sharing the units. Most of them planned to take turns surveying and entering data directly into the PDA, and would then enter paper derived data into the units each evening.

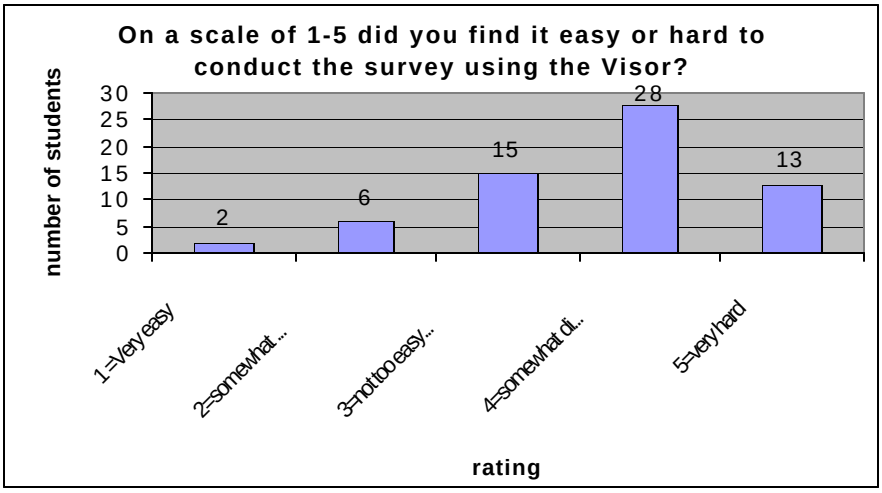
Plans for downloading data from the PDAs to the laptop computer were left vague as the students left for the field. COBES II requires the students to be in the field continuously for three weeks. A member of the faculty joins them on site for one-week rotations, thus three faculty go out during their time in the field. Joseph Rotich suggested that he might accompany the COBES coordinator on one of his weekly visits to the students to help with the back-up of data. Otherwise students would be able to download their data upon their return to Eldoret. As field conditions unfolded, Joseph Roitich found he could not move in the more than five districts to track the students and help them out.

In the field, the PDA did not work out as planned. Several scenarios ensued. The majority of students ended up not using the PDAs to conduct surveys at all. Those who did use the PDAs, primarily entered paper and pencil survey data into their PDA daily. In some cases the PDA was assigned to one person, and everyone else in the group used paper and pencil to do the surveys. Several of the PDAs failed to function after an initial success period. Problems were detailed after the students returned in the Post-Survey User Questionnaire filled out by each of the COBES II students (see below).

Saving time on data entry was projected to be the largest advantage for the students using the PDAs especially since they were sharing the units to actually do the surveys. For normal use, the Faculty of Health Sciences has between 8 and 10 computers available to over 500 students. The hope was that the PDA's would expedite data entry and transfer to a central computer. Unfortunately, when the students had problems in the field using the PDAs for surveys, apparently few of them tried or were able to transfer data as anticipated.

Post Project Questionnaire

The COBES II students were a group combined from three disciplines within the University. The group (those who filled out the post-test questionnaire) was made up of 32 medical students, 20 nursing students, 16 environmental health students and one other for a total of 69 students. They were asked questions about training to use the PDA, how their group used the unit, about problems that arose, and for their comments and suggestions. Not all students answered all questions. Of those who completed the user questionnaire, 51 or 74% stated that they did not get enough training before using the visor though 85% also stated that they were not afraid to use the Visor after the training. They responded about their general experience with the use of the PDA as follows:



When asked how their group chose to use the PDAs, most students responded that it caused so many problems that they did not use it at all. Some used it for a short time (2 days to 1 week) and then abandoned the PDA. Other students noted that their group used paper and pencil surveys, then entered the data into their PDA.

Students listed the problems they encountered as follows:
Survey questions were poorly worded – 62% (43 students).
Not sure data entered accurately – 41% (28 students)
Surveys were slower with the PDA than with paper and pencil – 32% (22 students)
Screen too small – 23% (16 students)
Problems reading screen in bright light – 14% (10 students)
People found the PDA distracting – 14% (10 students)

In comments that students wrote about the problems they confronted, most were frustrated about the wording to questions, commenting for instance that, “not all survey questions could be recorded on the visor,” and, “some information cannot be pre-coded.” In addition they wanted to be able to analyze data

in the field as it was entered. They were bothered that they did not have the ability to access data once it was entered.

On the other hand students did like some things about using the PDAs for surveying. They listed the following advantages:
Convenient size to carry around – 57% (39 students)
Don't have to worry about keeping track of papers – 36% (25 students)
Fun to use – 28% (19 students)
Easy to use – 23% (16 students)
Surveys are more accurate – 16% (11 students)
Surveys are faster – 14% (10 students)

Students were asked whether they thought using the PDA to do the survey changed the way they interacted with respondents. Their comments noted both that the PDA made interactions better because it demanded people's attention and that people realized the survey was scientific, and that interactions were worse because it was distracting.

Finally, students made comments about how the PDA could be used more profitably to conduct surveys and again many commented that it would work better with better programming and wording. Three students thought it would be more suitable to have one PDA per student, three thought more training would be helpful, and six liked using it as a calculator. One student thought it would have been useful to have better backup in the field with the ability to analyze data in the field.

Discussion and Lessons Learned

Although it was not as successful as anticipated, the COBES II experience yielded valuable insights for the continuation of this project and for use of PDAs in the field in general. The goal to test the concept of using handheld computers to do surveys in the field in Africa may benefit as much from success as from a trial run where there are clear lessons to be learned. In the case of the COBES II survey there are indeed conspicuous lessons, the major component of which is related to time.

The survey itself caused major problems on a few different levels. Though faculty were apparently aware of the capabilities of the PDA, some of the survey questions were written in such a way as to make translation to the PDA format difficult. Had the PDAs arrived in Eldoret earlier, students and faculty might have had an opportunity to become more familiar with the limitations of the PDA format in a more timely manner. The 'translation' from paper to the PDA was so full of problems that when it was tried in the field it was generally not usable. There was not time to pre-test the survey as it was written for the PDA, an absolutely essential task in any assessment regardless of the method used for transmission.

Training was rushed. Fred Kakaire, the Africa Project Manager for SATELLIFE spent much of his short time at Moi working on the translation of the survey into Pendragon, and less time than was needed for the students. Because the COBES II survey was not ready for the PDAs when the students were trained, they used the survey that had been developed for the measles campaign in Ghana rather than their own survey. Had the students been able to use the COBES II survey in training it seems probable that they would have been trained more thoroughly and had an opportunity to search for errors in the survey. Joe Mamlin commented that the students "had one day but needed three or four."

Pinched time compounded problems in the field. The short training meant that students were not completely familiar with the PDA and when they encountered problems were unable to solve them in any way except to abandon the PDA and revert entirely to the paper and pencil format.

Other issues arose that also contributed to the lack of success of the COBES II survey. Because there were only 10 PDAs available for the survey conducted by approximately 70 interviewers, students were forced to share use of the units. In both training and during use in the field, individual students had less contact with and less familiarity with the technology than they needed. Sparse supervision by someone closely involved in the PDA Project and lack of back-up also created problems. It is not clear how much of a problem the equipment itself presented. *(Joseph Rotich and Fred have been asked to comment on this.)*

Future

The PDAs will be used at Moi for further surveys throughout the duration of the PDA Project and beyond, so it will be critical to take account of the lessons learned.

In future years it might be sensible to assign the PDAs to one group of COBES II students working in one village where in a group of surveyors, each student would have a PDA to use. Though this kind of set up might raise the question of fairness it could create a more reasonable test.

Spend more time training including use of the COBES II survey in training sessions.

Consider back-up of data in the field by having supervisor visit COBES II students at least one time. If surveys are done in one village instead of 10, then the laptop computer could go with students to that site for back-up.

Pre-test all PDA surveys.

Annex 9. COBES IV survey evaluation – Kenya, August 2002

SATISFACTION and USE of PDAs
EVALUATION of COBES IV
August 8, 2002

Background
Ten fourth year medical students at Moi Faculty of Health Sciences were provided use of hand held computers also called personal digital assistants (PDAs) to manage the survey and research instruments they developed for their Community Based Education and Service (COBES) IV projects. At the time the students obtained the PDAs in early May, they were nearly done with the survey aspects of their projects and were beginning the analysis phase. The students were apparently very keen on getting access to the PDAs to help them enter their survey data and manage the analysis. The sixty or so students in the fourth year class "balloted" (in the West this is called drawing straws) to see which ten would get to use the PDAs. Students were required to complete their work over the next month.
Fred Kakaire traveled to Moi on May 5-6, 2002 to finish the task of translating the ten COBES IV research surveys to Pendragon Forms (the PDA survey software). He downloaded the surveys to the COBES IV PDAs and trained those students on use of the PDAs for their survey work.

Method
Project topics researched by the COBES IV students who used PDAs included the following titles:
- KAP Study on Smoking Among Adolescents in Eldoret Municipality
- Perinatal Outcomes of Babies (Pre-Term) Born of PIH Mothers and Due to Other Causes
- Causes and Risk Factors of Maternal Mortality in Moi Teaching and Referral Hospital (MTRH)
- HIV/AIDS Counseling KAP study on Health Professionals in Eldoret Municipality
- Patterns of Compliance Among TB Patients at MTRH and Effect of HIV on Compliance
- Epidemiology of Ocular Injuries (Blunt and Penetrating) at MTRH
- A Study on the Risk Factors and Predisposing Factors to Burns in Patients Admitted at MTRH
- Assessments of Applications of the Nursing Process as a Method of Nursing Practice and Evaluation of Nursing
- The Prevalence and Predisposing Factors of Anaemia Among Pregnant Women Attending Antenatal Clinic of MTRH

Research was conducted by students at the Moi Teaching and Referral Hospital (7 students) and in Eldoret Municipality (2 students).

When the COBES IV project was completed in July, the ten students who had used the PDAs filled out a 'Use Questionnaire' with questions concerning their activities and experience.

Results
All ten students completed a questionnaire about their use of the PDAs though not all answered every question.

On experience with computers and training:
Students were asked to rate their level of expertise with use of computers and were found to have had varying levels of experience. One student reported no previous experience, 3 rated themselves as

beginners, 4 thought they had a moderate amount of experience and 2 declared that they had lots of experience.

With that backdrop, 70% of the students found that they had adequate training on use of the PDA. Though 60% of the students were nervous about using the PDA prior to training, only 20% remained nervous after the training was complete (one of those was the student who had no previous computer experience).
Nine out of the 10 students reported they liked using the PDAs. Five students found that using a PDA was either very easy or somewhat easy, and three more thought it was "not too easy/not too hard." One student found it to be very difficult.

Activities with PDAs
Most COBES IV students used the PDAs to enter data from paper surveys done earlier. Two students were unable to incorporate the use of the PDA into their COBES IV project. One of those noted that though he/she thought it was a good idea, it would have been better if the PDA had been presented earlier in the project. The other felt his/her use of the PDA would have benefited from more training.

Overall, the ten COBES IV students conducted an average of 146 surveys or individual interviews (range of 47 to 384) for their projects. Students used their PDA to do on average 54 of those surveys (range 0 to 210).

Problems & Advantages
The most commonly cited problem with use of the PDAs (chosen by users when presented with a list) was that the batteries ran out too fast (7 users). Five users reported that they were bothered that they were unable to change survey questions. On the other hand students found many likable features. Eight students appreciated the advantage of not having to keep track of papers, eight found the PDA to be a convenient size to carry around, six said it saved time doing data entry and five liked that it was easy to use.

Suggestions
Students had the following suggestions:
- (More) "training on how to enter data in computer."
- "More PDA programs as they may have to interview several respondents at the same time."
- "It's a good idea. PDAs are very fast and time saving. But let the users be trained on how to tackle all difficulties encountered by the previous users of Visor."
- "Give them earlier - get used to using them."
- "Allow flexibility - students should input the questions and program for conditions to be applied in data collections."
- "Nothing on MS Access - currently not very popular."
- "The Visors should be given early in the year so that projects can be designed with them in mind."
- "To be provided to all groups with adequate training."
- "Use Visor but after adequate training and students given time long before exams to learn and teach each other."
- "Should be given to students early enough to allow them to understand the Visor well and to avoid time wastage."
- "They should be availed to all students doing quantitative research/ Teach students how to transfer information into relevant package in the computer."

Conclusions and Lessons Learned

The biggest problem with the COBES IV project was no doubt the distribution of the PDAs in May, after the bulk of survey work was completed by students. (The PDAs had been in use by COBES II students through mid April.) Earlier distribution would have allowed students to design their surveys with the requirements of the survey software in mind, and to directly enter data into the PDAs. They may have then found the advantage of 'skipping' the data entry function to be a distinct time-saver.

Training and support were also areas that were targeted with suggestions for improvement. Although 70% of COBES IV students found that training was adequate, the problems they encountered and the comments they made suggested that more training and subsequent support would have been beneficial to the success of the project. Students had problems making changes to their surveys after the Pendragon version was hot synced to their PDA. More support could have helped alleviate this problem as SATELLIFE has discovered that a saved "unfrozen" version of a survey can be altered. Also, some students had problems with the transfer of data including unfamiliarity with Microsoft Access, which is the program that interfaces with Pendragon. It is clear that someone at Moi must be thoroughly trained in the subtleties of Pendragon in order for this survey application to be useful for a variety of projects and individuals.

A few students suggested that more PDAs be made available to students who are doing quantitative research. If the PDAs can be incorporated into research with sufficient training and support, then the advantages of saving time and relieving pressure on existing computer facilities may be realized. In that eventuality, additional PDAs made available to more students would undoubtedly be recognized as a worthy objective.

Annex 10. 6th-year students evaluation report – Kenya, August 2002

SATELLIFE – MOI PDA PROJECT
QUESTIONNAIRE for 6th-year Students
POST USE OF PDA's - First and Second Rotations

Results
At the close of the first rotation questionnaires were received from 12 of the 30 sixth year students who used PDAs. Though that rotation ran for eight weeks from March 18 to May 26, students did not receive the PDAs with training until April 22, thus they had use of the units for about 5 weeks. These students did not have the Skyscape reference material (5Minute Clinical Consult, 5Minute Pediatrics, Harriet Lane Pediatrics, Pocket Ob/Gyn and A2Z Drugs) since it was not added until June 10 at the beginning of the second rotation. Eight of the 30 students in the second rotation completed questionnaires at the close of their experience. The second rotation ran from May 27 to July 21. In the first rotation, there were seven students from Internal Medicine and five from Pediatrics. In the second rotation there were two students from Internal Medicine, two from Pediatrics and two form Obstetrics/Gynecology.

Students had a mostly positive but mixed reaction to the training they received in use of the PDAs. In the first rotation 8 students (67%) said they got enough training, 4 (33%) said they did not. In the second rotation 5 students (63%) reported receiving enough training while 3 (37%) said it was not enough. Nonetheless, while in the first rotation 2 students reported they were nervous about using the PDAs both before and after the training (same individuals), no students were nervous with the second rotation. Seven students in the first rotation (58%) found it very or somewhat easy to use the PDAs but four (33%) found it to be very hard. However, in the second rotation six students (75%) thought it was very or somewhat easy and no one thought it was very hard. The students in the second rotation appeared to have had a more positive experience overall with all reporting they liked using the PDAs while exactly half in the first rotation liked using the PDAs and half did not.

Students were asked to rate the content applications that were loaded on the PDAs. A majority in all cases found the treatment guidelines to be very or somewhat useful. Most popular were the TB guidelines that were found to be very useful by seven out of the eight students in the second rotation. In the first rotation, one third of students described the TB and malaria guidelines as not useful. The essential drug lists were given a mixed response, though most students thought they were at least somewhat useful. The medical calculator was thought to be very or somewhat useful by all of the second rotation students, and by 75% of the first rotation students. The calculators in that application that garnered particular notice were the pregnancy calculator and the dose calculator.

The Skyscape applications were not available to the first rotation students. They were found to be either very or somewhat useful by all of the second rotation students. It should be noted that there were small response rates because not all students had all of the applications. The references that appeared to generate the most enthusiasm (very useful responses) were A2Z Drug, 5Minute Pediatrics, and 5Minute Clinical Consult.

Students were queried about problems they encountered with using the PDAs. The one problem that engendered the largest overall response was that "batteries ran out too fast," reported by 45% of students

in both rotations. Three students also felt that the screen was too small. No other problem generated more than one response.

In response to what they like about using a PDA, students especially noted that it is a convenient size to carry around. Students in the second rotation, in contrast to the first (75% vs. 16%), reported that the PDAs gave them "access to information that is otherwise unavailable or difficult to get." This was confirmed by the fact that in the second rotation, seven of the eight students reported that other people had asked them for information that they had on their PDA, whereas in the first rotation only 5 students (41%) reported being asked for information.

Perhaps the true test of whether students found the PDAs to be useful, is the question of whether they would like to own one in their future medical practice. All of the students in the second rotation and overall 90% thought they would like to have one. They were asked what the maximum they would spend to get their own PDA and answers ranged from US$ 6 to US$102. The average amount was US$ 58.

Conclusions and Lessons Learned

The fact that few students turned in post-rotation questionnaires is troubling and casts doubt on results. (It is hoped that this is a management problem that will be resolved in future rotations.) Nonetheless, responses are tentatively encouraging. It appears that training could be strengthened so that more than two thirds of students will feel prepared to use the units. Even with the training sessions as they were, most students found the PDAs at least somewhat easy to use. As a progression, the students in the second rotation, who had more content (Skyscape materials added), appeared more satisfied, seemed to use the PDAs more, and were asked for information more. They liked the Skyscape applications, and when they had those references to use, they also liked the SATELLIFE installed applications better. This suggests that good content engenders use of all content. As has been found in other SATELLIFE PDA Project surveys, the biggest problem encountered in everyday use is with batteries that run out too fast. Nearly all students concluded that a PDA would be useful to a future medical practice, so perhaps for those who did not get quite what they needed, they were at least able to imagine and appreciate the concept of using the PDA to access information.

First Rotation: March – May 2002 (12 respondents)

Which rotation have you most recently completed at Moi University? (choose one)	7 Internal Medical 5 Pediatrics 0 Obstetrics/Gynecology
Did you get enough training before using the PDA?	8 Yes 4 No
Were you nervous about using the PDA before the training?	2 Yes 10 No
Were you nervous about using the PDA after the training?	2 Yes (same respondents as above) 10 No
Overall, did you like using the PDA?	6 Yes 6 No
On a scale of 1-5 did you find it easy or hard to access information on the PDA?	3 – very easy 4 – somewhat easy 1 – not too easy, not too hard 0 – somewhat difficult 4 – very hard

Please rate the usefulness in your medical practice of each of the following content applications:	(CIRCLE ANSWER) Very useful / Somewhat useful / Not useful
Medical calculator	2 / 7 / 3
WHO essential drug list	3 / 7 / 2
Kenya essential drug list	4 / 7 / 1
HIV/AIDS guidelines	8 / 3 / 1
TB guidelines	5 / 3 / 4
Malaria guidelines	4 / 4 / 4
If you used the medical calculator, which calculators did you find to be the most useful?	Dose calculator – 2 Conversions – 2 Pregnancy – 1 Apgar - 1
Please rate the usefulness in your medical practice of each of the following text applications:	Very useful / Somewhat useful / Not useful / N/A
5 Minute Clinical Consult	2 / 2 / 1 / 7
Harriet Lane	0 / 1 / 1 / 10
5 Minute Pediatrics	2 / 1 / 0 / 10
A to Z Drugs	1 / 0 / 0 / 11
Pocket OB/GYN	1 / 0 / 0 / 11
Did other people ask you for information that you had on the PDA?	5 Yes 7 No
Did you have any of the following problems when using the PDA? (choose all that apply)	0 Problems reading screen in bright light 1 Screen too small 1 Hard to keep screen clean 0 Lost the stylus 5 Batteries ran out too fast Other: *"Did not want to get used to using the PDA when I wasn't going to be using one in future." "Went off after a few minutes."*
What did you like most about using the PDA? (choose all that apply)	4 Challenge of learning new technology 3 Boosts my professional self confidence 4 It helps me look more professional/increases prestige 2 Access to information that is otherwise unavailable or difficult to get. 1 People loved seeing it 3 It is fun to use 7 Convenient size to carry around
Do you think it would be useful to you in your future medical practice to have a PDA?	10 Yes 2 No
If it were available, what is the maximum amount you would spend to get your own PDA?	Average suggested: US$ 60 Range: US$ 13-102

Rotation 2: June – July 2002 (8 respondents)

Which rotation have you most recently completed at Moi University? (choose one)	2 Internal Medical 4 Pediatrics 2 Obstetrics/Gynecology
Did you get enough training before using the PDA?	5 Yes 3 No
Were you nervous about using the PDA before the training?	0 Yes 8 No
Were you nervous about using the PDA after the training?	0 Yes 8 No
Overall, did you like using the PDA?	8 Yes 0 No
On a scale of 1-5 did you find it easy or hard to access information on the PDA?	5 – very easy 1 – somewhat easy 2 – not too easy, not too hard 0 – somewhat difficult 0 – very hard
Please rate the usefulness in your medical practice of each of the following content applications:	(CIRCLE ANSWER) Very useful / Somewhat useful / Not useful
Medical calculator	4 / 4 / 0
WHO essential drug list	4 / 4 / 0
Kenya essential drug list	3 / 4 / 0
HIV/AIDS guidelines	5 / 2 / 0
TB guidelines	7 / 1 / 0
Malaria guidelines	6 / 2 / 0
If you used the medical calculator, which calculators did you find to be the most useful?	Dose calculator – 1 Pediatrics – 2 Pregnancy – 3 Lungs – 1 IV calculator – 1
Please rate the usefulness in your medical practice of each of the following text applications:	Very useful / Somewhat useful / Not useful / N/A
5 Minute Clinical Consult	4 / 1 / 0 / 3
Harriet Lane	2 / 3 / 0 / 3
5 Minute Pediatrics	7 / 0 / 0 / 1
A to Z Drugs	5 / 1 / 0 / 2
Pocket OB/GYN	0 / 2 / 0 / 6
Did other people ask you for information that you had on the PDA?	7 Yes 1 No
Did you have any of the following problems when using the PDA? (choose all that apply)	0 Problems reading screen in bright light 2 Screen too small 0 Hard to keep screen clean 0 Lost the stylus 4 Batteries ran out too fast

What did you like most about using the PDA? (choose all that apply)	3 Challenge of learning new technology 1 Boosts my professional self confidence 2 It helps me look more professional/increases prestige 6 Access to information that is otherwise unavailable or difficult to get. 0 People loved seeing it 3 It is fun to use 6 Convenient size to carry around
Do you think it would be useful to you in your future medical practice to have a PDA?	8 Yes 0 No
If it were available, what is the maximum amount you would spend to get your own PDA?	Average suggested: US$ 40 Range: US$ 6-89 Median: US$ 25

Annex 11. Mid-term evaluation report – Uganda, August 2002

Uganda Mid-Project Questionnaire Results
August 2002

Questionnaires were completed in late July and early August by 21 of the 39 PDA users. At this midway point in the project, the Ugandan PDA users had been assigned to complete a malaria survey on patients they saw, but did not yet have access to any information content such as treatment guidelines or reference textbooks. Some of the PDA users had recently received their units and were thus "not eligible" to fill out a mid-project questionnaire that was aimed at determining their experience using the PDAs in the field.

Results
Sixteen of the PDA users who completed the questionnaire are physicians or medical officers, 2 are intern doctors, 1 a military officer, and 2 noted "other" job titles. The PDA participant list notes at least 1 pharmacist. Incidentally, the participant list also shows the participants to be split evenly between genders.

On the subject of training and experience, 17 participants (81%) found the training to be adequate. Eighteen participants had previous computer experience (86%) and only one (5%) had no previous computer experience. Two thirds of the PDA users (67%) described previous computer experience as "moderate", 3 participants (14%) considered themselves beginners, and 3 described themselves as having "lots of experience."

The malaria survey they conducted was thought by most – 15 participants (71%) – to be easy, while 4 (19%) found it "not too easy / not too hard." No one thought it was difficult to do, and in fact 18 (86%) project participants stated a preference for using the PDA over using paper and pencil to conduct the survey. They completed an average of 9.5 malaria surveys per day (range 1.5 to 50, median 5) with 12 individuals responding with a specific number to the question about how many surveys they conducted per day. The months during which they have been using the PDAs have not thus far been during an active malaria season.

The PDA related problem that generated the biggest response from users was that their batteries ran out too fast (11 participants – 52%). Six PDA users did not note any problems at all, four thought people found the PDA to be a distraction, and three thought surveys were slower on the PDA than with paper and pencil. Three also found they could not be sure that the data was entered accurately, but no other problem generated a response from more than one or two individuals.

PDA users noted many advantages of the units as follows:
- 17 participants found that they liked the convenient size for carrying,
- 16 participants liked that they did not have to worry about keeping track of papers,
- 15 PDA users noted that it is easy to use,
- 14 said that it is fun to use,
- 11 thought that surveys are faster using a PDA,
- 7 felt that surveys are more accurate.
- 8 thought that "people loved seeing it".

Participants were trained and encouraged to use other features of their PDA and most (95%) took advantage of built-in options. The address book and calculator were most popular. Many also used the date book and to do list features, a few noted they liked the city time lookup, and one enterprising individual installed some games to play.

Conclusion

From this mid-project questionnaire it appears that the PDA users are about where they might be expected to be in their adoption of the handheld computers. The training was adequate for most participants, the survey has been relatively easy to conduct and they are adopting the miscellaneous features of the PDA to use in their everyday life. We can thus hope that the addition of information content will be readily accepted and widely used. The amount of time batteries last appears to be a problem that may be a significant and recurring issue for PDA users in Uganda

QUESTIONNAIRE

What is your job title? (choose only one)	Physician = 4 Medical Officer = 12 Intern Doctor = 2 Other = 2 Military Officer = 1
Did you get enough training using the Visor?	17 Yes 4 No
Were you afraid to use the Visor before training?	5 Yes 14 No
Were you afraid to use the Visor after training?	21 Yes 0 No
Did you like using the Visor?	20 Yes 0 No
On a scale of 1-5 did you find it easy or hard to conduct a survey with the Visor?	9 – very easy 6 – somewhat easy 4 – not too easy, not too hard 0 – somewhat difficult 0 – very difficult
Would you rather use the Visor or paper and pencil to conduct this survey?	18 Visor 3 Paper
Did you have any of the following problems when completing surveys? (choose all that apply)	0 Problems reading screen 1 Screen too small 0 Hard to keep screen clean 2 Lost the stylus 11 Batteries ran out too fast 1 Lost my place in the survey 0 Survey questions were poorly worded 4 People surveyed found the Visor distracting 5 Surveys are slower to do than with paper 3 Not sure data entered accurately 6 No problems noted Other: *"Repetition of questions" "Lost no. of people seen (count)" "Some other questions needed such as other drugs patient is on"*

What did you like most about using the Visor? (choose all that apply)	15 Easy to use 8 People loved seeing it 16 Don't have to worry about keeping track of papers 14 It is fun to use 11 Surveys are faster 7 Surveys are more accurate 17 Convenient size to carry around Other: *"Small yet holds lots of data" "Can use it for personal use such as diary" "I hope for more data installed"*
About how many surveys were you able to complete per day?	Average = 9.5 Range = 1.5 to 50 Median = 5 12 individuals answered question
Have you had previous experience with computers?	18 Yes 1 No
Prior to this project, what would you say your level of expertise was with computers?	1 No experience 3 Beginner 14 Moderate 3 Lots of experience
Did you use the Visor for anything other than surveys?	19 Yes 1 No
If you answered yes to the previous question, which of the following things did you use on the Visor? (Choose all that apply)	11 Calendar (keeping track of what day it is) 14 Date book (writing in appointments) 16 Addresses/Phone # list 16 Calculator 3 Expense tracking 10 To do list Other: Games (1); City Times (2) *"Use beams to receive other programs form colleagues using PDAs"*

.

Annex 12. Evaluation interviews, October-November 2002

Uganda

Monday 7 October

Project Partners

Professor Sewankambo	Dean, Faculty of Medicine, Makerere University/Principal investigator
Mr. Fred Kakaire	SATELLIFE Project Field Manager/Co-investigator
Mr. Ceasar Barole	Project site coordinator

Tuesday 8 October

Project Participants

Dr. Catherine Nansamba	Kawempe Community Clinic
Dr. Elizabeth Namukwaya	Rubaga Hospital
Dr. Evelyn Nabankema	Mengo Hospital
Dr. Ndiwalana	Mengo Hospital
Dr. Julian Nabatanzi	Mengo Hospital
Dr. Fatuma Namusoke	Mengo Hospital
Dr. Ayebare	Mengo Hospital
Dr. Ssonko	Mengo Hospital
Dr. David Nsibambi	Mengo Hospital
Dr. David Muyanja	Mengo Hospital
Dr. N.K. Okone	CEU, FOM

Wednesday 9 October

Paul Ekwaru	Statistician, Makerere University
Dr. Joy Naiga	Mulago Hospital
Dr. Sara Nakubulwa	Mengo Hospital
Dr. David Meya	Mengo Hospital

Thursday 10 October

Dr. Alia Godfrey	Mulago Hospital
Dr. Hasifa Kasule	Mulago Hospital
Dr. Susan Nabadda	Kibuli Hospital
Dr. N. Bulya Semiyaga	CEU, FOM
Dr. G.W. Bukenya	Mengo Hospital
Dr. James Mutumba	Mengo Hospital
Dr. Kiwanuka Mayambala	Mengo Hospital
Dr. Senzoga	KCC Clinic
Dr. Patrick Okello	HealthNet Uganda

Friday 11 October

Dr. David Torr	Joda Clinic
Dr. Godfrey Habomugisha	Naguru Health Centre

Kenya

Tuesday 15 October

Dr. Doug Shaffer	Coordinator, Indiana University

Wednesday 16 October

Project Partners

Dr. B.O. Khwa Otsyula	Dean, Moi Faculty of Health Sciences
Dr. Joseph Rotich	Coordinator, Moi University
Mr. John Bii	Coordinator, Moi University

Project Participants/Rotation

Murithi Mwiti	Medicine
Ayub Gitaka	
Charlotte Polle	Medicine
Edith Apondi	Surgery
Kevin Nyambaka	Medicine
Fred Chite	Medicine

Thursday 17 October

KG Bor	Paediatrics
Kazungu Boniface	Psychiatry
Habel Amg'ani	Paediatrics
Andrea Mwikamba	Psychiatry
Ambrose Rotich	Paediatrics
John Ombolta	Paediatric
Moses Shibona	Surgery
David Kibor	Medicine
Stephen Okelo	Medicine
Mary Kariuki	Psychiatry
Helen Koech	Psychiatry
Mohammed Abdullah	Medicine
Dr. Fabian Esamai	Head of Pediatrics and Chairman of COBES

Project Partners (by telephone)

Tuesday 12 November

Holly Ladd, JD,	Executive Director, SATELLIFE
Leela McCullough, Ed.D.	Director of Information Services, SATELLIFE
Balazs Kosaras	Technical Director, SATELLIFE

Thursday 14 November

Rebecca Riccio, M.A.	Director of Programs, SATELLIFE
Amy Galblum	Handheld Computer Project Manager, SATELLIFE

Friday 22 November

Rustom Masalawala	Portfolio Manager, Acumen

Annex 13. Bridges.org questionnaire and summary of results – Uganda, October 2002

Uganda Participant Questionnaire
SATELLIFE PDA Project Evaluation
7 - 11 October 2002

Question	Response
Occupation	4 Physician 2 Intern 17 Medical Officer 0 Medical Student 4 Other (post-grad, OB/GYN, Msc CEB)
TECHNOLOGY	
1. Prior to this project how familiar or unfamiliar were you with computers?	5 very familiar 14 somewhat familiar 5 familiar 2 somewhat unfamiliar 0 very unfamiliar
2. Do you have regular access to computers?	20 yes 7 no
3. Please estimate how much time you spend using computers per week.	Range from 1 to 25 hours per week Average 8.36 Median 7
4. Do you have regular access to the Internet?	17 yes 10 no
5. Please estimate how much time you spend using the Internet per week.	Range from .5 to 14 hours per week Average 4.82 Median 3
6. Please rate your ease of use of the PDA now.	14 very easy 11 somewhat easy 2 not too easy, not too difficult 0 somewhat difficult 0 very difficult
7. How many hours of training did you have prior to using the PDA?	Range from .5 to 3.5 Average 1.3 Median 1
8. How would you rate the ability of the trainers?	21 very helpful 5 somewhat helpful 0 not too helpful, not too unhelpful 0 somewhat unhelpful 0 very unhelpful 1 does not apply
9. Which training materials/methods did you find the most helpful? (more than one chosen)	6 training manual 7 initial training 0 worksheet 7 ongoing technical assistance

	1 does not apply 1 no answer 5 invalid, more than one answer
10. Did you feel as though you needed additional training while using the PDA?	16 yes 8 no 3 no answer
11. How long did the PDA operate before the batteries needed to be changed?	Range from 1 to 12 weeks Average 3
12. How often did you change the batteries while using the PDA?	Range from every 1 to 3.5 weeks Average 2.8 Median 2
13. How easy or difficult was it to obtain batteries?	9 very easy 12 somewhat easy 4 not too easy, not too difficult 2 somewhat difficult 0 very difficult 0 does not apply
14. How much did batteries cost?	For two AAA batteries: Range from 2500 to 5000 Ugandan Shillings Average 3072 Median 2850
15. Will you be able to afford to keep buying batteries?	22 yes 4 no 1 maybe
16. How appropriate do you think this type of technology is for collecting information in practice?	17 very appropriate 9 somewhat appropriate 1 neither appropriate nor in appropriate 0 somewhat inappropriate 0 very inappropriate
17. Did the PDA ever have a technical problem or did it break?	10 yes 17 no
18. If so, please briefly describe.	"Lost data after delaying to replace batteries", medical officer "The screen froze and couldn't respond when tapped", medical officer "Batteries ran down", post-grad student "The device froze and couldn't work for a time", medical office/computer scientist "Loss of data when battery flat", physician "It was crushed by a car door", physician
19. How sturdy (robust) or fragile did you find the PDA?	3 very robust 7 somewhat robust 10 not too robust, not too fragile 7 somewhat fragile 0 very fragile
20. If there was a problem with the PDA, were you able to fix it or get it fixed?	18 yes 4 no 2 does not apply 3 no answer

21. How easy or difficult was it to coordinate with the Project staff to download from the PDA to the laptop (hot sync)?	11 very easy 15 somewhat easy 1 not too easy, not too difficult 0 somewhat difficult 0 very difficult
22. If you had difficulties, please explain briefly.	"Project staff not very regular", medical officer "He had to call me first to fix an appointment so he could come to the clinic and download the data", medical officer
23. How easy or difficult was it to download information from the PDA to the laptop (sync)?	13 very easy 8 somewhat easy 2 not too easy, not too difficult 1 somewhat difficult 0 very difficult 3 no answer
24. If you used the backup module, how useful or not useful did you find it?	21 very useful 3 somewhat useful 1 not too useful, not too useless 0 somewhat useless 0 very useless 1 does not apply 1 no answer
25. If you used a modem to transfer data, how useful or not useful did you find it?	2 very useful 1 somewhat useful 0 not too useful, not too useless 0 somewhat useless 0 very useless 18 does not apply 6 no answer
26. Did you use Graffiti to write in the PDA?	22 yes 5 no
27. If yes, how long did it take to learn Graffiti?	Range from .15 to 90 days Average 11.47 Median 3.5
28. How comfortable or uncomfortable did you feel about carrying the PDA in terms of security?	10 very comfortable 7 somewhat comfortable 8 not too comfortable, not too uncomfortable 1 somewhat uncomfortable 1 very uncomfortable
29. Did you worry about loss or theft of the PDA?	22 yes 5 no
30. Please briefly explain your answer.	"Worry of theft and possibilities of breakages", medical officer "People can steal any thing which appears valuable", medical officer "From a past experience, I feared carrying it around from being stolen", medical officer "I worried that since it is unique and very useful, it could be stolen", medical officer

CONTENT	
31. Did you use the PDA for anything other than surveys or medical information access?	27 yes 0 no
32. If you answered "yes" to the previous question, please describe briefly.	"For appointments, for reference into 5MCC or A-Z drugs, for games", medical officer "For personal data", medical officer "Programming, my activities, making notes during seminars, storing addresses and emails", medical officer "Address book, games, calculator", medical officer "Personal records and daily reminders", medical officer "As a reference manual on ward rounds and clinics", physician
33. Approximately how often did you use the PDA all together?	Hours per day: Range .5 to 24 Average 4.25 Median 2 Hours per week: Range 4 to 15 Average 9.38 Median 10
34. Did you download any additional content to the PDA on your own?	5 yes 22 no
35. If so, please describe briefly.	"WHO guidelines on TB, malaria and [diseases] drug HIV", medical officer "Virus scanner, Worldmate", medical officer "Beamed some programs", post graduate doctor
36. How often did you use the PDA to access medical information?	Per day: Range 1 to 24 Average 3.47 Median 2 Per week: Range 1 to 25 Average 6.81 Median 4
37. How quickly or slowly were you able to find the medical information that you needed on the PDA?	15 very quickly 11 somewhat quickly 1 not too quickly, not too slowly 0 somewhat slowly 0 very slowly
38. Did you use the PDA for any of these activities (check all that apply)?	18 differential diagnosis 17 investigations 11 definitive diagnosis 25 treatment 22 general knowledge 14 advise to other health practitioners 6 preparing reports/research
39. If you did not have this kind of information on a PDA, would you have sought it from another source?	27 yes 0 no 0 not applicable

40. If you sought this information from another source, how much time did it save you by accessing it on a PDA?	Range from 1 to 36 hours/week Average 9.37 Median 6 (Note: many respondents answered "many", "saved me time", "a lot of time", "very many")
41. Did having access to information on the PDA make you feel any more confident in these activities (check all that apply)?	19 differential diagnosis 13 investigations 10 definitive diagnosis 21 treatment 20 general knowledge 12 advise to other health practitioners 7 preparation of reports/ research
42. When were you most likely to use the PDA? (more than one chosen)	7 to look up information before a patient is in the room 13 to look up information during a patient visit 12 to look up information just after a patient leaves 22 to look up information at home 19 when prescribing drugs 5 other
43. How helpful did you find the malaria treatment guidelines?	16 very helpful 9 somewhat helpful 2 not too helpful, not too unhelpful 0 somewhat unhelpful 0 very unhelpful
44. Did your treatment of malaria change after receiving the guidelines?	7 yes 18 no 2 no answer
45. If you used any of the drug databases, which did you find the most helpful? (more than one chosen)	0 WHO Essential Drug List 1 Uganda Drug List 16 A to Z Drugs 1 Not applicable 9 multiple answers, therefore invalid
46. Did the information on the PDA change the drugs or the dosages you prescribed to patients?	12 yes 13 no 2 no answer
47. Please briefly explain your answer.	"I was able to give [more] correct paediactric dosages than before", medical officer "They were the same as the ones I knew", medical officer "It helped me confirm what I needed to get more information on", medical officer "They are the same dosages as the ones I was used to", medical officer "The prescription dosages of ARV drugs", medical officer/computer scientist "Dosages for pediatric patients", medical officer

48. How useful did you find the PDA in your rotation?	15 very useful 8 somewhat useful 1 not too useful, not too useless 0 somewhat useless 0 very useless 3 no answer
49. Did the use of the PDA to access information during patient consultations improve your ability to treat patients effectively?	9 significant improvement 17 some improvement 1 no improvement
50. Please briefly explain.	"It helped me to get other possibilities apart from the disease conditions I was thinking about", medical officer "The PDA helped me as a quick reference in management", medical officer "It provided a quick access when more information was needed", medical officer "Correct dosages given, and drug interactions known", medical officer "Quick access to information meant informed decisions", medical officer/computer scientist "Getting correct dosages, having a wider range of drugs to use", medical officer "I give more accurate treatment and better compliance to treatment", medical officer "My work station has no library, the PDA was a handy source of information", medical officer
51. Did the fact that you accessed information on the PDA during patient consultations have a positive or negative impact on your interactions with patients?	7 very positive 11 somewhat positive 7 neither positive or negative 0 somewhat negative 0 very negative 2 did not apply
52. How more or less professional do think that your patients perceived you when you used the PDA while with a patient?	12 much more professional 4 somewhat more professional 4 not more professional, not less professional 1 somewhat unprofessional 0 very unprofessional 4 did not use PDA in front of patient 2 no answer
53. Did your patients ask you questions about the PDA?	13 yes 14 no
54. Did patients express any concern about your use of the PDA?	5 yes 20 no 2 no answer
55. If yes, briefly describe.	"No verbal complaints but signs could show that they are impatient", medical officer "Some thought I was just doing my own thing and ignoring them", medical officer

	"They wanted to know what it was, some thought I was playing a game", medical officer "They were impressed that such a small device can have vital info", post grad student
56. What information on the PDA did you find most helpful? (more than one chosen)	9 Uganda drug list 9 WHO Essential Drug List 11 HIV/AIDS treatment guidelines 6 TB treatment guidelines 14 Malaria treatment guidelines 16 5MCC 18 A to Z Drugs 5 Pocket Ob/Gyn 2 5 Min Pediatrics 0 Harriet Lane 11 MedCalc
57. Which calculator in MedCalc did you find most helpful?	The majority of the respondents answered BMI calculator
58. Please rate how helpful each application is on a scale of 1 to 5. 1 very helpful 2 somewhat helpful 3 neither helpful or unhelpful 4 somewhat unhelpful 5 very unhelpful	Uganda drug list Ave 2.12 Median 2 WHO Essential Drug List 2.12 2 HIV/AIDS treatment guidelines 1.94 1 TB treatment guidelines 1.87 2 Malaria treatment guidelines 2.12 2 5MCC 1.60 1 A to Z Drugs 1.45 1 Pocket Ob/Gyn 1.83 1.5 5 Min Pediatrics 1.50 1.5 Harriet Lane 2.50 2.5 MedCalc 1.71 1
59. How easy or difficult was it to navigate between the different applications?	9 very easy 12 somewhat easy 3 not too easy, not too difficult 0 somewhat difficult 0 very difficult 3 no answer
60. After participating in this project, where are you most likely to look for medical information? (more than one chosen)	12 books 5 Internet mailing list 18 Internet web site 11 medical journal 3 ministry of health 3 talk to fellow student 2 talk to professor 2 talk to other professor 21 PDA
61. After participating in this project, are you more likely or less likely to look up medical information than you were before the project?	18 more likely 4 somewhat more likely 1 not more likely, not less likely 2 somewhat less likely 0 very less likely

	2 no answer
62. What other information would you find helpful to have on the PDA?	"Reference books on public health", medical officer "Standard up to date textbooks", medical officer "Internet, more books", medical officer "Emergency drugs list", medical officer "Statistical data and formulae", physician "Pocket ob/gyn, paediatrics information", medical officer "Current systemic medical research, reviews", post grad student "Spreadsheets, pictures/diagrams", medical officer/computer scientist "Tropical medicine topics", medical officer "More facts on voluntary HIV counseling and testing and mother-to-child HIV transmission and prevention", MSc CEB student
63. Would you pay for additional medical texts to place on the PDA?	23 yes 1 no 3 no answer
64. If yes, how much?	Range 5000 to 90,000 Ugandan Shilling Average 25,900 Median 14,000 (Other answers include "not certain", "reasonable amount, "depends on the cost", "something cost effective")
65. How often did you use the PDA to conduct a survey?	Range .43 to 10 per day Average 1.54 Median 1 (Question not clear, answers varied significantly)
66. How easy or difficult did you find it to conduct surveys using the PDA?	15 very easy 8 somewhat easy 3 not too easy, not too difficult 0 somewhat difficult 0 very difficult 1 no answer
67. Did the fact that you used the PDA to conduct surveys during patient consultation have a negative or positive effect on your interaction with the patient?	5 very positive 9 somewhat positive 9 not positive, not negative 1 somewhat negative 0 very negative 1 don't know 2 no answer
68. Please briefly explain your answer.	"Patients think you are wasting their time", medical office "My use of the PDA in their presence was immaterial and didn't really affect our interaction", medical officer

	"Made patients more interested in my advice and information", physician "Patients said they didn't mind", medial office "They were impressed with the sophistication", post grad student "Patients received a very confident answer from me", medical officer/computer scientist "Better rapport and professional outlook", medical officer "The data was filled in after the patient leaves", medical office "I needed to know more about patient", post graduate doctor "Easy consultation", medical officer
69. How important or unimportant do you think that the information gathered in the surveys is?	14 very important 9 somewhat important 1 not too important, not too unimportant 0 somewhat unimportant 0 very unimportant 3 no answer
70. How many surveys were you able to complete?	Range 2 to 154 Average 47.25 Median 11
71. Do you prefer to conduct the surveys with a pen and paper or the PDA?	25 PDA 1 pen and paper 1 no answer
72. Did you find the PDA more helpful for survey collecting or accessing information?	6 collecting surveys 12 accessing information 9 checked both
73. Are you interested in seeing the report results on the malaria data collected?	24 yes 0 no 3 no answer
74. Did you want to keep the PDA?	26 yes 0 no 1 no answer
75. Have you thought of other ways to use the PDA in your practice?	22 yes 5 no
76. Have you thought of other ways to use the PDA in your workplace?	18 yes 6 no 3 no answer
77. Have you thought of other ways to use the PDA in other areas of your life?	21 yes 4 no 2 no answer
78. If you answered yes to any of the three previous questions, could you please explain?	"As a student of public health having reference books on PDA can be very helpful and also to do my own references", medical officer "Access new information on Internet if installed, to help my fellow doctors with new information and get the Internet", medical

	officer "Using it to communicate with a fellow health professional to make quick consultations, accessing the Internet and email, formatting my own form for my surveys of interest", medical officer "Statistical formulae for epidemiological surveys", physician "For email and Internet purposes, to set up appointments, to store more medical information for use in my practice", medical officer "Because the PDA is handy and has a lot of functions, it is very convenient to apply not only in medicine but in day to day activities" "Wireless, mobile communication with other doctors at a distance, viewing medical images and storing them, communicate online", medical officer/computer scientist "Addition of more books (recent)", intern "Store facts about interesting cases met in practice, for appointments and reminders", medical officer
79. Would you recommend a PDA to your colleagues or friends?	26 yes 0 no 1 no answer
80. Overall, how would you rate your experience in this project?	15 very positive 11 somewhat positive 0 neither positive or negative 0 somewhat negative 0 very negative 1 no answer
81. Do you think that your experience in this project would have been different if you had not been able to keep the PDA?	19 yes 5 no 3 no answer
82. Did you fully understand all the questions listed here? If not, please indicate any questions that you did not fully understand.	22 yes 3 no 2 no answer
83. Do you have any comments concerning this questionnaire or any specific questions listed? If yes, please add comments.	4 yes 13 no 10 no answer

Please add any other comments or suggestions that you might have about the PDA project.

"The challenge is to get medical professionals to appreciate the advantages of PDA and ICT in general to improve the efficiency", medical officer

"The PDA should have a rechargeable battery as the dry batteries are expensive"
"Up to date textbooks and journals should be included on the PDA and where possible if it can be connected to Internet for access to information."
"PDA should be provided with a leather cover for safety", medical officer

"Could you please include Internet access on the PDA and more books, 5MCC, 5MPED, etc", medical officer

"PDAs are very useful gadgets which can [simplify] one's daily [tasks] and many more people should be made aware of them and increase accessibility", medical officer

"The PDA project has brought doctors closer to the computer …the PDA project is definitely the place I would like to work actively with", medical officer/computer scientist

"Use of say, solar power as source of power or re-chargeable batteries", medical officer

"PDA needs a covering for protection, increase its capacity to be able to accommodate more books", intern

"Provide all participants a port for hotsync operations, provide participants with re-chargeable batteries", MSc CEB student

Annex 14. Bridges.org questionnaire and summary of results – Kenya, October 2002

Kenya Participant Questionnaire
SATELLIFE PDA Project Evaluation
14 - 18 October 2002

Question	Response
Current rotation	6 Internal Medicine 6 OB/Gyn 7 Paediatrics 4 Surgery 4 Psychiatry
TECHNOLOGY	
Prior to this project how familiar or unfamiliar were you with computers?	7 very familiar 6 somewhat familiar 11 familiar 1 somewhat unfamiliar 2 very unfamiliar
Do you have regular access to computers?	19 yes 7 no 1 no answer
Please estimate how much time you spend using computers per week.	Range .02 to 35 hours/week Average 4.27 Median 2.5
Do you have regular access to the Internet?	14 yes 13 no
Please estimate how much time you spend using the Internet per week.	Range .02 to 3 hours/week Average 1.05 Median 1
Please rate your ease of use of the PDA now.	9 very easy 14 somewhat easy 4 not too easy, not too difficult 0 somewhat difficult 0 very difficult
How many hours of training did you have prior to using the PDA?	Range .5 to 10 Average 1.83 Median 1.5
How would you rate the ability of the trainers?	16 very helpful 8 somewhat helpful 0 not too helpful, not too unhelpful 0 somewhat unhelpful 0 very unhelpful
Which training materials/methods did you find the most helpful?	3 training manual 17 initial training 6 worksheet 4 ongoing technical assistance

How helpful or unhelpful did you find the ongoing technical assistance provided?	13 very helpful 9 somewhat helpful 1 not too helpful, not too unhelpful 1 somewhat unhelpful 0 very unhelpful
How long did the PDA operate before the batteries needed to be changed?	Range .14 to 5 weeks Average 2.18 Median 2
How often did you change the batteries while using the PDA?	Range every 1 to 4 weeks Average 2.08 Median 2
How easy or difficult was it to obtain batteries?	13 very easy 5 somewhat easy 5 not too easy, not too difficult 3 somewhat difficult 1 very difficult 0 does not apply
Did the PDA ever have a technical problem or did it break?	9 yes 18 no
If so, please describe.	"Went off, had to look for technical help", 6th-year pediatric "'Freezing' asking for 'reset' I did not know how to but now I know", 6th-year pediatrics "It 'hanged', couldn't go off, had to take batteries out (one by one) and replace – it then resumed", 6th-year internal medicine "Could not respond to any operation until I was helped", 6th-year ob/gyn "It blacked out", 6th-year ob/gyn "It hanged – stopped working", 6th-year psychiatry "Fell from my pocket and shattered the screen", 6th-year ob/gyn "Using the stylus to follow the dot was a bit of confusion for me", 6th-year internal medicine
How sturdy (robust) or fragile did you find the PDA?	2 very robust 5 somewhat robust 14 not too robust, not too fragile 5 somewhat fragile 1 very fragile
If there was a problem with the PDA, were you able to fix it or get it fixed?	15 yes 4 no 7 no answer
How easy or difficult was it to coordinate with the Project staff to download from the PDA to the laptop (hot sync)?	14 very easy 7 somewhat easy 1 not too easy, not too difficult 1 somewhat difficult 0 very difficult 4 no answer

If you had difficulties, please explain briefly.	"Initially, it was difficult to find our way around the hotsync issue", 6th-year, pediatric "The person supplying the batteries is not easily available", 6th-year ob/gyn "Sometimes the place is locked – inconvenient", 6th-year psychiatry "I never got another PDA when the other broke", 6th-year ob/gyn "Some information outdated and could not be hotsynced", 6th-year surgery "Getting the people to hotsync", 6th-year internal medicine
How easy or difficult was it to download information from the PDA to the laptop (sync)?	15 very easy 5 somewhat easy 4 not too easy, not too difficult 1 somewhat difficult 0 very difficult 2 no answer
If you used the backup module, how useful or not useful did you find it?	4 very useful 4 somewhat useful 1 not too useful, not too useless 0 somewhat useless 0 very useless 11 does not apply 7 no answer
If you used a modem to transfer data, how useful or not useful did you find it?	4 very useful 5 somewhat useful 0 not too useful, not too useless 0 somewhat useless 0 very useless 11 does not apply 7 no answer
Did you use Graffiti to write in the PDA?	22 yes 5 no
If yes, how long did it take to learn Graffiti?	Range .007 to 7 days Average 1.7 Median 1
How comfortable or uncomfortable did you feel about carrying the PDA in terms of security?	14 very comfortable 6 somewhat comfortable 5 not too comfortable, not too uncomfortable 1 somewhat uncomfortable 1 very uncomfortable
Did you worry about loss or theft of the PDA?	15 yes 12 no
Please briefly explain your answer.	"It is an expensive item which will cost a fortune to get another one", 6th-year psychiatry "Can quietly drop/slip out of a pocket, can be forgotten/left in a bed or class", 6th-year pediatrics

	"Portable and small therefore easy to care for", 6th-year surgery "It is a small and admirable equipment and there are thieves around; one has to be very careful", 6th-year internal medicine "I might forget it somewhere", 6th-year ob/gyn "There is a possibility of leaving it in the ward", 6th-year pediatrics "I keep it safely", 6th-year pediatrics
CONTENT	
Did you use the PDA for anything other than surveys or medical information access?	22 yes 5 no
If you answered "yes" to the previous question, what was it?	"For figuring out dosages, appointments" - 6th-year, pediatric "Games", 6th-year pediatrics "Games, time, calculator", 6th-year surgery "Time plan, games, city clock (for our interest in geography), 6th-year internal medicine "Games, to-do list, memo, database", 6th-year ob/gyn "Datebook, schedule, games, list my shopping, calculator", 6th-year psychiatry
Approximately how often did you use the PDA all together?	Hours per day: Range 1 to 5 Average 2.10 Median 2 Hours per week: Range 3 to 40 Average 12.08 Median 10
Did you download any additional content to the PDA on your own?	6 yes 19 no 2 no answer
If so, what content did you download?	"Games", 6th-year internal medicine "I wasn't aware this was possible", 6th-year psychiatry "Medicine", 6th-year psychiatry
How often did you use the PDA to access medical information?	Per day: Range .75 to 20 Average 5.09 Median 3 Per week: Range 1 to 30 Average 12.89 Median 10
How quickly or slowly were you able to find the medical information that you needed on the PDA?	13 very quickly 10 somewhat quickly 3 not too quickly, not too slowly 0 somewhat slowly

	0 very slowly 1 no answer
Did you use the PDA for any of these activities (check all that apply)?	20 differential diagnosis 20 investigations 18 definitive diagnosis 23 treatment 19 general knowledge 5 advise to other health practitioners 1 preparing reports/research
If you did not have this kind of information on a PDA, would you have sought it from another source?	26 yes 0 no 1 not applicable
If you sought this information from another source, how much time did it save you by accessing it on a PDA?	Range 1 to 60 hours/week Average 10 Median 4 (Comments included "not easy to quantify")
Did having access to information on the PDA make you feel any more confident in these activities (check all that apply)?	21 differential diagnosis 22 investigations 20 definitive diagnosis 23 treatment 17 general knowledge 8 advise to other health practitioners 2 preparation of reports/ research
When were you most likely to use the PDA? (more than one chosen)	8 to look up information before a patient is in the room 12 to look up information during a patient visit 11 to look up information just after a patient leaves 0 to look up information at home 18 when prescribing drugs 0 other
How helpful did you find the malaria treatment guidelines?	10 very helpful 6 somewhat helpful 2 not too helpful, not too unhelpful 0 somewhat unhelpful 1 very unhelpful 8 no answer
Did your treatment of malaria change after receiving the guidelines?	1 yes 19 no 5 does not apply 2 no answer
Please briefly explain your answer.	"Dosages were clearer", 6th-year, paediatrics "Malaria not very common in psychiatry, 6th-year psychiatry "The information in the PDA is similar to the one I already had – just made me more confident", 6th-year psychiatry "The same treatment except for IM quinine", 6th-year surgery

	"The current mode of Rx of malaria is still emphasized by the consultants and its not very different than the on in the PDA", 6th-year internal medicine "I could not access the information", 6th-year ob/gyn "I have the national malaria guidelines book", 6th-year pediatrics
If you used any of the drug databases, which did you find the most helpful?	0 WHO Essential Drug List 1 Kenya Drug List 15 A to Z Drugs 4 Not applicable 7 chose multiple answers, not valid
Did the information on the PDA change the drugs or the dosages you prescribed to patients?	10 yes 14 no 3 no answer
Please briefly explain your answer.	"Was able to tailor dosages to particular patients", 6th-year pediatrics "Contradiction of a drug in a condition I had prescribed a drug for", 6th-year psychiatry "The readily available dosage regime made it easy to prescribe specific for age eg cardine glycosida", 6th-year pediatrics "Similarity", 6th-year surgery "Most the same as [noted] in the wards", 6th-year internal medicine "Rx given so we give drugs as to what is available [for] costs [for] effectivity in Kenya", 6th-year ob/gyn "Gave the preferred drugs", 6th-year pediatrics "By learning about drug interactions", 6th-year psychiatry "It's miles to the books", 6th-year pediatrics "Some drugs not locally available, some drug databases contradicted same textbook information", 6th-year surgery "Knew the side effects and dosages better", 6th-year internal medicine
How useful did you find the PDA in your rotation?	14 very useful 6 somewhat useful 4 not too useful, not too useless 2 somewhat useless (sur and psych) 1 very useless (psych)
Did the use of the PDA to access information during patient consultations improve your ability to treat patients effectively?	6 significant improvement 15 some improvement 5 no improvement 1 does not apply
Please briefly explain your answer.	"Was able to tell clearly the diagnostic treatment and explain prognosis", 6th-year

	pediatric “Easy access to information which would have taken longer to acquire if I were to go for textbooks”, 6th-year psychiatry “Easy access to relevant information of investigation, diagnosis, dosage, etc.", 6th-year pediatrics “Could find most of the treatment of conditions defined”, 6th-year surgery “Not so many changes warranted by the information in the PDA”, 6th-year internal medicine “Did not really much on it”, 6th-year ob/gyn “Reference”, 6th-year ob/gyn “I was able to access information immediately [as] I required it, and this enhanced my memory”, 6th-year pediatrics “No psychiatry information”, 6th-year psychiatry “Modes of treatment differ from what is done locally”, 6th-year ob/gyn “There was no relevant surgery text”, 6th-year surgery “Differential Rx, investigation”, 6th-year internal medicine
Did the fact that you accessed information on the PDA during patient consultations have a positive or negative impact on your interactions with patients?	4 very positive 5 somewhat positive 14 neither positive or negative 0 somewhat negative 0 very negative 1 does not apply 3 no answer
How more or less professional do think that your patients perceived you when you used the PDA while with a patient?	5 much more professional 5 somewhat more professional 6 not more professional, not less professional 4 somewhat unprofessional 0 very unprofessional 4 did not use PDA in front of patient 3 no answer
Did your patients ask you questions about the PDA?	4 yes 20 no 3 no answer
Did patients express any concern about your use of the PDA?	1 yes 23 no 3 no answer
If yes, please briefly describe.	“Children were interested in knowing what it was all about", 6th-year pediatrics “I think patients prefer me to know [any] treatment off head (i.e. with prior knowledge)

	and not in their presence", 6th-year internal medicine
What information on the PDA did you find most helpful? (more than one chosen)	5 Kenya drug list 6 WHO Essential Drug List 8 HIV/AIDS treatment guidelines 5 TB treatment guidelines 7 Malaria treatment guidelines 7 5MCC 13 A to Z Drugs 6 Pocket Ob/Gyn 9 5 Min Pediatrics 6 Harriet Lane 6 MedCalc
Which calculator in MedCalc did you find most helpful?	Of those who responded, the pregnancy calculator was reported as the most helpful, followed by the BMI Calculator
Please rate how helpful each application is on a scale of 1 to 5. 1 very helpful 2 somewhat helpful 3 neither helpful or unhelpful 4 somewhat unhelpful 5 very unhelpful	Average Median Kenya drug list 2.28 2 WHO Essential Drug List 2.89 3 HIV/AIDS treatment guidelines 2.26 2 TB treatment guidelines 2.44 2 Malaria treatment guidelines 2.13 1.5 5MCC 2.07 1.5 A to Z Drugs 2.45 2 Pocket Ob/Gyn 1.86 1 5 Min Pediatrics 2.55 2 Harriet Lane 3.30 3 MedCalc 2.13 1
How easy or difficult was it to navigate between the different applications?	10 very easy 10 somewhat easy 4 not too easy, not too difficult 2 somewhat difficult 0 very difficult 1 no answer
After participating in this project, where are you most likely to look for medical information? (more than one chosen)	17 books 2 Internet mailing list 5 Internet web site 9 medical journal 3 ministry of health 9 talk to fellow student 6 talk to professor 1 talk to other professor 21 PDA
After participating in this project, are you more likely or less likely to look up medical information than you were before the project?	17 more likely 5 somewhat more likely 2 not more likely, not less likely 1 somewhat less likely 0 very less likely 2 no answer

What other information would you find helpful to have on the PDA?	"Lecture notes", 6th-year pediatrics "More tropical medicine, more on interpretation of lab investigations", 6th-year pediatrics "Other rotations", 6th-year surgery "More relevant information to our set-up", 6th-year internal medicine "More of tropical medicine", 6th-year ob/gyn "Information on epidemiology in Kenya", 6th-year ob/gyn "Psychiatry rotation", 6th-year psychiatry "Illustrations", 6th-year pediatrics "Rx local diseases", 6th-year ob/gyn "Surgery textbooks or information", 6th-year surgery "Medical dictionary", 6th-year internal medicine
Would you pay for additional medical texts to place on the PDA?	19 yes 6 no 2 no answer
If yes, how much?	Range 200 to 5000 Kenyan Shillings Average 2507 Median 2000 (Comments in text include: "if it is 10% more or less than cost of books", "as much as I can", "depends on cost of available text")
Did you want to keep the PDA?	19 yes 0 no 8 no answer
Have you thought of other ways to use the PDA in your practice?	15 yes 9 no 3 no answer
Have you thought of other ways to use the PDA in your workplace?	13 yes 11 no 3 no answer
Have you thought of other ways to use the PDA in other areas of your life?	15 yes 9 no 3 no answer
If you answered yes to any of the three previous questions, could you please explain?	"For research, planning daily activities", 6th-year pediatrics "Easy access to information at any time, convenient to carry around; refreshment-like games; calculations of financial expenditures", 6th-year psychiatry "Keeping information and records like appointments", 6th-year pediatrics "PDA [with] all clinical information on diseases and treatment, drug interactions and side effects", 6th-year surgery

	" As a reference for new information, sometimes saves time", 6th-year surgery "It is useful in accessing medical information and for portable", 6th-year internal medicine "Have geographical locations on PDAs with brief description", 6th-year internal medicine
Would you recommend a PDA to your colleagues or friends?	26 yes 0 no 1 no answer
Overall, how would you rate your experience in this project?	15 very positive 8 somewhat positive 1 neither positive or negative 0 somewhat negative 0 very negative 3 no answer
Do you think that your experience in this project would have been different if you had been able to keep the PDA?	20 yes 4 no 3 no answer
Did you fully understand all the questions listed here? If not, please indicate any questions that you did not fully understand.	21 yes 5 no 1 no answer
Do you have any comments concerning this questionnaire or any specific questions listed? If yes, please add comments.	2 yes 18 no 7 no answer

Please add any other comments or suggestions that you might have about the PDA project.

"It should be able to have all the books in all rotation[s] concurrently. I will need to remind myself of pediatric information even after leaving the rotation without having to borrow a PDA from another person. Access to hotsync needs to be improved. Access to batteries needs to be improved", 6th-year pediatrics

"How could I have added information to the PDA?", 6th-year ob/gyn

"Give the PDA to the student at 6th-year for study to keep", 6th-year psychiatry

"Please give out this PDA to all students from basic year to clinicals", 6th-year internal medicine

Annex 15. Report on content challenges and solutions, May 2002

The SATELLIFE PDA Project
Content Challenges
May 1, 2002

From the start of SATELLIFE's pilot PDA Project, the content used as an information resource for health workers in developing countries necessitated careful consideration. Originally, the PDA Project planned to use "off-the-shelf" software and content for the PDAs that were to be sent to Uganda and Kenya. However, at the conclusion of the PDA Partners Kickoff meeting in January it became clear that ready-made content would not be adequate or feasible in all cases.

Drug Database
A comprehensive drug database was considered an important cornerstone for the information content, as drug information is often not readily available in Kenya and Uganda. There are several drug database applications available for the PDA. The participants at the Kickoff meeting looked at ePocrates Rx, Dr. Drugs, and ePharmacopoeia. After examining these options, the participants concluded that there was no standard drug database suitable for use in Kenya or Uganda. The Kickoff meeting participants, particularly the physicians, felt that it was not ethical to include a drug database that offered drugs that were not available, or with names and/or doses that were different from those recommended for the population.

SATELLIFE decided to use the WHO Model Essential Drug List and the Kenya and Uganda country specific drug lists. The WHO Essential Drug List was easy to access from the WHO web site, but was not available in either a Word or Text version. The country specific drug lists from Kenya and Uganda were more difficult to locate. The list for Kenya was eventually mailed twice from WHO in Geneva in print format and finally faxed from Kenya, arriving only days before the PDA shipping deadline. The list for Uganda was obtained in an electronic format.

Each of these three databases required somewhat different tactics for conversion into a format usable on the PDA. The WHO Model List was the most complex and involved several conversions from text to Excel to HTML. We also had to convert the list from a table format into a vertical format to fit the width of the Visor screen. The Kenya list was scanned using OCR software, then converted to HTML after which it was proofread to check for the OCR accuracy. The text from Uganda was converted directly to HTML.

Disease Treatment Guidelines
Treatment guidelines for malaria, TB, and HIV/AIDS were prepared for the PDAs that were shipped to Kenya and Uganda. None of the treatment guidelines for the three diseases were the same in both countries so six different projects were implemented to convert the guidelines for the PDA. The process for each was resolved as follows:

Content	Country	Original version	Conversion
HIV/AIDS	Uganda	Print copy received from Ministry of Health (MOH) {small bound book}	Typed to Word, converted to HTML
TB	Uganda	Print version from MOH {spiral	Typed to Word, converted to

		bound booklet}	HTML
Malaria	Uganda	Electronic file in Word from MOH.	Converted to HTML
HIV/AIDS	Kenya	Electronic file in Word prepared by Brown University	Converted to HTML
TB	Kenya	Electronic PDF file from WHO	Converted to HTML
Malaria	Kenya	Electronic version in XML on web	Converted to HTML

Converting to the Palm Operating System was complicated, involving numerous steps. Specific problems encountered included:

- Screen width means viewer is unable to see entire table on the PDA screen. This limits ability to include tables and caused reformatting issues, so tables were converted to text.
- Microsoft Word HTML is not recognized by PDA browser software.
- Microsoft Word HTML does not always preserve the integrity of the formatting, requiring manual HTML coding.
- Process requires scanning of a document, conversion from bitmap to HTML using OCR software, manual coding of HTML and proofreading. This is a fairly inaccurate and time-consuming process, with several opportunities for mistakes.
- Manually typed documents also require manual conversion to HTML and proofreading, which is equally time-consuming and inaccurate.
- Unable to include flow-charts, figures, and drawings.
- Unable to use different font styles and sizes.
- Readability of large documents on the PDA is poor.

Medical Textbook

SATELLIFE intended to include a recognized and comprehensive medical textbook on the PDA to address the paucity of medical information in Africa. Several PDA formatted texts were examined at the Partnership Kickoff meeting in January. Meeting participants deemed Harrison's Principles of Internal Medicine Companion Handbook to be the best choice based on content and interface.

Communication with Harrison's publisher, McGraw Hill, commenced immediately in an effort to obtain permission to use the text at little or no cost since the $80.00 per copy was beyond the budget for content. Despite weekly reminders, entreaties based on deadlines, and assistance from friends at the Massachusetts Medical Society, permission has still not been granted as of 5/1/02. Much to the disappointment of the partners at Moi Faculty of Health Sciences in Kenya, the PDAs were shipped to Kenya and Uganda without the inclusion of a textbook. While negotiations with McGraw Hill were stalled, a search was re-instituted for an alternative textbook. Faculty at Moi suggested the Five-Minute Clinical Consult (5MCC) published by Lippincott, Williams and Wilkins, powered for the PDA by Skyscape. One email and a telephone call to Skyscape over the space of two days enabled SATELLIFE to use the 5MCC for the PDA Project.

The 5MCC uses 3.8MB of memory out of the total 8MB available on the Handspring Visor Neo. Harrison's uses 1.1MB of memory. The drug databases and treatment guidelines together constitute less than 1MB of memory. In addition, there are other specialized texts available for the PDA that might be useful for users. Discussions are continuing on the possible addition of content and will continue throughout the life of the project. Content may be added at any time through the synchronization feature of the handheld computer. Limited memory may become an issue constraining choices. Though it is possible to add content via a Handspring Memory Module (similar to putting a CD-Rom into a computer), the Memory Module expense is beyond the capacity of the PDA Project.

Other Content

In addition to the drug databases, textbook and treatment guidelines, participants at the Partners Kickoff Meeting responded favorably to the pregnancy calculator application. When SATELLIFE discovered that PregPro calculator was not free, MedCalc was installed as a substitute. MedCalc includes a pregnancy calculator and additionally has over forty other medical calculators such as calculators for IV administration, growth, body mass index, and cardiovascular output.

A 'hit counter' was loaded onto the PDAs to track the number of times and length of time a particular application is used. The hit counter was developed by an independent contractor and obtained at a discount for a bulk number of copies.

Lessons Learned

Using off-the-shelf content is not as simple as SATELLIFE originally envisioned. Once the decision was made to adapt content to the PDA, considerable time and effort was involved. Not all content was adaptable in its entirety, especially charts, graphs, and diagrams. There is still considerable room for development of good, inexpensive or free medical content for the PDA, especially content designed for use by health professionals in the developing world.

Annex 16. About bridges.org

Bridges.org is an international NGO with a mission to promote effective technology use in the developing world, help people in developing countries use ICT to improve their lives, and tackle the digital divide. It is a Section 21 non-profit corporation in South Africa, and a 501(c)(3) non-profit corporation in the United States. It was founded in 2000 in Washington DC, and has its main office in Cape Town. Its multi-disciplinary staff, and engaged board and advisors bring together a wide range of experience in ICT and related issues from the worlds of business, academia, technology and development. Bridges.org also combines involvement in the highest levels of international technology policy-making with participation in ground level projects in developing countries and disadvantaged communities, research, and report writing. It is one of only a few organisations that bring a holistic vision to the issues involved in ICT-enabled development. It has established an international reputation for the quality and objectivity of its work, and has produced reports for the United Nations ICT Task Force, the World Economic Forum (WEF), and a number of multi-national corporations and civil society organisations.

Bridges.org looks at what is known and what is being done about international and domestic digital divides, highlights trends, and draws conclusions about what more is needed to tackle the range of problems. It reviews basic facts about ICT access and use, and provides resources for further information. It examines approaches to the problems, considers ground level initiatives and government policies that play a role, and reflects on what is working best and what is failing – and why. Finally, it illustrates the key elements necessary for integrating technology into society in an effective, sustainable way so that people can put technology to use to improve their lives. This is what bridges.org calls *Real Access* to technology, which has become a term of art in the development community. The organization brings an entrepreneurial attitude to its social mission, and is committed to working with, instead of against, government agencies and the business community. And it encourages organizations involved in ICT development to improve what they do, and relay the lessons they have learned to the international development community.

Recent work includes: a seminal report on the digital divide, *Spanning the Digital Divide: Understanding and Tackling the Issues* (2001), which has been downloaded more than 14,000 times since publication; a pilot project to develop new methods of delivering entrepreneurship support at ground level for the WEF's Enterprise Channelling Organisation (ECHO) in Cape Town (2002); reports commissioned by the UN ICT Task Force, including *Supporting Entrepreneurship in Developing Countries: Survey of the Field and Inventory of Initiatives*, and *Measuring Success in Entrepreneurship Support Initiatives: What Works, and What More is Needed* (2002); and a series of case studies on ICT-enabled development in Africa (2002-2003). The organization also produced a WEF consultation report entitled *Better, Faster, Cheaper: Developing and Leveraging World Class ICT Networks for Social and Economic Advancement* on e-readiness in the SADC region (2001), and recently completed the first stage of a programme designed to build ICT policy-making capacity in Africa, in collaboration with WEF, the NEPAD Secretariat, and the e-Africa Commission. It is currently engaged in a research study to examine the realities of open source and proprietary software environments in Africa.

To learn more about bridges.org, visit http://www.bridges.org.