

**SURGICAL TASK-SHIFTING IN AFRICA:
A COMPREHENSIVE AND SYSTEMATIC REVIEW**

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Abstract

Background This systematic review focuses on discussing the critical shortage of surgeons and access to surgical services in many low income African nations and the difficulties encountered by non-physician clinicians who are trained to increase the surgical workforce by carrying out less severe surgeries and peri-operative care. By critically assessing the literature this review seeks to present the benefits to surgical task shifting and the most commonly encountered problem with this type of healthcare intervention

Methods PubMed, The Cochrane Library, and OVID libraries were used to collect published peer reviewed articles using specific search terms and applying strict inclusion and exclusion criteria. More than 300 articles were discovered initially and were pared down to 10 articles that were individually analyzed for content

Results After critical analysis of the 10 articles it was clear that task shifting increased the surgical workforce in select low-income African nations but that it was often viewed with some hostility from other medical professionals. Most complained that the non-physician clinicians (NPC) lacked oversight and continued training to keep them abreast of new research. In all most articles found the use of NPCs essential to health systems in Africa.

Conclusion Task shifting as a means to increase surgical care in Africa, and increase accessibility to the most basic of surgical care can be effective. In order to maintain task shifting as a viable and useful tool to increase surgical care, programs must be put into place in order to ensure proper continued training and oversight of NPC's. There exists a hole in the literature regarding the effectiveness of different task shifting training programs

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Surgical Task Shifting in Africa: Comprehensive Review

Training of Non-Physician Clinicians in Medically Underserved Populations

Introduction

According to the World Health Organization, Africa currently harbors one quarter of the world's disease burden and maintains but one percent of the world's health workforce (Weiser, 2008). Of that burden, violence, injury from traffic accidents, and obstetric emergencies are the leading causes of morbidity and mortality, all of which require surgical intervention. Surgically trained physicians however are proportionally misrepresented in many African countries, in a health care workforce that is already grossly inadequate. Africa has a generalized lack of physicians, even fewer physicians working in rural areas and once subspecialties requiring extra training are taken into account the shortage becomes deplorable. Surgical care has been neglected in the past for being too expensive and too acute to fix many of the problems of global health. Historically global health initiatives have been focused on long-term problems such as nutrition, and treating chronic diseases. More recently however, the WHO has noted that the cost effectiveness of surgical intervention may rival that of long-term public health projects (Weiser, 2008). Much of this is due to an epidemiologic shift from diseases of populations, to more acute and individual injuries due to childbirth, and more importantly to an increasing number of traffic accidents occurring in developing nations. The WHO has stated that increasing surgical care is not only important, but that the gaps in access must be identified and rectified, and more importantly that effective surgical implementation is economically feasible. One of the main facets of the global push for increased surgical care in low and middle income countries (LMIC) is to utilize a program begun during the AIDS crisis of the late 1980's and 90's, that being the use of non-physician clinicians (NPCs). During the AIDS epidemic in Africa, NPCs or health workers who are not professionally trained physicians were trained in basic health care and provided much of the low-level care to sick patients. This shift in the workload opened up the professionally trained physicians to focus on caring for the higher risk patients, and developing strategies to care for a higher number of patients. More recently this practice has been used in LMIC countries in Africa to extend the reach of surgeons. This review will seek to characterize the state of NPCs and the model of "task shifting" in the surgical theatre to increase the reach of trained surgeons in Sub-Saharan Africa. This comprehensive review will focus on the effectiveness and the need for non-physician clinicians

in the surgical theatre as measured by a decrease in mortality and morbidity, and by an increase in the number of surgeries performed by trained surgeons in these regions. There is a paucity of quantitative research in this area, and so it is difficult to recommend specific healthcare policy changes or improvements. A systematic review on the training programs is to follow.

Surgical Disparities

Paul Farmer the director of the NGO, Partners in Health, which has long been at the forefront of global health, has referred to surgery as the “neglected stepchild of global health.” (Kushner, 2010) It is estimated that of the 234 million surgeries occurring worldwide per year, only 26% take place in the poorest counties (Weiser, 2008). According to Farmer, the lack of surgical intervention is responsible for up to 15% of global disability-adjusted life years (DALY), and that complications from surgery are one of the top 15 causes of disability worldwide (Bae, 2011). One of the chief difficulties in providing surgical care, defined by Chu et al 2009, as safe provision of pre-operative, operative, and post-operative surgical and anesthesia services in resource limited settings, is the shortage of trained surgical professionals (Chu, 2009). Often times, surgical equipment and proper sterile products can be imported into high need areas, but without proper personnel to operate, there is a breakdown in the accessibility and safety of surgical care. In addition there are documented inadequacies in many countries including the lack of competitive salaries as compared to wealthier nations. In East Africa, there are 0.25 fully trained surgeons per 100,000 persons as compared to 5.69 per 100,000 in the United States (Weiser, 2008). Surgery in many sub-Saharan African nations is often overlooked due to the lack of the most basic care that takes precedent. In Uganda, a country that the WHO has deemed as having a severe shortage of healthcare workers for its needs, there are only 0.4 healthcare workers, including all physicians, mid-wives, nurses, technicians and medical aides per 1000 people. As a comparison, the WHO has noted that any country with fewer than 2.28 healthcare workers per 1000 population is considered to have a severe shortage (Weiser, 2008). This shortage of even the most basic of a healthcare workforce means that coverage of essential interventions is unlikely. Uganda’s neighbors fare no better. The Central African Republic has only 0.08 physicians per 1000 persons; Ethiopia and Sierra Leone have 0.03 per 1000, and Tanzania 0.02 per 1000 people. In total, according to a WHO bulletin on healthcare worker shortage in Africa, for 12 of the poorest countries there is an average of 0.09 physicians per 1000 persons (Weiser, 2008). This shortage directly correlates to the outcomes of many medical and surgical procedures. With fewer physicians for a population, there are fewer physicians able to provide surgical services.

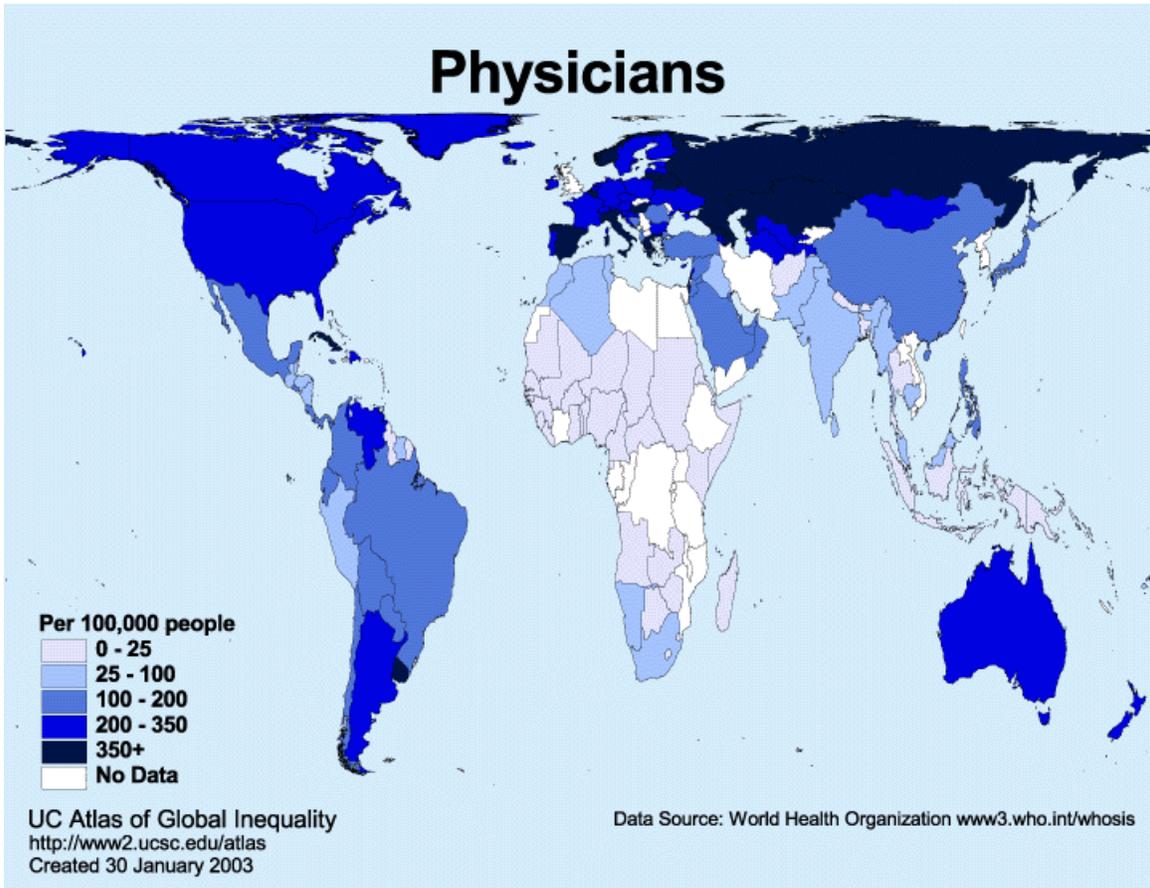


Image 1: Global distribution of physicians per 100,000 people

One surgical procedure is done for every 371 people in Ugandan hospitals as compared to one surgical procedure done for every 25 people in hospitals worldwide (Linden, 2012). Nearly 75% of the surgeries performed, specifically in Uganda, were emergency surgeries, and there are not enough Ugandan physicians trained in performing emergency surgery to properly respond to this crisis (Linden, 2012). Due to the lack of proper training for many health-care workers, trained surgeons must partake in minor surgical cases including wound-debridement, suturing or dressing-changes; thereby precluding them from the more serious abdominal surgeries, or orthopedic cases (Linden, 2012). In this sense, a form of task-shifting, by training non-physician clinicians to operate in minor surgical procedures, would free up the limited resource of the trained surgeon to focus on more important cases, and begin to work towards bringing surgical care in Africa closer to worldwide standards. This may reflect the preference of lesser-trained surgical staff to deal with less complicated cases, but this trend of trained surgeons taking care of minor cases is seen in other African district hospitals. This suggests that in resource-limited areas, many surgical interventions could be properly by non-surgeons.

There exists a dual brain drain in many African countries as many trained physicians either leave their country once they have completed their training, or begin practice in treating the endemic infections diseases, such as HIV/AIDS (Lassi, 2013). In addition, funding priorities in Africa favor infectious diseases, thusly, surgery and perioperative care have been greatly neglected (Ogediz, 2008).

Historical Use of NPC

Non-physician clinicians have been in use in Africa since the 1950s. Ethiopia was the first African nation to institute an official education program for NPCs in 1954 (Cumbi, 2007). In Mozambique, the exodus of physicians during the civil war in the 1970s through the 1990s was the impetus for establishing NPC cadres to care for the population, and possibly most famously, Ghana, in 1969, made a commitment to primary health delivery which led to the establishment of the Ghana Rural Health Service. The Rural Health Service trained health center superintendents who were later known as medical assistants who provided a majority of rural health care in Ghana. (Gajewski 2012) As the global disease burden shifted throughout the century after the establishment of NPCs, their roles changed, and became less of a solely rural health care provider and began being utilized in the major metropolitan centers of Africa. The global HIV and AIDS crisis of the 1980s and 1990s has harmed no region of the world more so than sub-Saharan Africa. According to regional statistics by the United Nations, sub-Saharan Africa accounts for more than “23.5 million of the 34 million” people living with HIV and AIDS globally (Suzan-Monti, 2015) Coupled with the severe shortage of physicians, countries began to adopt the care model of task shifting by rationally distributing tasks from more specialized to less-specialized health workers. Task-shifting improved access to antiretroviral treatment (ART) from 6.6 million people with HIV in 2010 to 8 million people in 2011, a 20% increase in only one year.

The Southern African nation of Zambia experienced a 14.4% prevalence of AIDS in 2001, which was nearly double what they had experienced prior. Similar to other comparable nations, there were not enough healthcare professionals to treat the massive section of the population that needed care (Beard, 2014). The traditional physician-dependent model of distributing health care was grossly underprepared to treat such a large population. In order to address the severe human resource shortage, the Zambian Ministry of Health integrated task-shifting among providers. The program shifted work from physicians to nurses, and from nurses to community health workers, and in many cases, the workload of community health workers was shifted to family members and the general public. The success of the program

maximized the potential of health care providers at all levels and allowed for the expansion of health services in areas under severe resource constraint.

After the implementation of task-shifting, and the subsequent enrollment of 71,000 HIV-infected Zambians into ART programs, Zambia saw a drop in prevalence from 14.4% in 2001 to 12.5% in 2011, and a decrease in the death rate to HIV/AIDS from 72,000 in 2001 to 31,000 only ten years later (Suzan-Monti, 2015)

The World Health Organization recognizes the shortfall of physicians in Africa, and has also noted the success of the use of task-shifting and in collaboration with the Office of the United States Global AIDS Coordinator (OGAC), developed the WHO/OGAC Task Shifting Project. The goal of the collaboration was to develop training programs that would effectively train NPCs and more importantly to retain those health care workers (Chu, 2009). Multiple programs have adopted similar training regimens to decentralize healthcare. Nurses are trained at hospitals and medical schools to undertake a range of tasks that were formerly the responsibility of doctors. These include managing patients with HIV who have opportunistic infections (such as herpes zoster, oral thrush, diarrhea); diagnosing tuberculosis from positive sputum; prescribing medications for other varied maladies; determining whether or not patients with HIV are eligible for antiretroviral therapy; and managing patients on antiretroviral therapy. The tasks that were formerly the duty of the nurses have been shifted to medical assistants, who too are now being trained in hospitals, community health centers, and medical schools. They have been tasked with: HIV testing; counseling and education on antiretroviral therapy; monitoring and support adherence to antiretroviral therapy; triage; clinical follow-up; and varied clerical duties associated with patient adherence to therapy. In order to provide the manpower for the task-shifting model, many countries have expanded their human resources for delivering HIV and AIDS services. The personnel, who are taking over the work of the more formally trained nurses, are being trained specifically for their task (Galukande, 2013).

Current Use of NPC in Surgery

When compared to training NPCs for HIV care, training them for surgical care holds its own challenges and difficulties in providing a good medical practice. In HIV care, standardized drug regimens and lab investigation made it relatively simple to provide algorithm based medical care via a wide array of medical personnel. Task shifting in HIV care has done so well because of the development of standardized protocols and simplified clinical guidelines that drive medical decision-making.

Tanzania utilized the HIV/AIDS NPC formula to begin training medical workers in minor surgical operations. Today, NPCs are responsible for much of the surgical care in the Tanzanian district hospitals. The use of NPC's in surgery has resulted in a 46-fold increase in the workforce capacity estimations, compared to previous calculations of surgeon supply in Tanzania. (Beard, 2014). According to Beard et al., although there is a dearth of literature on the outcomes of NPC's in surgery, the known outcomes thus far have been positive. In non-obstetric medical surgical procedures, the in-hospital postoperative mortality rate was less than 2% overall. Certain surgeries had slightly higher mortality rates than others, emergency inguinal hernia repair mortality rate was 3.1%, but this was much lower than the rate of 21% in Nigeria for the same surgery (Beard, 2014).

Surgical Training Programs

Ghana was one of the first nations to utilize the practice of task-shifting. In 1969 a program was devised to train medical assistants for one year in diagnosing and treating the most common of disorders in areas where physicians were scarce. In the 1990s, doctors began informally training nurses and midwives in manual vacuum aspiration to control uterine bleeding during childbirth (Mullan, 2007). In the late 1990s, a training curriculum for health assistants to nurses was developed, and although there were delays in its implementation, the program has had success in providing a greater number of healthcare workers with minimal but sufficient medical technique training (Mullan, 2007). A majority of the programs aimed at training mid level medical workers are algorithm based in order to ensure ease of implementation in regions where the general population has little context for medical care delivery.

Médecins Sans Frontières (MSF) is one of the best-known organizations for providing medical care in underserved countries, and has been providing healthcare in Somalia since the 1980's. Somalia has been a difficult country in which to provide medical support in the form of foreign-born physicians, as is the common practice of MSF. In order to provide surgical care for a population grossly underserved by its medical force, MSF engaged in initiating a task-shifting model. MSF established a hospital was established in Galguduud Somalia, the point of which was to reduce the surgical mortality due to complications of pregnancy and child-birth, and from violent and non-violent trauma (Chu, 2011). MSF employed expatriate surgeons and anesthesiologists to establish safe surgical practices regarding sterilization of instruments, stocking essential medications, organizing the surgical theatre, and procuring blood products. They developed guidelines for antibiotic therapy, indications for surgery, and began to train the local health authorities, the majority of whom were not actual physicians in surgical and anesthesia skills (Chu, 2011)

MSF was forced to leave Somalia in 2008, two years after establishing their hospital in central Somalia due to the death of several MSF employees. Since then this de facto NPC hospital has continued to operate, and is run remotely from Nairobi Kenya by a team of several MSF coordinators. MSF still supports a single Somali doctor who was trained in trauma surgery

by MSF, who performs a majority of surgeries at the hospital. The doctor has a nurse who was trained as an NPC who both assists the doctor, and carries out surgeries on their own. In addition, there are several anesthetic nurses who do all anesthetics (Chu, 2011)

In the two years that MSF was in-country and one year after they left, over 2000 surgeries were performed with only 8 cases of operative mortality. After 2008, all of the surgeries performed were by the Somali doctor, and the surgical nurse. In the period that the doctor and nurse worked alone 2008-2009, the perioperative mortality was lower (0.2%, 2 cases) compared to 2006-2007 (1.7%, 6 cases), when the MSF team was still in place. The majority of the cases were due to violence related trauma and accidental trauma, so many cases involved debridement or cleaning of wounds, so the staff was not completing many complex operations. However, the caseload in Somalia is very similar to that in many neighboring countries, therefore, the use of NPC's in surgery is an important consideration considering the lack of local surgeons in resource-limited settings (Chu, 2011).

Conclusion

The use of non-physician clinicians has been proven as an effective and arguably necessary practice to extend decent healthcare to populations in resource-limited settings. Mid level health workers such as nurses and medical assistants can be trained in basic and even some complex surgical interventions with good outcomes, and low perioperative mortality. NPC's were and remain imperative in the fight against HIV and AIDS, and they will continue to extend healthcare to regions of Africa that are grossly underrepresented by physicians. In this same light, medical professionals must be trained in all fields of medicine, including surgery. As the nature of injury shifts from diseases of pestilence to trauma, and those of warfare, the medical community must also shift. Following this comprehensive review is a systematic review for identifying the best protocols for initiating task-shifting programs specific to surgical intervention in medically underserved regions. It is the goal of this project to identify the most effective ways to train NPCs to carry out surgical procedures with success and low complications.

References

- Bae, Jin Yung, et al. "Surgery as a public health intervention: common misconceptions versus the truth." *Bulletin of the World Health Organization*, vol. 89, no. 6, Jan. 2011, pp. 394–394., doi:10.2471/blt.11.088229.
- Beard, J. H., Oresanya, L. B., Akoko, L., Mwanga, A., Mkony, C. A., & Dicker, R. A. (2014). Surgical Task-Shifting in a Low-Resource Setting: Outcomes After Major Surgery Performed by Nonphysician Clinicians in Tanzania. *World Journal of Surgery*, 38(6), 1398-1404. doi:10.1007/s00268-013-2446-2
- Chu, K. M., Ford, N. P., & Trelles, M. (2011). Providing surgical care in Somalia: A model of task shifting. *Conflict and Health*, 5(1), 12. doi:10.1186/1752-1505-5-12
- Chu, K., Rosseel, P., Gielis, P., & Ford, N. (2009). Surgical Task Shifting in Sub-Saharan Africa. *PLoS Medicine*, 6(5). doi:10.1371/journal.pmed.1000078
- Cumbi, A., Pereira, C., Malalane, R., Vaz, F., Mccord, C., Bacci, A., & Bergström, S. (2007). Major surgery delegation to mid-level health practitioners in Mozambique: health professionals perceptions. *Human Resources for Health*, 5(1). doi:10.1186/1478-4491-5-27
- Gajewski, J., Mweemba, C., Cheelo, M., Mccauley, T., Kachimba, J., Borgstein, E., . . . Brugha, R. (2017). Non-physician clinicians in rural Africa: lessons from the Medical Licentiate programme in Zambia. *Human Resources for Health*, 15(1). doi:10.1186/s12960-017-0233-0
- Galukande, M., Kaggwa, S., Sekimpi, P., Kakaire, O., Katamba, A., Munabi, I., . . . Luboga, S. (2013). Use of surgical task shifting to scale up essential surgical services: a feasibility analysis at facility level in Uganda. *BMC Health Services Research*, 13(1). doi:10.1186/1472-6963-13-292
- Hoyler M., Hagander L., Gillies R., Riviello R., Chu K., Bergstrom S., Meara J., (2015). Surgical care by non-surgeons in low-income and middle-income countries: a systematic review. *Surgical Human Resources for Health* (45)
- Kushner, Adam L. "Addressing the Millennium Development Goals From a Surgical Perspective." *Archives of Surgery*, vol. 145, no. 2, Jan. 2010, p. 154., doi:10.1001/archsurg.2009.263.
- Lassi, Z. S., Cometto, G., Huicho, L., & Bhutta, Z. A. (2013). Quality of care provided by mid-level health workers: systematic review and meta-analysis. *Bulletin of the World Health Organization*, 91(11). doi:10.2471/blt.13.118786

- Linden, A. F., Sekidde, F. S., Galukande, M., Knowlton, L. M., Chackungal, S., & Mcqueen, K. A. (2012). Challenges of Surgery in Developing Countries: A Survey of Surgical and Anesthesia Capacity in Uganda's Public Hospitals. *World Journal of Surgery*, 36(5), 1056-1065. doi:10.1007/s00268-012-1482-7
- Mcpake, B., & Mensah, K. (2008). Task shifting in health care in resource-poor countries. *The Lancet*, 372(9642), 870-871. doi:10.1016/s0140-6736(08)61375-6
- Mullan, F., & Frehywot, S. (2007). Non-physician clinicians in 47 sub-Saharan African countries. *The Lancet*, 370(9605), 2158-2163. doi:10.1016/s0140-6736(07)60785-5
- Ogediz D., Kihhambu M., Galukande M., Dubowitz G., Mabwaijano J., Mijumbi C., Cherian M., Kaggwa S., Luboga S. (2008) Africa's neglected surgical workforce crisis. *The Lancet*, 371
- Suzan-Monti, M, et al. "Benefits of task-Shifting HIV care to nurses in terms of health-Related quality of life in patients initiating antiretroviral therapy in rural district hospitals in Cameroon [Stratall Agence Nationale de Recherche sur le SIDA (ANRS) 12110/Ensemble pour un." *HIV Medicine*, vol. 16, no. 5, 2015, pp. 307–318., doi:10.1111/hiv.12213.
- Weiser, Thomas G, et al. "An estimation of the global volume of surgery: a modeling strategy based on available data." *The Lancet*, vol. 372, no. 9633, 2008, pp. 139–144., doi:10.1016/s0140-6736(08)60878-8.

Systematic Review

Introduction and Significance

According to the World Health Organization, Africa currently harbors one quarter of the world's disease burden and maintains only one percent of the world's health workforce (Weiser, 2008). Of that burden, violence, injury from traffic accidents, and obstetric emergencies are the leading causes of morbidity and mortality. These leaders of mortality are medical emergencies that often times may be treated with surgical intervention. Surgically trained physicians however are proportionally misrepresented in many African countries, often in a healthcare workforce that is already grossly inadequate. Large regions of Africa have a generalized lack of physicians, and most of those physicians are grouped in the metropolitan areas, leaving rural Africa with inadequate medical care. When specialist physicians are taken into account, that disparity becomes wholly inadequate for the population. On a global scale surgical care has been neglected for being too expensive and difficult to implement on a global scale and still be cost-effective. Historically, global health initiatives have been focused on long-term problems like nutrition, treating chronic disease, and addressing basic healthcare needs. For such a large population with so few physicians the impetus is on treating the most with what is available. More recently however, the World Health Organization has noted that the cost-effectiveness of surgical intervention may in fact rival that of some long-term public health projects (Weiser 2008). This is due to an epidemiologic shift from disease of populations, to more acute injuries due to childbirth, automobile accidents, and more recently an increase of trauma due to increased mechanization brought by foreign investment. The World Health Organization has stated that increasing surgical care is not only an imperative, but that gaps in access must be identified and rectified, and that an implementation must be economically feasible. One of the major facets of the global push for increased surgical care in low and middle income countries (LMIC) is to utilize a program borrowed from the response to the AIDS crisis of the late 1980's and 1990's, during which non-physician clinicians (NPC's) were utilized to broaden the healthcare workforce. NPC's were often mid-level healthcare workers including nurses, nursing assistants and medical assistants who were trained in specific duties in the care of the increasing burden of sick patients. This shift in the workload freed the professionally

trained physicians to focus on caring for higher risk patients, and plan strategies in order to treat the largest number of patients. More recently this practice has been utilized to some effect to increase the access to surgical care in Africa and extend the reach of the few trained surgeons who practice there.

Paul Farmer the director of the NGO, Partners in Health, which has long been at the forefront of global health, has referred to surgery as the “neglected stepchild of global health.” (Kushner, 2010) It is estimated that of the 234 million surgeries occurring worldwide per year, only 26% take place in the poorest counties (Weiser, 2008). According to Farmer, the lack of surgical intervention is responsible for up to 15% of global disability-adjusted life years (DALY), and that complications from surgery are one of the top 15 causes of disability worldwide (Bae, 2011). One of the chief difficulties in providing surgical care, defined by Chu et al 2009, as safe provision of pre-operative, operative, and post-operative surgical and anesthesia services in resource limited settings, is the shortage of trained surgical professionals (Chu, 2009). Often times, surgical equipment and proper sterile products can be imported into high need areas, but without proper personnel to operate, there is a breakdown in the accessibility and safety of surgical care. In addition there are documented inadequacies in many countries including the lack of competitive salaries as compared to wealthier nations. In East Africa, there are 0.25 fully trained surgeons per 100,000 persons as compared to 5.69 per 100,000 in the United States (Weiser, 2008). Surgery in many sub-Saharan African nations is often overlooked due to the lack of the most basic care that takes precedent. In Uganda, a country that the WHO has deemed as having a severe shortage of healthcare workers for its needs, there are only 0.4 healthcare workers, including all physicians, mid-wives, nurses, technicians and medical aides per 1000 people. As a comparison, the WHO has noted that any country with fewer than 2.28 healthcare workers per 1000 population is considered to have a severe shortage (Weiser, 2008). This shortage of even the most basic of a healthcare workforce means that coverage of essential interventions is unlikely. Uganda’s neighbors fare no better. The Central African Republic has only 0.08 physicians per 1000 persons; Ethiopia and Sierra Leone have 0.03 per 1000, and Tanzania 0.02 per 1000 people. In total, according to a WHO bulletin on healthcare worker shortage in Africa, for 12 of the poorest countries there is an average of 0.09 physicians per

1000 persons (Weiser, 2008). This shortage directly correlates to the outcomes of many medical and surgical procedures. With fewer physicians for a population, there are fewer physicians able to provide surgical services.

One surgical procedure is completed for every 371 people in Ugandan hospitals as compared to one per 25 people in hospitals worldwide (Linden, 2012). Nearly 75% of all surgeries performed in Uganda are emergency surgeries, and there are not enough Ugandan physicians trained in emergent surgery to properly respond to the need (Linden, 2012). Due to the lack of proper training for many mid-level health-care workers, there is a burden of work that falls on the surgeons and other physicians to partake in minor surgical cases, including wound debridement and management, suturing and dressing changes for minor trauma, and other less critical objectives which precludes them from some of the more specialized abdominal surgery or orthopedic surgeries (Linden, 2012).

This shortage of health care workers to manage low-acuity problems, coupled with the lack of a sufficient physician force is one of the reasons that many health ministries are looking toward task-shifting in an attempt to address such a gross inadequacy. Task shifting is one direction used to share the burden of the health crisis to less-trained mid-level providers. By training non-physician clinicians (NPC) to operate in minor surgical procedures, the classically trained surgeons are freed up to focus their work on more acute and involved cases, and narrow the gap of inadequate surgical care in Africa.

Historically non-physician clinicians have been practicing in Africa since the 1950s. Ethiopia was the first African nation to institute an official education program for NPCs in 1954 (Cumbi, 2007). Mozambique saw a mass exodus of physicians during a civil war that began in 1977 and lasted through the 1990s, and a de-facto cadre of NPC's grew out of desperation. Perhaps most successful was a commitment to primary health development in 1969 in Ghana that included the establishment of the Ghana Rural Health Service (Mullan, 2007). The Rural Health Service trained health center superintendents in the basics of healthcare and dispatched them to the most remote and rural parts of the country. As the global disease burden shifted throughout the century, the roles of NPCs changed and became less of a strictly rural health provider and were shifted to providing care in the new metropolitan centers of Africa. The

global HIV and AIDS crisis that began in the 1980s and 1990s brought NPCs into the spotlight as the most effective form of public health delivery. According to regional statistics by the United Nations, sub-Saharan Africa accounts for more than 23.5 of the 34 million people living with HIV and AIDS globally (Suzan-Monti, 2015) Coupled with the severe shortage of physicians, countries began to adopt the care model of task shifting by rationally distributing tasks from more specialized to less specialized health workers. Task-shifting improved access to antiretroviral treatment from 6.6 million people with HIV in 2010 to 8 million people in 2011 a 20% increase in only one year (Suzan-Monti, 2015).

The World Health Organization recognizes the shortfall of physicians in Africa, and has noted the success of the use of task-shifting in differing areas of healthcare. In collaboration with the Office of the United States Global AIDS Coordinator (OGAC), the WHO has developed the WHO/OGAC Task Shifting Project. The goal of the collaboration has been to develop training programs that would effectively train and retain NPCs in the countries most severely affected by the health care shortfall (Chu, 2009). Multiple programs have adopted similar training regimens to the WHO/OGAC Project in order to decentralize health care. Through this program, nurses are trained at hospitals and medical schools to undertake an increasing role in the treatment of certain diseases that historically fell under the responsibility of a physician. The tasks of the nurses have greatly shifted to medical assistants, who too are being trained in hospitals, health centers and medical schools to carry out more basic functions. There exists a hole in the data regarding a comprehensive view on how NPC's are viewed in the field, and how they contribute to providing surgical care to the most needs populations in Africa. The following review examines the feasibility of using NPC's in the surgical theatre and the accomplishments and shortfalls of the use of task-shifting in surgery in Africa.

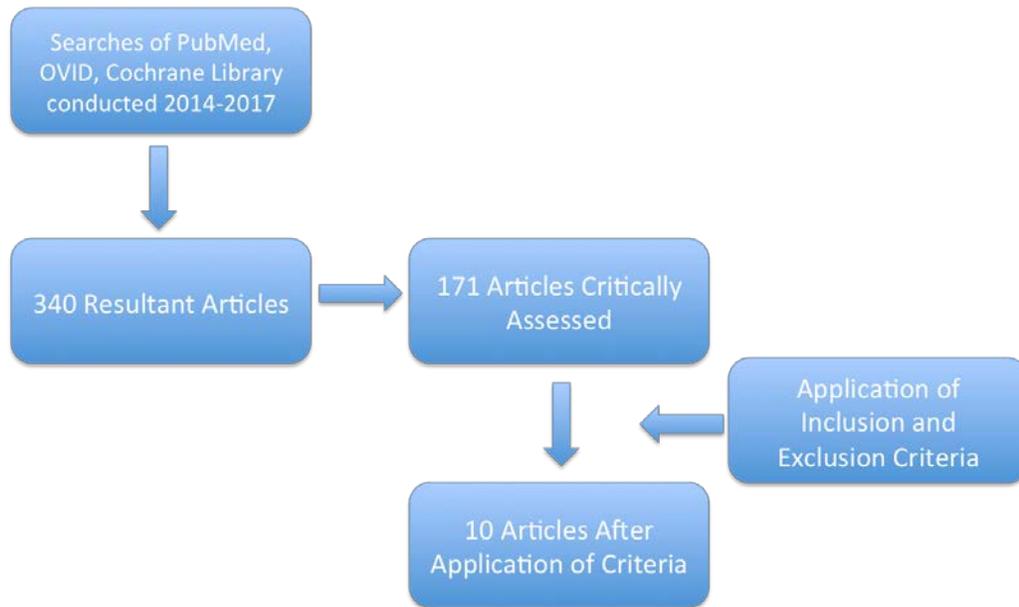
Methods

Three databases were used to collect data for this systematic review. Data were collected periodically from June 2014 through January 2017 by searching specific terms on PubMed, OVID, the Cochrane Library. The specific terms used were: “*Task shifting surgery; Task shifting surgery Africa; Task shifting value; Non-physician clinicians surgery.*” The collected papers were read and included or excluded based on certain inclusion and exclusion criteria. In order to ensure the quality and validity of the articles used, only peer-reviewed journals printed in English were used. For a publication to be considered it had to contain controlled clinical trials if relevant. In the initial search, over 340 articles resulted, and when critically assessed for redundancy, relevance and English language, that number fell to 171. With the application of the inclusion and exclusion criteria that number fell to 10 appropriate articles in support of a systematic review. Inclusion and exclusion criteria are elucidated in *Table 1* and a chart regarding article selection is seen in *Figure 1*. Each article chosen was critically analyzed for the advantages of utilizing task shifting in surgery, the challenges faced by either the programs training the NPCs, or the NPCs themselves, and the places for improvement in using task-shifting to increase surgical care in Africa. The results of this assessment are found in the “Results” section as well as summarized in *Table 2*.

Table 1: Inclusion/Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
<ul style="list-style-type: none"> - Includes information regarding NPC's in Africa and their utilization in surgery or peri-surgical treatment 	<ul style="list-style-type: none"> - Study not related to surgery or peri-surgical outcomes, or to task shifting and the uses of NPC's in surgery
<ul style="list-style-type: none"> - Includes information regarding the positive or negative aspects of utilizing task-shifting and NPC's in surgery in Africa 	<ul style="list-style-type: none"> - Study published prior to 2000
<ul style="list-style-type: none"> - Takes into account the accounts of individual surgical task-shifting programs in African regions 	<ul style="list-style-type: none"> - Study performed in resource-rich nation

Figure 2: Process for data collection and study selection



Results

The results of this systematic review can be divided into several main categories. The studies focused on the advantages of utilizing task-shifting in the surgical theatre, the challenges specific to the use of task-shifting in surgery, and the places for improvement in utilizing task-shifting to increase the depth of surgical care in Africa.

The advantages of utilizing task-shifting to train non-physician clinicians in the operating theatre were well described. All ten of the studies described the use of NPCs as beneficial in increasing the number of qualified members of the surgical workforce. The studies were unanimous in describing the increase in surgical care, and the benefit of having more people qualified to perform surgeries. The given lack of surgeons was a commonality between all of the studies, and the use of NPCs, regardless of training level would increase surgical care by presence alone. But Linden 2012 described the increase and usefulness of NPCs was impressive especially in the setting of so few support resources.

The challenges specific to utilizing task-shifting in the operating room were similar amongst the studies. Gajewski 2012 employed in-depth interviews to characterize the challenges of the Medical Licentiate program in Zambia, which trained and licensed the NPCs. Gajewski noted that one of the most common complaints amongst the NPCs was a lack of respect from surgeons and other physicians. All ten of the studies noted a lack of supervision as a common problem. Half of the studies named a lack of upward mobility or inability to properly compensate NPCs as a problem to retaining a sufficient enough task-shifting workforce.

The places where surgical task-shifting could be improved were similar among the ten studies. While no one study specifically stated an improvement plan, Galukande 2013 stated that the efforts to train and retain NPCs were supported by the existing health workforce, but that increased oversight and training were needed to retain the NPCs. Gajewski 2017 also noted that increasing the support and training for the NPCs would aid in retaining workers in areas where healthcare was grossly inadequate. Six of the 10 studies noted adequate oversight and training as an area of improvement going forward with expanding the role of NPCs in Africa.

Table 1 – Studies included in Systematic Review

Author /Date	Location	Number Trained	Training Methods	Length of Training	Assessment of Training?	Results
Fehling 2013 ^[13]	South Sudan	33 FHW	Needs assessment	5 days	No	NA
Nelson 2012 ^[14]	South Sudan	708 FHW, 72 trainers	Pictorial checklists and physical exam training.	8 days for trainers, 5 days for FHWs	Yes, OSCE assessment with pre & post-exam.	Mean OSCE scores were increased 2-3 months after training for maternal assessments while mean OSCE scores were unchanged 2-3 months post training for infant assessments.
Uzochukwu 2008 ^[15]	Nigeria	32 CHW	Classroom, simulation and clinical training.	4 days, 8 hours each	Yes, written exam and clinical observation, management compared to physician diagnosis and treatment.	Better able to assess and classify the child and begin proper treatment for malaria, measles, diarrhea and pneumonia.
Kelly 2001 ^[16]	Kenya	336 CHW	Classroom training with flowsheets and protocols, video and clinical training.	3 weeks with 1 week refresher course	Yes, clinical observation and interviews.	CHW post training clinical assessment scores did not improve after training.
Kumar 2008 ^[17]	India	35 CHW 8 days 50 CHW 5 days	Group discussions, video demonstration and role play.	5 days vs 8 days	Yes, written examination.	Post-training scores were increased identically for 5-day vs 8-day training.
Puette 2013 ^[18]	Bangladesh	179 CHW	Protocol training regarding severe acute malnutrition, monthly supervision visits and refreshers .	2 days	Yes, monthly supervision visits and interviews of CHW.	89% of CHW had >90% error free case management of severe acute malnutrition post training.
Ohnmar 2012 ^[19]	Myanmar	23 CHW	Educational flipchart training in recognition of malaria.	2 days	Yes, written test.	Increased diagnosis and proper treatment of malaria, no decrease in time to treatment.
Kalyango 2012 ^[20]	Uganda	125 CHW	Clinical scenarios, case reviews and written exams.	6 days	Yes, meeting with supervisors and written exams.	Training improved recognition of malaria and PNA.
Chaudhary 2005 ^[21]	India	54 CHW	Follow-up refresher courses after initial training with group discussion, video demonstration and role playing.	1 day after initial 5-day course.	Yes, record reviews, observation and supervisor assessments.	Follow-up refresher courses at shorter intervals help increase retained knowledge.
Anand 2004 ^[22]	India	15 CHW	Classroom training, video demonstration and clinical teaching.	3 days with a refresher training 1 month later.	Yes, pre-training assessment, post-training and refresher.	Training improved CHW knowledge and management – no mortality benefit in region.
Rowe 2006 ^[23]	Kenya	114 CHW	10 days of lectures, reviewing case scenarios and role playing, 5 days of clinical practice	15 days initial training with 6-15 day refresher course 3 months later.	Yes, clinical observation and interviews.	Training increased treatment quality, refresher course did not improve retention.
Thompson 2008 ^[24]	Armenia	387 CHW	Classroom based teaching of clinical signs, symptoms and basic public health principles.	16 hours.	Yes, Evaluation of health literacy of the community in which trained workers lived.	Increase community's health literacy of breast feeding, immunization rates and HIV awareness in community.
Hamer 2012 ^[25]	Zambia	18 CHW	Lectures, role playing, supervised clinical practice and hands-on training with malaria lab test.	5 days with 2 day refresher course 6 months later.	Yes, Practical skills assessment.	CHW can accurately diagnose and treat malaria with rapid diagnostic tests.
Hadi 2003 ^[26]	Bangladesh	120 CHW	Classroom lectures concerning signs and symptoms of acute respiratory infections and record-keeping training.	3 days with a 1 day refresher 1 month post training.	Yes, CHW diagnosis compared with physician diagnosis.	CHWs are able to accurately diagnose and refer patients to higher levels of care.
Le Loux 2010 ^[27]	South Africa	65 CHW	Classroom based training of growth chart completion, recognition of child abuse and helping mothers bond with their babies.	1 month	Yes, supervised home visits during month of training.	Statistically more infants reached normative weight in the group reached by the CHW.

Discussion

There is a defined lack of surgical access in Africa, which results in an increased morbidity and mortality from pathophysiology that could be addressed with surgical intervention. As such, there is a benefit to using non-physician clinicians to increase the surgical workforce in Africa. By utilizing task-shifting and training lower level cadres to participate in surgical operations, resource poor countries were able to increase the accessibility of general and specialized surgical services. Linden 2012 described the breadth to which NPCs performed nearly all of the surgeries in Uganda, and how impressive the capabilities were even in a country with little infrastructure.

Many of the studies addressed in this review assessed the difficulties faced by NPCs in resource poor countries. It was common that many of the NPC's felt as though they lacked enough support from their government or superiors. Often times this was mirrored by a distrust of the NPCs by staff surgeons who did not feel as though the NPCs were trained well enough, or had sufficient continuing education to keep them up to date. In addition many described low morale amongst the NPCs as a detractor to the programs, however this was only in two of the 10 studies and in countries with high levels of violence and unrest.

A major limitation to this study is verifiable data. Many countries in Africa utilize some sort of task-shifting program in order to increase their health corps. This includes NPC's to work as general clinicians, assists with labor and delivery, pediatrics, and also with surgery. While the NPC's trained in surgery often require higher levels of training and subsequent associated costs, there exists a dearth of data on the actual training programs beyond the level of education provided in each country. In addition, each country has its own task-shifting program often derived from that countries individual response to the AIDS crisis which makes data regarding generalized use of lower quality.

Conclusion and Future Direction

The conclusion to be drawn from this systematic review is that task-shifting as a means to increase surgical care in Africa and increase the accessibility to even the most basic of surgical care can be effective. However, in order to maintain task-shifting as a viable option to increase the surgical workforce, steps must be taken to ensure that a sufficient number of NPC's are properly trained and provided with a positive environment designed to increase the knowledge of, and retain qualified NPC's. There is a growing global literature base characterizing the use and advantage of NPC's in different aspect of healthcare, and the use of task-shifting is a proven way to ameliorate the lack of surgical care in countries that have so little to provide patients that require surgery. At this point the data is fragmented and given that each country has its own individual plan for training NPC's it is difficult to equate studies to one another.

A major hole in the literature is the effectiveness of individual training programs for NPC's in different countries. Assessing different methods and the advantages that they have in producing a more stable surgical workforce is necessary to continue to train effective NPC's in Africa. The impact this study has on the literature is that it demonstrates the known fact that the act of task-shifting increases the accessibility to surgical care, and that the challenges to task-shifting are multi-faceted. This study elucidates the difficulties with training and retaining NPC's who perform surgical operations and care. Finally there is a clear need for more robust studies to determine the most effective methods for training a cadre of NPC's in surgical care.

References

- Bae, Jin Yung, et al. "Surgery as a public health intervention: common misconceptions versus the truth." *Bulletin of the World Health Organization*, vol. 89, no. 6, Jan. 2011, pp. 394–394., doi:10.2471/blt.11.088229.
- Beard, J. H., Oresanya, L. B., Akoko, L., Mwanga, A., Mkony, C. A., & Dicker, R. A. (2014). Surgical Task-Shifting in a Low-Resource Setting: Outcomes After Major Surgery Performed by Nonphysician Clinicians in Tanzania. *World Journal of Surgery*, 38(6), 1398-1404. doi:10.1007/s00268-013-2446-2
- Chu, K. M., Ford, N. P., & Trelles, M. (2011). Providing surgical care in Somalia: A model of task shifting. *Conflict and Health*, 5(1), 12. doi:10.1186/1752-1505-5-12
- Chu, K., Havet, P., Ford, N., & Trelles, M. (2010). Surgical care for the direct and indirect victims of violence in the eastern Democratic Republic of Congo. *Conflict and Health*, 4(1), 6. doi:10.1186/1752-1505-4-6
- Chu, K., Rosseel, P., Gielis, P., & Ford, N. (2009). Surgical Task Shifting in Sub-Saharan Africa. *PLoS Medicine*, 6(5). doi:10.1371/journal.pmed.1000078
- Cumbi, A., Pereira, C., Malalane, R., Vaz, F., Mccord, C., Bacci, A., & Bergström, S. (2007). Major surgery delegation to mid-level health practitioners in Mozambique: health professionals perceptions. *Human Resources for Health*, 5(1). doi:10.1186/1478-4491-5-27
- Dambisya, Y. M., & Matinhure, S. (2012). Policy and programmatic implications of task shifting in Uganda: a case study. *BMC Health Services Research*, 12(1). doi:10.1186/1472-6963-12-61
- Gajewski, J., Mweemba, C., Cheelo, M., Mccauley, T., Kachimba, J., Borgstein, E., . . . Brugha, R. (2017). Non-physician clinicians in rural Africa: lessons from the Medical Licentiate programme in Zambia. *Human Resources for Health*, 15(1). doi:10.1186/s12960-017-0233-0
- Galukande, M., Kaggwa, S., Sekimpi, P., Kakaire, O., Katamba, A., Munabi, I., . . . Luboga, S. (2013). Use of surgical task shifting to scale up essential surgical services: a feasibility analysis at facility level in Uganda. *BMC Health Services Research*, 13(1). doi:10.1186/1472-6963-13-292
- Hoyler M., Hagander L., Gillies R., Riviello R., Chu K., Bergstrom S., Meara J., (2015). Surgical care by non-surgeons in low-income and middle-income countries: a systematic review. *Surgical Human Resources for Health* (45)

- Kushner, Adam L. "Addressing the Millennium Development Goals From a Surgical Perspective." *Archives of Surgery*, vol. 145, no. 2, Jan. 2010, p. 154., doi:10.1001/archsurg.2009.263.
- Lassi, Z. S., Cometto, G., Huicho, L., & Bhutta, Z. A. (2013). Quality of care provided by mid-level health workers: systematic review and meta-analysis. *Bulletin of the World Health Organization*, 91(11). doi:10.2471/blt.13.118786
- Linden, A. F., Sekidde, F. S., Galukande, M., Knowlton, L. M., Chackungal, S., & Mcqueen, K. A. (2012). Challenges of Surgery in Developing Countries: A Survey of Surgical and Anesthesia Capacity in Uganda's Public Hospitals. *World Journal of Surgery*, 36(5), 1056-1065. doi:10.1007/s00268-012-1482-7
- Livingston, M. H., Dacruz, J., Pemberton, J., Ozgediz, D., & Poenaru, D. (2015). Mortality of pediatric surgical conditions in low and middle income countries in Africa. *Journal of Pediatric Surgery*, 50(5), 760-764. doi:10.1016/j.jpedsurg.2015.02.031
- Mcpake, B., & Mensah, K. (2008). Task shifting in health care in resource-poor countries. *The Lancet*, 372(9642), 870-871. doi:10.1016/s0140-6736(08)61375-6
- Mullan, F., & Frehywot, S. (2007). Non-physician clinicians in 47 sub-Saharan African countries. *The Lancet*, 370(9605), 2158-2163. doi:10.1016/s0140-6736(07)60785-5
- Sani, R., Sanoussi, S., Didier, J. L., Salifou, G. M., & Abarchi, H. (2013). Rural Surgery in Niger: A Multicentric Study in 21 District Hospitals. *Indian Journal of Surgery*, 77(S3), 822-826. doi:10.1007/s12262-013-1015-0
- Suzan-Monti, M, et al. "Benefits of task-Shifting HIV care to nurses in terms of health-Related quality of life in patients initiating antiretroviral therapy in rural district hospitals in Cameroon [Stratall Agence Nationale de Recherche sur le SIDA (ANRS) 12110/Ensemble pour un." *HIV Medicine*, vol. 16, no. 5, 2015, pp. 307–318., doi:10.1111/hiv.12213.
- Tyson, A. F., Msiska, N., Kiser, M., Samuel, J. C., Mclean, S., Varela, C., & Charles, A. G. (2014). Delivery of operative pediatric surgical care by physicians and non-physician clinicians in Malawi. *International Journal of Surgery*, 12(5), 509-515. doi:10.1016/j.ijisu.2014.02.009
- Weiser, Thomas G, et al. "An estimation of the global volume of surgery: a modeling strategy based on available data." *The Lancet*, vol. 372, no. 9633, 2008, pp. 139–144., doi:10.1016/s0140-6736(08)60878-8. doi:10.1016/j.ijisu.2014.02.009