

UCSF

UC San Francisco Previously Published Works

Title

Implementation of an Ultraviolet Phototherapy Service at a National Referral Hospital in Western Kenya: Reflections on Challenges and Lessons Learned

Permalink

<https://escholarship.org/uc/item/8x5747dd>

Journal

Dermatology and Therapy, 10(1)

ISSN

2193-8210

Authors

Ly, Karen
Chang, Aileen Y
Kiprono, Samson K
[et al.](#)

Publication Date

2020-02-01

DOI

10.1007/s13555-019-00342-1

Peer reviewed



Implementation of an Ultraviolet Phototherapy Service at a National Referral Hospital in Western Kenya: Reflections on Challenges and Lessons Learned

Karen Ly · Aileen Y. Chang · Samson K. Kiprono · Margareth Jose · Mary Patricia Smith ·
Kristen Beck · Sahil Sekhon · Isabel Muraguri · Margaret Mungai · Sarah J. Coates ·
Quinn Thibodeaux · Sarah Hulse · Marissa Gualberto · Caleb Jeon · Mio Nakamura ·
Tina Bhutani · Toby Maurer · Wilson Liao

Received: September 12, 2019 / Published online: November 16, 2019
© The Author(s) 2019

ABSTRACT

Introduction: In order to manage skin conditions at a national referral hospital level in Kenya, specialized dermatology services, such as dermatologic surgery, dermatopathology, phototherapy, and sub-specialty care, should be offered, as is typically available in referral hospitals around the world. A Kenyan patient with

prurigo nodularis, whose severe itch remitted after phototherapy treatment at the University of California, San Francisco (UCSF), inspired the development of a phototherapy service at Academic Model Providing Access to Healthcare (AMPATH), a partnership in Western Kenya between Moi Teaching and Referral Hospital, Moi University College of Health Sciences, and a consortium of North American academic medical centers.

Methods: Initial project funds were raised through a crowdfunding campaign and fundraising events. A new narrowband ultraviolet B phototherapy unit and replacement bulbs were donated and air shipped to Eldoret, Kenya. A team of dermatologists and phototherapy nurses from UCSF conducted a 2-day training session. US-based dermatologists affiliated with

Karen Ly and Aileen Y. Chang contributed equally as co-first authors.

Toby Maurer and Wilson Liao contributed equally as co-last authors.

Enhanced Digital Features To view enhanced digital features for this article go to <https://doi.org/10.6084/m9.figshare.10075427>.

K. Ly · A. Y. Chang (✉) · M. Jose · M. P. Smith ·
K. Beck · S. Sekhon · I. Muraguri · S. J. Coates ·
Q. Thibodeaux · S. Hulse · M. Gualberto · C. Jeon ·
M. Nakamura · T. Bhutani · W. Liao
Department of Dermatology, University of
California, San Francisco, CA, USA
e-mail: aileen.chang@ucsf.edu

A. Y. Chang · S. K. Kiprono · S. J. Coates · T. Maurer
Academic Model Providing Access to Healthcare,
Eldoret, Kenya

S. K. Kiprono
Department of Medicine, Moi University School of
Medicine, Eldoret, Kenya

M. Mungai
Moi Teaching and Referral Hospital, Eldoret, Kenya

C. Jeon
Division of Dermatology, Harbor-UCLA Medical
Center, Torrance, CA, USA

M. Nakamura
Department of Dermatology, University of
Michigan, Ann Arbor, MI, USA

T. Maurer
Department of Dermatology, Indiana University,
Indianapolis, IN, USA

AMPATH provide ongoing support through regular communication and on-site visits.

Results: Early in implementation, challenges faced included training clinical staff with limited experience in phototherapy and improving communication between nurses and clinicians. More recent challenges include frequent rotation of specialty clinic nurses in the dermatology clinic, adaptation of phototherapy guidelines to balance patient volume with service delivery capacity, and training assessment of disease activity in darkly pigmented skin.

Conclusion: Strategies that have been helpful in addressing implementation challenges include: increasing on-site and remote training opportunities for clinicians and nurses, developing a tiered payment schema, educating patients to combat misconceptions about phototherapy, dynamic phototherapy referral guidelines to accommodate service delivery capacity, and prioritizing the engagement of a multidisciplinary team.

Keywords: Africa; Dermatology; Kenya; Low- and middle-income countries; Phototherapy; Resource-limited settings; Ultraviolet light; UVB

Key Summary Points

In order to manage skin conditions at a national referral hospital level in Kenya, specialized dermatology services, such as phototherapy, should be offered, as are routinely available at referral hospitals around the world.

A Kenyan patient with intractable pruritus, whose symptoms remitted after phototherapy treatment at the University of California, San Francisco (UCSF), inspired the development of a phototherapy service at Academic Model Providing Access to Healthcare (AMPATH), a partnership in Western Kenya between Moi Teaching and Referral Hospital, Moi University College of Health Sciences, and a consortium of North American academic medical centers.

Implementation challenges faced included training of clinical staff with limited experience in phototherapy, developing phototherapy as a sustainable service, educating patients, adapting phototherapy guidelines to a local context, and multidisciplinary collaboration.

Strategies that have been helpful include increasing training opportunities, developing a tiered payment schema, educating patients, maintaining dynamic phototherapy guidelines, and prioritizing the engagement of a multidisciplinary team.

INTRODUCTION

In order to manage skin conditions at a national referral hospital level, specialized dermatology services such as dermatologic surgery, dermatopathology, phototherapy, and sub-specialty care, should be offered, as are routinely available at referral hospitals around the world. While visiting family near San Francisco, California, a Kenyan patient with Fitzpatrick skin type 6 presented for evaluation to the University of California, San Francisco (UCSF) Psoriasis and Skin Treatment Center. This patient had been suffering from intractable pruritus for 1 year despite seeking care from providers in Kenya and the United States. At UCSF, the patient was successfully treated with narrow-band ultraviolet B (nbUVB) phototherapy for severe pruritus from prurigo nodularis. This patient's subsequent motivation to improve the treatment of skin diseases in Kenya inspired the development of an ultraviolet phototherapy service in Western Kenya, where UCSF dermatologists had been helping to develop dermatology capacity through AMPATH (Academic Model Providing Access to Healthcare) for 10 years.

Since 2001, AMPATH has been a partnership between Moi Teaching and Referral Hospital (MTRH), Moi University College of Health

Sciences (MUCHS), and a consortium of North American academic medical centers. AMPATH, a President's Emergency Plan for AIDS Relief—United States Agency for International Development supported implementing partner, collaborates with the Ministry of Health to serve a catchment area of over 4 million people and has supported HIV care delivery for over 150,000 patients at over 500 sites across Western Kenya. Using the infrastructure and healthcare delivery model created through HIV care, AMPATH has been providing care for other chronic diseases, including dermatologic conditions.

MTRH, one of Kenya's two national referral hospitals, serves approximately 24 million people from Western Kenya and neighboring countries. The MTRH campus provides both inpatient and outpatient services, with several specialty care buildings including the AMPATH Centre (HIV care), Chandaria Centre for Cancer and Chronic Diseases, Riley Mother Baby Hospital, Shoe4Africa Children's Hospital, Rafiki Center for Excellence in Adolescent Health, and Majaliwa Surgical Center. There are two dermatology consultants (attendings) and two dermatology clinical officers (mid-level providers who have completed additional dermatology training) providing care at MTRH. The dermatology clinic is part of the specialty clinics. Nurses assigned to the specialty clinics rotate among dermatology, cardiology, diabetes, neurology, and mental health clinics. Through MUCHS, a Masters in Medicine (MMed) of Dermatology program is anticipated to enroll its first class in September 2020 and will be the first MMed of Dermatology program in Kenya. Dermatology registrars (residents) will complete the clinical training component of their MMed program at MTRH.

As called for by the Government of Kenya, the provision of affordable, equitable, and accessible care that is responsive to population needs includes providing care for skin conditions. This is considered an essential health service that should be offered across the healthcare system, from primary care facilities to national hospitals [1]. Kenya is a lower middle-income country with a population of 51.4 million, of which 36.8% live on less than \$1.90 per day [2]. The life expectancy is 67.3 years,

mortality rate in children under age five is 46 per 1000 live births, and the nationwide prevalence of HIV is 4.8% of the population ages 15–49 years old [2]. The prevalence of skin disorders in Kenya has been estimated to be 29.6–50.9% [3–5]. Common skin conditions include tinea versicolor, tinea capitis, scabies, atopic dermatitis, psoriasis, vitiligo, acne vulgaris, and dermatitis [5, 6]. The National Hospital Insurance Fund (NHIF) is the main health insurer, covering 16% of Kenyans [7]. NHIF contribution is mandatory for formal sector workers and voluntary for informal sector workers. Although informal sector workers form 83.4% of total employed individuals in Kenya [8], they accounted for only 24% of the total number of individuals enrolled in the NHIF in 2017 [9]. At MTRH, the vast majority of patients work in the informal sector, do not contribute to NHIF, and pay for healthcare expenses out-of-pocket.

In the public healthcare system of Kenya, there is limited access to specialty care, unreliable supply of medications and medical supplies, and suboptimal health system infrastructure. At primary care and county facilities, clinical officers and nurses are often called upon to provide dermatologic care, though many have limited training in the diagnosis and treatment of skin diseases [10]. The availability of dermatologic therapies varies based on healthcare facility level and facility supply. Phototherapy and biologic therapies are not readily available. The rationale for developing an ultraviolet phototherapy service was that it would enhance the specialized dermatology care being provided at MTRH and support the clinical training of MUCHS dermatology registrars who represent the future local dermatology consultant workforce. In this manuscript, we will discuss the challenges and lessons learned thus far from the development and implementation of the ultraviolet phototherapy service at MTRH.

METHODS

Multiple fundraising events and a crowdfunding campaign were used to fund the initial costs

of this project. A fundraising website described the inspiration and mission of our project: raise funds for a state-of-the-art phototherapy unit for MTRH; enhance MTRH as the clinical training site for MUCHS dermatology registrars; and build capacity to deliver dermatologic care to Kenyans. A video was created telling the story of our Kenyan patient and this patient's desire to bring phototherapy to Kenya. The website and video were circulated within the UCSF community, via email, text, and social media, to raise support and increase interest. We also partnered with a local establishment in San Francisco to host a fundraising event, with admission fees and a portion of proceeds going toward our campaign.

Ultimately, National Biological Corporation (Beachwood, Ohio, USA) donated a new nbUVB cabinet phototherapy unit (model FOLDALITE® 32, Fig. 1). nbUVB was chosen, rather than broadband UVB or UVA, due to its safety profile [11–14] and efficacy in a range of dermatologic conditions. Approvals and import permits were

obtained after 6 months of close communication between UCSF dermatologists, National Biological Corporation, and MTRH executive leadership. The phototherapy machine and bulbs, including replacement bulbs, were shipped by air from the United States to Nairobi, Kenya and then onward to Eldoret, Kenya. During this 6-month period, a suitable room within MTRH was identified and approved to be used for phototherapy. Modifications to the room were made including fan installation, window tinting, and securing of doors and windows. Machine installation was performed by the MTRH Department of Medical Engineering.

After installation of the phototherapy machine, a team of UCSF dermatologists and phototherapy nurses traveled to Kenya to conduct a 2-day initial training session for the specialty clinic nurses, dermatology clinical officers, and dermatologists. This training covered diseases treated with phototherapy, dose administration, shielding, machine calibration, documentation, and the assessment of side



Fig. 1 Narrowband ultraviolet B cabinet phototherapy unit

effects and treatment response. Instruction was provided in the form of lectures and hands-on training with the phototherapy machine. The UCSF team has provided ongoing support through regular communication via conference calls and electronic mail. Additionally, US-based dermatologists affiliated with AMPATH make regular visits to Kenya to support the implementation process. Machine calibration is performed weekly by phototherapy nurses, and the MTRH Department of Medical Engineering performs regular machine maintenance.

Since treatment of patients began, constant feedback has been elicited from nurses and clinicians involved with the provision of phototherapy. This feedback will be discussed in the Results section. This article does not contain any studies with human participants or animals performed by any of the authors.

RESULTS

Between February 2018 and August 2019, 62 patients received phototherapy treatment at MTRH for a range of skin conditions, including psoriasis, atopic dermatitis, cutaneous T-cell lymphoma, and vitiligo. Early on in implementation, the challenges faced by nurses included learning a new advanced skill set as none were familiar with phototherapy prior to training, developing a documentation system for tracking patients and their progress, and effectively communicating their concerns with the dermatology clinical officers and consultants. Challenges faced by dermatology clinical officers and consultants included becoming familiar with the clinical indications for phototherapy, understanding risks, benefits, and alternatives to phototherapy, and recognizing side effects from phototherapy. More recent challenges include frequent rotation of specialty clinic nurses in the dermatology clinic and adaptation of phototherapy guidelines to the local context such that patient volume is balanced with the capacity of the phototherapy service. Another ongoing challenge has been lack of large-volume topical corticosteroids, which are often used as adjuvant therapy in most conditions treated with ultraviolet therapy.

DISCUSSION

The first ultraviolet phototherapy service in Western Kenya has been developed and implementation is ongoing. The challenges we have encountered are related to the introduction of a relatively unfamiliar therapy and provision of this service to a patient population that predominantly pays for healthcare expenses entirely out-of-pocket. Herein, we will discuss our challenges, lessons learned, and future directions (Table 1).

One of the biggest challenges has been training a clinical team composed of nurses, dermatology clinical officers, and dermatology consultants with limited to no prior experience administering phototherapy. Education was initially provided through a 2-day orientation session, which included lectures, practical exercises, and clinical case studies. Based on feedback from the clinical team, additional opportunities for training were identified as necessary to optimize and standardize care. To address this need, we introduced on-site refresher training sessions led by UCSF personnel with certification in phototherapy administration. During these sessions, important concepts are reviewed and reinforced through presentations and practical demonstrations. During regularly scheduled video conference calls with the UCSF team, clinicians and nurses can discuss challenging clinical cases. Furthermore, it became apparent that the frequent rotation of specialty clinic nurses among the various specialty clinics was a barrier to phototherapy implementation. Some nurses had not attended the initial training session; some were more interested in phototherapy than others and thus more receptive to training than others. To address this, MTRH nursing leadership assigned three specialty clinic nurses, each of whom had shown interest in phototherapy, to the dermatology clinic. Having the same dermatology nurses has allowed us to focus training efforts on personnel who will be consistently posted to the dermatology clinic, which has facilitated efficient phototherapy knowledge and skills acquisition and optimized the safety, efficacy, and standards of phototherapy service delivery.

Table 1 Establishment of a phototherapy service in Eldoret, Kenya—key challenges, solutions, and future directions

Key Challenges	Solutions Implemented
Provider education <i>Training a clinical team with limited phototherapy knowledge and experience</i>	Two-day orientation session for specialty clinic nurses, dermatology clinical officers, and dermatologists On-site refresher training sessions Regularly scheduled video conference calls One of three specialty clinic nurses with training and interest in phototherapy is always assigned to dermatology clinic Posters in clinic with referral and dosing guidelines
Financial considerations <i>Balancing affordability with clinic sustainability</i>	Negotiation with the National Hospital Insurance Fund to include phototherapy as a covered service Tiered payment schema Profit allocated to the hospital's dermatology department
Patient education <i>Misconceptions about phototherapy</i>	Patient orientation session and take-home educational pamphlets Nurses reinforce phototherapy education at every visit
Clinical care <i>Adapting phototherapy referral and treatment guidelines to local context</i>	Dynamic phototherapy referral guidelines: strict early in implementation to limit referrals while the service was developing and later modified with increased service delivery capacity Utilize dosing guidelines used by University of California, San Francisco (UCSF) collaborators and anticipate these may be adjusted with increased local experience
Multidisciplinary collaboration <i>Engagement of multidisciplinary stakeholders</i>	Development of a new professional and cultural norm between clinicians and nurses through open communication, regular meetings, frequent solicitation of feedback Discussion with hospital administrators to determine payment structure, clinic space allotment, staff allocation, and equipment security Partnership with hospital pharmacists to develop compounding of topical corticosteroids
Future directions	
	Develop training tools for assessment of disease activity in darkly pigmented skin Conduct observational studies to evaluate patient outcomes for a range of skin diseases Assess patient acceptability of phototherapy Evaluate the phototherapy service's financial model Engage in opportunities to collaborate with other phototherapy services in Africa

Another challenge was addressing financial considerations related to balancing affordability of accessing phototherapy with its sustainability

as a clinical service. Phototherapy typically requires multiple sessions per week for at least 2–3 months. In addition to treatment cost,

travel cost and travel time can be significant barriers to accessing care as these are associated with lost income. Patients travel approximately 1–2 h to reach the clinic, and some come from Nairobi, which is at least 6 h away by road in a private vehicle and longer by public transportation. When determining the suitability of a phototherapy referral, the clinician considers the clinical appropriateness (e.g., diagnosis, prior treatments failed, degree of body surface area involvement, contraindications) and all patient costs related to phototherapy, including the cost per session, cost of travel, and anticipated number of sessions. These aspects of phototherapy are discussed with patients before this treatment modality is initiated.

In order to develop phototherapy as a sustainable clinical service, establishing a revenue stream that balances financial viability with patient affordability was a high priority from the beginning. We worked with the NHIF to include phototherapy cost for those with NHIF insurance. Approximately 10% of our phototherapy patients have NHIF insurance. Initially, the main challenge with the use of NHIF was obtaining approval before every phototherapy session. We negotiated with NHIF to provide phototherapy as a package of eight sessions. For individuals without NHIF coverage, which accounts for the vast majority of patients, a reduced fee is offered. For those individuals with limited to no ability to pay, a social worker is engaged to assess the need for a payment plan and consider waiver of treatment costs. Transportation costs continue to be a barrier. On various occasions, staff have used personal funds to assist patients. Of note, the cost of the FOLDALITE® 32 nbUVB machine was 13,900 USD, replacement bulbs were 3400 USD, and a UVB-500C metering device and stand was 780 USD. The nbUVB unit was donated, while the replacement bulbs, metering device and stand were purchased using the initial funds raised. With regard to sustainability, the phototherapy service has become a core service provided by the hospital. All profit generated from the phototherapy service is directed towards supporting the MTRH dermatology department. With a forward-looking financial plan, the donation of the phototherapy

machine has helped build dermatology capacity in a sustainable manner and supports the patient care, teaching, and research mission of AMPATH Dermatology.

As ultraviolet phototherapy is a new and unfamiliar technology to many Kenyans, misconceptions have posed a significant challenge. Misconceptions include the belief that nbUVB phototherapy is identical to the form of radiation therapy used to treat cancer (e.g., X-ray therapy), greatly increases the risk of skin cancer, or that skin improvement equates to a cure. Misconceptions manifest in patients' reluctance to initiate treatment or a failure to return to clinic once improvement is achieved, often times leading to disease recurrence. To combat misconceptions, patients are educated on expectations regarding treatment duration, treatment outcomes, and potential side effects through an orientation session and take-home educational pamphlets. Nurses reinforce important points at every visit and have been instrumental in addressing misconceptions.

Challenges related to clinical care are ongoing as implementation progresses. At the beginning of implementation, we used strict phototherapy referral guidelines that required large body surface area involvement or failure of topical and systemic medications to avoid a large number of referrals while we had a new service with clinicians and nurses lacking hands-on phototherapy experience. After the aforementioned challenges related to training, nurse staffing, and NHIF reimbursement were addressed over the first one and a half years of implementation, phototherapy referral guidelines were modified to allow for patients with a lower body surface area involvement and without a systemic medication trial. As the dermatology clinic's patient volume grows and the number of dermatology providers increases with the MMed program, we will continue to use dynamic phototherapy referral guidelines to maintain service delivery standards, safety, and efficacy. For determining the starting dose and dosing schedule, we have used the clinical experience at the UCSF Psoriasis and Skin Treatment Center to guide our approach (Fig. 2). We anticipate that these working guidelines will be adjusted as we gain more

NARROW BAND DOSING

Psoriasis

Skin Type	Initial Dose	Subsequent Increase*
I	130 mJ	15-50 mJ
II	220 mJ	15-75 mJ
III	260 mJ	15-100 mJ
IV	330 mJ	15-150 mJ
V	350 mJ	15-200 mJ
VI	400 mJ	15-200 mJ

+ Vitiligo

Skin Type	Initial Dose	Subsequent Increase*
I	130 mJ	15-50 mJ
<i>Treat all patients as if they have baseline skin type I</i>		

Atopic Dermatitis / Generalized Pruritus / Prurigo Nodularis

Skin Type	Initial Dose	Subsequent Increase*
I	130 mJ	15-50 mJ
II	220 mJ	15-50 mJ
III	260 mJ	15-100 mJ
IV	330 mJ	15-100 mJ
V	350 mJ	15-150 mJ
VI	400 mJ	15-150 mJ

* Typical dose increase is between 15-30mJ per visit

- **Patients with any photosensitizing drug:** decrease 1 skin type when starting light
- **Patients adding photosensitizing drugs during therapy:** decrease by 50%, then proceed with skin type protocol
- **Dealing with missed visits (applies to *all skin types*):**

1-7 days	Increase per skin type
8-11 days	Hold dose constant
12-20 days	Decrease by 25%
21-27 days	Decrease by 50%
28 or more days	Start over at beginning

Fig. 2 Narrowband ultraviolet B dosing guidelines utilized at Moi Teaching and Referral Hospital (separate file)

experience using phototherapy at MTRH. Another challenge has been training nurses in the assessment of disease activity in inflammatory skin conditions, particularly when

erythema can be challenging to appreciate in darkly pigmented skin. While dermatologists with experience treating skin conditions in darkly pigmented patients anecdotally report

that they rely on other signs of inflammation (e.g., scale, induration) and patient-reported symptoms (e.g., itch, pain), we have not identified published guidelines or training tools for assessment of disease activity in darkly pigmented skin.

Implementation of the phototherapy service has required the support of a multidisciplinary team, comprised of clinicians, nurses, pharmacists, and hospital administrators. The engagement of these multidisciplinary stakeholders has been crucial since project inception. Due to specialized training and an advanced skill set, clinicians play a fundamental leadership role in multi-disciplinary teams and must be able to work closely with nurses, amongst other healthcare professionals. While clinicians make referrals to phototherapy, phototherapy administration is nursing-led, meaning nurses are the ones who assess patients at each phototherapy session, manage side effects, decide on dosing for the session, determine which areas to shield, and ensure infection prevention and control measures are implemented. Clinicians review patients periodically but not at every phototherapy session. Ultimately, nurses must be empowered, supported, and invested in excelling at phototherapy administration. We have initiated several strategies to try to establish a new professional and cultural norm in the phototherapy clinic: regular clinical and administrative meetings attended by both clinicians and nurses, close communication with hospital nursing leadership, and regular solicitation of feedback from nurses and clinicians. Another essential stakeholder is hospital administration. Implementation of any clinical service, particularly a novel one, requires close partnership with hospital administrators to negotiate issues around service payment structure, clinic space allotment, staff allocation, and security/safeguarding of equipment and supplies. We have also engaged with hospital pharmacists to try to develop compounding of topical corticosteroids in order to increase the availability of 500-g jars, as only 15- to 30-g tubes are commercially available. Specifically related to phototherapy, topical corticosteroids are used as adjuvant therapy and to treat side effects. With the availability of 500-g jars of

topical corticosteroids, we anticipate that fewer patients may need phototherapy services.

To date, dermatology capacity development work at AMPATH has occurred at the national referral hospital level because in order to provide affordable, equitable, and accessible dermatologic care, there must be specialized dermatology services and an adequate number of dermatology consultants working in the public healthcare system. With the development of the MMed of Dermatology at MUCHS and the phototherapy service at MTRH, progress is being made towards increasing dermatology capacity at the referral level. More recently, we have started to develop a strategy to address dermatology capacity at the primary care, sub-county, and county facilities. We have initiated dermatology continuing medical education sessions for clinicians and nurses at sub-county and county facilities within the MTRH catchment area. We also plan to pilot a teledermatology program to increase access to dermatologic care. Finally, we have started developing a community-based outreach program that aims to sensitize communities within the catchment area of MTRH that dermatologic conditions can be treated with a variety of therapies, some of which are available at primary care and county facilities and others at the national referral level.

Future directions for the phototherapy service are numerous. We plan to evaluate the phototherapy service, specifically conducting observational studies to evaluate patient outcomes for a range of skin diseases, assess patient acceptability of phototherapy, and evaluate the financial model. We plan to develop training tools for assessment of disease activity in darkly pigmented skin. Phototherapy services exist in other African countries; however, we have not been able to find publications from these services describing their experience or reporting clinical outcomes. We are seeking opportunities to learn from, and collaborate with, other phototherapy services in Africa.

CONCLUSIONS

In conclusion, there have been multiple challenges in the implementation of an ultraviolet

phototherapy service at a national referral hospital in Western Kenya. Strategies that have been helpful in addressing implementation challenges include: increasing on-site and remote training opportunities for clinicians and nurses, developing a tiered payment schema, educating patients to combat misconceptions about phototherapy, dynamic phototherapy referral guidelines to accommodate service delivery capacity, and prioritizing the engagement of a multidisciplinary team. Future work includes developing training tools for assessment of disease activity in darkly pigmented skin, conducting observational studies to evaluate patient outcomes, assessing patient acceptability of phototherapy, evaluating the financial model of the service, and improving dermatology care across the public healthcare system in Western Kenya.

ACKNOWLEDGEMENTS

We wish to thank the dedicated nurses and clinicians taking care of phototherapy patients at Moi Teaching and Referral Hospital. We also wish to thank National Biological Corporation for their donation of the phototherapy machine to Moi Teaching and Referral Hospital, as well as all donors who have provided financial support to this program.

Funding. No funding or sponsorship was received for this study or publication of this article. Aileen Chang was supported by the National Institutes of Health Research Training Grant R25 TW009343 funded by the Fogarty International Center; the National Institute of Mental Health; the National Health, Lung and Blood Institute; and the Office of Research on Women's Health, as well as the University of California Global Health Institute. Sarah Coates is supported by the National Cancer Institute and the Fogarty International Center of the National Institutes of Health under Award Number D43TW009343, as well as the University of California Global Health Institute. Wilson Liao is funded in part by a grant from the National Institutes of Health (U01AI119125).

The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health or the University of California Global Health Institute.

Authorship. All named authors meet the International Committee of Medical Journal Editors (ICMJE) criteria for authorship for this article, take responsibility for the integrity of the work as a whole, and have given their approval for this version to be published.

Authorship Contributions. Aileen Y. Chang and Karen Ly contributed equally to this paper. Toby Maurer and Wilson Liao also contributed equally to this paper.

Disclosures. Tina Bhutani has received research funding from Janssen, Merck, Celgene, and Regeneron and served as a consultant for AbbVie and Lilly. Wilson Liao has received research grant funding from AbbVie, Amgen, Janssen, Novartis, Regeneron, and Sanofi and is a member of the journal's Editorial Board. Karen Ly, Aileen Y. Chang, Samson K. Kiprono, Margaret Jose, Mary Patricia Smith, Kristen Beck, Sahil Sekhon, Isabel Muraguri, Margaret Mungai, Sarah J. Coates, Quinn Thibodeaux, Sarah Hulse, Marissa Gualberto, Caleb Jeon, Toby Maurer, and Mio Nakamura have nothing to disclose.

Compliance with Ethics Guidelines. This article does not contain any studies with human participants or animals performed by any of the authors.

Open Access. This article is distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any non-commercial use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made.

REFERENCES

1. Kenya Ministry Of Health. Transforming health: accelerating attainment of universal health coverage. Kenya Health Sector Strategic and Investment Plan (KHSSP), July 2013–June 2017:25-28. Available At: https://www.who.int/pmnch/media/events/2013/kenya_hssp.pdf. Accessed 28 Aug 2019.
2. The World Bank Group. Kenya. Available at: <https://data.worldbank.org/country/kenya?view=chart>. Accessed 19 Aug 2019.
3. Ayaya SO, Esamai FO. Health problems of street children in Eldoret, Kenya. *East Afr Med J*. 2001;78(12):624–9.
4. Schmeller W. Community health workers reduce skin diseases in East African children. *Int J Dermatol*. 1998;37(5):370–7.
5. Schmeller W, Dzikus A. Skin diseases in children in rural Kenya: long-term results of a dermatology project within the primary health care system. *Br J Dermatol*. 2001;144(1):118–24.
6. Verhagen AR, Koten JW, Chaddah VK, Patel RI. Skin diseases in Kenya. A clinical and histopathological study of 3168 patients. *Arch Dermatol*. 1968;98(6):577–86.
7. Kazungu JS, Barasa EW. Examining levels, distribution and correlates of health insurance coverage in Kenya. *Trop Med Int Health*. 2017;22(9):1175–85.
8. Kenya National Bureau of Statistics. Economic survey (2018), 2018:1. Available at: <https://www.knbs.or.ke/download/economic-survey-2018/>. Accessed 12 Oct 2019.
9. Barasa E, Rogo K, Mwaura N, Chuma J. Kenya National Hospital Insurance Fund Reforms: implications and lessons for universal health coverage. *Health Syst Reform*. 2018;4(4):346–61.
10. Hu J, McKoy K, Papier A, et al. Dermatology and HIV/AIDS in Africa. *J Glob Infect Dis*. 2011;3(3):275–80.
11. Hearn RM, Kerr AC, Rahim KF, Ferguson J, Dawe RS. Incidence of skin cancers in 3867 patients treated with narrow-band ultraviolet B phototherapy. *Br J Dermatol*. 2008;159(4):931–5.
12. Weischer M, Blum A, Eberhard F, Rocken M, Berneburg M. No evidence for increased skin cancer risk in psoriasis patients treated with broadband or narrowband UVB phototherapy: a first retrospective study. *Acta Derm Venereol*. 2004;84(5):370–4.
13. Black RJ, Gavin AT. Photocarcinogenic risk of narrowband ultraviolet B (TL-01) phototherapy: early follow-up data. *Br J Dermatol*. 2006;154:566–7.
14. Lee E, Koo J, Berger T. UVB phototherapy and skin cancer risk: a review of the literature. *Int J Dermatol*. 2005;44(5):355–60.