



A Model for Implementation and Sustainability of Urologic Services in the Developing World: Based on the 4-Year Experience of Knock Foundation Urologic Volunteers in Kenya and Ethiopia

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ABSTRACT

The purpose of the Knock Foundation initiative in sub-Saharan Africa, to date in Kenya and Ethiopia, is to bring modern urologic procedures, specifically cystoscopy, transurethral resection/vaporization of the prostate, and visual internal urethrotomy to an underserved population in a sustainable and therefore accessible fashion. The article describes in detail the 4-year effort of the Knock Foundation and its volunteers in bringing these procedures to previously underserved areas of Kenya and Ethiopia, teaching techniques to local physicians and building sustainable, if nascent, programs in urology at distinct institutions.

PURPOSE

The purpose of the Knock Foundation [1] (Knock) program in urology is to bring modern urologic procedures, specifically cystoscopy, transurethral resection of the prostate (TURP), and visual internal urethrotomy (VIU) to an underserved population in a sustainable fashion.

BACKGROUND

In late 2009, the Knock Foundation, acting through 2 of its founders and directors, F. Bruce Cohen and David Grossman, contacted Susan Blaustein, director of the Millennium Cities Initiative [2] (MCI) of the Earth Institute of Columbia University, New York, New York, seeking its help in facilitating a medical mission to one of the 11 millennium cities located in sub-Saharan Africa. The MCI is, among other things, a facilitator for nongovernmental organizations (NGOs) via the employment of local representatives whose mission it is to serve as catalysts for change. Working in concert with MCI, its representative in Kisumu, Kenya, Beldina Opiyo-Omolo, and United Therapies LLC [3] (UT) of Park Ridge, Illinois, Knock successfully sponsored

a medical mission trip to Nyanza Provincial General Hospital (NPGH) [4] in Kisumu, Kenya [5]. The initial purpose of that mission was to provide urologic services to the surrounding population and much-needed supplies to the local hospital.

Kisumu is situated on the western edge of the country on the northeastern shores of Lake Victoria, with its vast surface area of 69,000 square kilometers. With an estimated population of 500,000 [6], Kisumu is the fastest growing metropolis in Kenya and has grown to become the principal administrative, communication, commercial, and industrial center in the Lake Basin region, an area that traverses the whole of Nyanza, western Rift Valley, and western provinces in Kenya. Kisumu has gradually become one of the poorest areas of Kenya. While absolute poverty in Kenya is high, affecting 29% of the population, Kisumu's rate is estimated to be nearly double that figure. Fifty-three percent of Kisumu's population lack reliable access to food, as compared to 39% in the second largest city, Mombasa, and only 8% in Nairobi [7]. Unemployment is high (30%), with at least 50% of the population engaged in the informal sector [8]. In addition, Kisumu's HIV/AIDS infection rate is approximately 15% [9] and it has a high prevalence of

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malaria and other infectious diseases. Like many other diseases, urologic disease, including benign prostatic hypertrophy (BPH) and urethral stricture (US) disease, are not uncommon disease states, but have been undertreated due to a lack of trained personnel and access to cystoscopy.

An acute public health area need is for further medical training, particularly in sub-specialty areas, including urology. Other than perhaps taking a 3-month urology course at KCMC Hospital in Moshi, Tanzania, there are very few urologists that go through the level of training found in the west. Following exhaustion of home remedies and the onset of urinary retention, available therapy for BPH has generally consisted of placement of a suprapubic tube followed by open prostatectomy performed, often incompletely and repeatedly, by general surgical staff. Treatment for US disease often consisted of rare dilation and/or suprapubic tube placement. Urethroplasty of any kind has been an uncommonly attempted procedure due to lack of training.

In 2010, the city itself was serviced by one solo private practice urologist Willis Oyeko, MD. A General surgeon by training, Dr. Oyeko transitioned to urology by virtue of such a 3-month residency at KCMC and functioned with a partial set of ACMI cystoscopic instruments, a resectoscope consisting of a single woven 24 Fr sheath, a solitary 30 degree lens, and 1 loop which he reused. Prior to Knock's arrival he had accomplished 1 TURP on his own. Because of the absolute unavailability of Glycine for irrigation, he was required to use sterile water.

An office visit with Dr. Oyeko cost the equivalent of about \$1.50, in an economy where daily income is often in the range of \$1 to \$2 [10]. A significant percentage of the population was unable to afford this or any other service in the private sector and sought care via the public sector.

Nyanza Provincial General Hospital (NPGH) has been in existence for more than 100 years. Since then, it has grown to become the referral hospital for the province, serving over 12 district hospitals in Nyanza and the neighboring districts in the western province and Nandi. Its principal mandate is to provide curative and preventative health services and to perform other services, as provided for by the Kenya Ministry of Health. It serves a population of more than 5 million in 3 provinces: Nyanza, Western Valley, and Rift Valley. As a publicly funded hospital, patients are required to pay nominal fees for services, including radiologic services as well as operating room fees. Moreover, patients are required to purchase supplies that will be used for their elective surgeries from an outside pharmacy and bring these supplies to the operating room the day prior to the scheduled surgery; if they fail to do so the surgery is

oftentimes cancelled. Many people are unable to afford even these costs and must wait and save, in some cases for years in order to undergo a procedure. Fortunately, these costs are waived in emergencies.

Prior to Knock's arrival, the hospital possessed no urologic equipment beyond a limited array of Foley catheters and a single set of Van Buren sounds. Moreover, the dearth of equipment meant that both TURP and visual internal urethrotomy (VIU) were unavailable. Our team found patients in retention from either BPH or stricture disease with suprapubic tubes that had been in place for almost 7 years. In 1 case, a gentleman had functioned without a change of tubing or a voiding trial for 6 years. We quickly realized that a simple 2-week mission would be little more than a Band-Aid and the goal of the mission evolved from the provision of limited services to one of building a urology service that would be useful long after our departure. Indeed the mission had evolved from that of just performing procedures to bringing (and leaving) enough equipment and training the general surgeons so they achieved a level of proficiency and were capable of performing such procedures long after we departed.

Consequently, Knock procured and donated functioning cystoscopic equipment and crafted a urology cart for organized instrument and consumable storage. An on-site C-arm was salvaged, repaired, and placed into use by Knock volunteer cysto/radiology tech, Robert Wadman that allowed for the performance of retrograde pyelograms and passage of ureteral stents. Knock trained operating room (OR) staff in the care and use of the cystoscopic equipment, and taught and supervised surgeons in the performance of TURP, VIU, and both end-to-end and 2-stage urethroplasty.

These accomplishments gelled during a second 2-week mission in 2011, during which Knock was able to provide a bipolar TURP device for use with sterile saline as well as the required training. Armed with knowledge gleaned from the prior mission to NPGH, and once again using the local MCI representative as a facilitator, Knock contacted Mekelle University in Mekelle, Ethiopia [11] to plan missions for 2012 and 2013.

Ethiopia, a country of some 90 million people, is served by a mere 60 urologists who have completed various stages of training, and possess variable and generally incomplete sets of cystoscopic equipment. Guide-wires and stents are rare commodities. Lithotripsy is available only in Addis Ababa, when the machine is functioning [12].

Mekelle, approximately 475 miles north of Addis Ababa, is a city of approximately 300,000 people. Mekelle, the capital of

the Tigray region, is one of the cities closest to the ports of Djibouti, which is used for most of Ethiopia's import and export trade on the Red Sea. The city is located at the hub of a road system connecting all of the region's urban centers.

To date, missions to Mekelle have been completed in 2012 and 2013; the 2013 mission was completed shortly before this writing. Knock Foundation urologists worked primarily at the university's Aydar Referral Hospital but also spent time at Mekelle Hospital, the equivalent of a public facility. Mekelle Hospital was built in 1962 to serve the then-20,000 people living in and around the city. Since then, there has been a 12-fold growth in the population.

Although the hospital has made efforts to increase its service offerings in response to the rapid urban expansion and mounting health needs, Ayder Referral Hospital, affiliated with Mekelle University, seems to be the pre-eminent facility in the region. Indeed, many of the shortages of equipment and supplies found at Mekelle Hospital were not in evidence at Ayder. Moreover, the facility itself was better maintained.

Learning from our experience in Kenya, and much like our second trip to Kenya, these missions mainly involved the training of 2 general surgeons in cystoscopy, retrograde pyelography, VIU, and TURP/BT. In addition, Knock also engaged in the supplementary training of a recent graduate of the nascent urologic residency program in Addis Ababa and provided fairly complete instrument sets for Ayder Referral Hospital, the recently graduated urologist, and supplemented the instrument set of the private practice urologist in Mekelle. We believe this should enable the physicians and the facilities to perform the procedures outlined above for years to come. Moreover, we are setting up a process for semi- or as-needed consultation with our Ethiopian counterparts. One of the general surgeons Knock helped train has matriculated in the new 3-year residency program in Addis Ababa, during which time he will be rotated periodically to the Ayder referral hospital.

DESCRIPTION OF THE PROGRAM

The goal of the Knock missions is the sustainable delivery of urologic services to an underserved population. In the Knock model, Knock directors work through MCI to identify an MCI city with an underserved population, hospital facility, cooperative administration, and eager medical staff.

Facilitated by the local MCI representative, arrangements are made for an approximately 2-week stay to provide surgical and cystoscopic services by volunteer urologists, solicited through Knock's relationship with physicians.

During the preparation phase, Knock actively solicits the donation and/or purchase of supplies, not limited to urologic

use, and equipment, in particular new and/or used cystoscopic equipment.

Much of the equipment and supplies are shipped on ahead via container, a process which Knock discovered requires a minimum of 4 months to insure both timely arrival and customs clearance. This is a laborious process, which is unique to each country. Thus, the challenge is compounded when one considers that Knock moves from country to country every 2 years.

Selected equipment that can be transported by hand and is absolutely essential to the mission is usually transported by hand to ensure that even if the container is delayed, the primary purpose of the mission can continue unabated.

During the mission, volunteer urologists, working in teams of 2 and occupying 2 or 3 of the site's available operating rooms, actively engage in open and endoscopic procedures and intensive teaching of staff general surgeons, residents, and medical students motivated to learn how to use cystoscopic equipment. The local surgeons are introduced to diagnostic cystoscopy, retrograde pyelography, stent placement, visual urethrotomy, TURP/BT, 2-stage urethroplasty, end-to-end urethroplasty and the use of vascularized penile flaps. By the conclusion of the first 2-week mission, the local staff has been able to successfully demonstrate use of the equipment in both diagnostically related cystoscopy and VIU with minimal supervision. Facility in TURP has not been so easily accomplished and has required a second site visit in each case. Other less common procedures include pyelo- or ureterolithotomy, cystolithotomy, radical nephrectomy and hypospadias repair, penile reconstruction, and repair of 1 case of extrophy (Table 1).

Given the dearth of local urological specialists, Knock has made the decision to actively work with a limited number of local private urologists. It works with them by providing them with additional advanced training and also supplies them with specialized equipment to buttress the limited equipment currently at their disposal. The decision was made to support private practice physicians based upon the belief that they ultimately serve the targeted population as well. Knock and the physician volunteers maintain contact with the surgeons with whom we work through the use of e-mail and Facebook [13].

A second mission to the host country and facility(ies) is undertaken the following year to solidify and continue hands-on training, particularly in TURP, help with difficult, recalcitrant cases, provide additional equipment with particular attention to filling in gaps in equipment discovered during the first mission, and, perhaps most importantly, solidify the interpersonal relationships that have developed between the visiting urologists and the host physicians, which will be further reinforced by continued contact via e-mail, social media, and video conferencing.

Table 1. A chart of procedures.

Procedures Done	Kisumu	Mekelle
Diagnostic cystoscopy	25	23
Cystoscopy/retrograde	6	7 (2 ureteral caths placed)
VIU	12	14 (1 failure going on to urethroplasty)
TURP/TUIP	17 (bipolar)	22 (mostly TUIP)*
TURBT	2 (< 2 cm)	1 (extensive disease referred to Addis Ababa)
Open prostatectomy	6 (1 postop death due to hypothermia)	7
Radical nephrectomy	2 (1 Wilms tumor)	1
Pyelolithotomy	6 (1 bilateral)	7 (1 ureterocolicostomy)
Cystolithotomy	3	2
Ureterolithotomy	--	4
Patch/flap urethroplasty	1	6
End-to-end urethroplasty	2	1
Staged urethroplasty	3	1
Distal hypospadias	1	5
Midshaft hypospadias	2	2
Proximal hypospadias	--	1 (adult)
Urethrocutaneous fistula	2 (1 prostates-rectal)**	1 (post-circ)
Penile reconstruction	--	2 (1 electrical burn, 1 post-circ amputation)
Extrophy repair	1	--
Epispadias repair	1	1 (simple closure)
Orchiopexy	2	--
Bilateral orchiectomy	3 (subcapsular)***	1 (subcapsular)
Herniorrhaphy	2	2
Gastroschisis closure	1	--
Mitrofanoff valve	--	--

*due to lack of glycine and use of water as irrigant

**secondary to an ox goring

***patients declined simple orchiectomy

During the intervening year and beyond the second mission Knock continues to collect both durable and disposable equipment to provide to the selected sites.

Program Requirements

- Identification of an underserved population
- General surgeons with a desire for training
- Local facilitator

- Cooperative hospital administration
- Urologic volunteer preceptors
- Adequate OR suites to allow for multiple teams. Ideally, one team to work on particularly difficult cases while a second team occupies a different OR, which is used for working with and training local surgeons
- At least two urologists per team, one for teaching and one for supervision and assistance
- Cysto/radiology tech
- Equipment (ideally from a single manufacturer)



- Cystoscopic sheaths, lenses, bridges, biopsy forceps, grasping forceps, endoscopic scissors
- Urethrotome, zero degree lens, cutting elements
- Resectoscope Set, adaptors, cutting loops, Collins knife, vaporization Electrodes, roller ball electrodes
- Light cords, adaptors, light source
- Video equipment (if possible)
- Electrical adaptors and step-up transformer(s)
- Cautery unit
- Sterilization/soaking trays
- C-arm
- Table adaptable for use in cystoscopy
- Stirrups
- Supplies, including the following:
 - Stents
 - Wires
 - Open ended catheters
 - Y tubing
 - Cords
 - 3-way Foley catheters

RESULTS

Kisumu

Results in Kisumu have been mixed due to the untimely death of our lead surgeon, Dr. Joseph Wayiwu. While diagnostic cystoscopy and VIU continue to be performed, despite the presence of bipolar equipment, the use of TURP has declined. Fortunately Dr. Willis Oyeko has recently affiliated with Maseno University Medical School and will be working at Nyanza General Hospital in the Department of Surgery as the staff urologist. Because of this a third trip to Kisumu has been planned for April of 2014 in conjunction with Cure Cervical Cancer and their organization of a see-and-treat clinic at the facility in order to assist Dr. Oyeko's efforts.

Mekelle

Results in Mekelle have been better. Cystoscopy, TURP (mostly TUIP), and VIU continue to be performed on a regular basis. The surgeons there have also accomplished ureteroscopy and are now more comfortable with and regularly engaged in the successful use of pyelolithotomy. Unfortunately, the exact numbers of procedures accomplished since our visits are not available to us. As previously mentioned, one of the surgeons we trained, Dr. Tsegay G. Yohannes Reda, has matriculated in the new 3-year residency in urology at the referral hospital in Addis Ababa.

Program Follow-Up and Requirements for Sustainability

As discussed above, follow-up of the initial site visits has consisted primarily of a second visit to solidify Knock's relationships, supplement equipment, and provide additional hands-on training. A third visit to NPGH is planned for April of 2014. Ideally, visits should consist of a month long "rotation," but this has not proved to be logistically feasible given that the Knock team consists of actively practicing urologists. Knock volunteer urologists have been able to maintain contact with providers at both sites via e-mail and social media, including Facebook. and are in the process of making arrangements for video conferencing.

Knock believes long-term sustainability of a program like this is dependent upon a number of factors, including:

- A fertile environment
- Training for both cystoscopists and technicians
- Ongoing training and educational opportunities
- Supplementation of existing equipment to fill gaps and build on existing equipment
- Provision of new specialized equipment
- Mechanisms for repair and/or replacement of equipment, goals setting forth with specificity that can and should be accomplished, and what teaching should be undertaken

Translational Aspects of Program and Future Efforts

Knock believes the model of careful site selection, site visit, teaching, provision of equipment, and continuing education can serve as a blueprint for future efforts in accelerating permanent advancement in not only urologic care in the developing world but other disease states.

For instance, the equipment provided to Ayder Referral Hospital has proven instrumental in the development of a locally operated fistula clinic opened shortly after the first Knock site visit. Further, the recent mission to Mekelle was coupled with a visit by curecervicalcancer.org (Director Patricia Gordon, MD) [14] to implement a program of visual cervical inspection with acetic acid (VIA) [15] for HPV and CIS coupled with immediate treatment using cryotherapy for positive tests. Following the Knock model, one of the attending OB/GYNE staff and 2 nurses were trained in VIA, equipment was delivered and installed, and a commitment was made to continue to supply light sources and CO2 beyond Knock's departure. As of this writing, there is a new clinic in place, which inspects and treats anywhere from 20 to 30 patients per day.

Cure Cervical Cancer is, in fact, planning to duplicate this effort



at Knock's original site in Kisumu, and as mentioned above Knock has plans to piggyback a third site visit to NPGH on to this project.

CONCLUSION

In conclusion, Knock believes this model represents a blueprint for the future dissemination of modern urologic (and other) care to the developing world in situations where there is a cooperative hospital administration and an environment where local physicians have both general surgical training and a desire to deliver basic urologic care to their patients. Knock also believes this model is translatable to other medical specialties given the necessary resources and dedication to appropriate follow-up.

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Joseph Wayiwu, MD of Kisumu, Kenya, an excellent surgeon, patient advocate, gentleman, and friend.

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