Perfusion Practice in Kenya

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Abstract: Standards and guidelines for cardiopulmonary bypass have been established by various professional societies. They serve as an instrument to guide safe and effective patient care. We conducted a survey of practicing perfusionists in Kenya to learn about their background, education, current clinical practice and about their knowledge, and attitude regarding standards and guidelines. Two multiple-choice surveys were distributed to all known practicing perfusionist in Kenya using SurveyMonkey (San Mateo, CA). Multiple-choice questions related to professional background, training, annual procedure volume, staffing models, clinical practices, the use of safety devices, and the use of checklists were included in the questionnaires. The survey also inquired about familiarity with American and European perfusion practice standards and guidelines and opinions on establishing standards in Kenya. Responses were received from 12 perfusionists practicing at 10 centers. Professional backgrounds included anesthesia nursing, clinical officers, and critical care nursing. Sixty-seven percent (8/12) received formal training and 33% (4/12) trained primarily through clinical instruction. Of those that received formal training, 63% (5/8) received 1–2 years of training, 25% (2/8) <1 year but more than 6 months, and 12.5% (1/8) received 6 months of formal training. The median clinical experience was 5 years (range 1–22). The median annual case load was 54 (range 0–100). Use of safety devices was reported as follows: level sensor 75% (9/12), air bubble detector 17% (2/12), one-way vent valves 67% (8/12), continuous venous oxygen saturation monitoring 25% (3/12), and gas supply analyzers 33% (4/12). More than one-third of the respondents had no knowledge of the American and European perfusion practice standards, and nearly two-thirds were aware of or had read them. This survey provides contextual information about perfusion practice in Kenya in 2021. There was consensus among perfusionists to develop standards and practice guidelines for Kenya. Keywords: standards, guidelines, perfusion practice, perfusion education.

According to Vervoort and colleagues, there are an estimated 4.5 billion people in the world without access to open-heart surgery, justifying the need to increase human and physical resources to expand cardiac surgery capacity (1). At the present time, the only effective treatment for symptomatic rheumatic heart disease is open-heart surgery, yet that lifesaving cardiac surgery is absent in many endemic regions like Kenya (2). In Kenya, access to open-heart surgery is limited because of the small number of cardiac surgery programs and the very limited number of cases done at those centers. Several of the more rural programs only operate when a team visits from abroad or when one of the urban Kenyan programs sends a team. Kenya is a country located in the eastern part of Sub-Saharan Africa (SSA) and has a population of approximately 55 million people (3). Recent epidemiological studies have shown that the burden of cardiovascular diseases (CVDs) is increasing in SSA with available projections suggesting that within a few decades from now CVDs and other noncommunicable diseases will overtake communicable diseases as the most frequent cause of death in this region (4). Furthermore, SSA has one of the highest rates of rheumatic heart disease in the world and has 23% of the world’s prevalent cases (8.9 million of the world’s 39.3 million estimated cases in 2017 were in SSA) (5).

The first reported open-heart surgical procedure with cardiopulmonary bypass (CPB) in Kenya was closure of an atrial septal defect, and it took place on May 27, 2021.
1975 (6). Much of the early open-heart surgery in Kenya was done with the assistance of visiting cardiac teams from other countries. Over time, programs developed more expertise and began operating independently; however, the growth of cardiac programs, in number and case volume, has been slow. Currently, there are 10 hospitals in Kenya that have open-heart surgery capabilities. Less than one-fourth of these programs do more than 100 open-heart surgery procedures per year. In a review of the first 10 years of cardiac surgery in Kenya published in 1992, Odhiambo listed shortage of technical staff, myocardial protection problems, and perfusion pump malfunctions among the leading contributors to mortality (6). These factors persist in creating challenges for cardiac surgery programs in Kenya today.

We conducted a survey to learn about current perfusionist training and practices in Kenya. We were particularly interested in perfusionist’s medical background, training, clinical annual case load, and staffing models. We were also interested in certain perfusion practices, the current use of various techniques, including safety devices and the use of checklists.

Standards and guidelines ranked by level of evidence have been established by perfusionist professional societies in various regions of the world (7–10). They serve to inform cardiac teams about what practices should be done, what practices should be considered, and those practices that may put patients at risk and should be avoided when providing extracorporeal support to patients. The aim of the survey was to establish a snapshot of current perfusion practice from the perspective of those currently providing care in this domain in Kenya. We also wanted to know about Kenyan perfusionists’ awareness of published standards and guidelines for perfusion and their attitude about establishing practice standards and guidelines for Kenya.

**METHODS**

A survey research proposal was developed, submitted, and ultimately approved by the Tenwek Hospital Institutional Ethics Review Committee (EIRB Protocol #2021–0017). An e-mail list of all known adult and pediatric perfusionists, currently practicing, in Kenya was compiled. Two surveys were developed using SurveyMonkey (San Mateo, CA). The first survey was comprised of 16 questions related to program demographics and techniques (see Appendix I). A link to the survey was sent by e-mail to all 12 practicing perfusionists in Kenya on January 3, 2021. Reminders were sent to nonrespondents. A second survey comprised of 10 questions related to perfusion training and background, annual procedure volume and familiarity with published standards and guidelines from the American Society of ExtraCorporeal Technology and the joint standard from the 2019 European Association for Cardio-Thoracic Surgery (EACTS)/European Association of Cardiothoracic Anaesthesiology (EACTA)/European Board for Cardiovascular Perfusion (see Appendix II) (11). The second survey was sent to all practicing Kenyan perfusionists on January 19, 2021.

To maintain confidentiality, respondent identifiers and the identity of the centers where they practice were removed. Categorical variables were reported as percentage of total responses. All continuous variables were reported as median values along with the range.

**RESULTS**

The map in Figure 1 shows the geographic location of the 10 active cardiac centers in Kenya. Responses were received from 12 perfusionists practicing at 10 centers (11/12 Survey I and 12/12 Survey II, with an overall response rate of 92%). Professional backgrounds included certified anesthesia nurse (25%), anesthetist clinical officer* (42%), other clinical officer (17%), critical care nursing (8%), and registered nurse (8%). Sixty-six percent (8/12) received formal training (comprised of didactic, clinical observations, and clinical instruction) and 33% (4/12) trained primarily through clinical instruction (trained-on-the-job). Of those that received formal training, 63% (5/8) received 1–2 years of training, 25% (2/8) < 1 year but ≥6 months, and 12.5% (1/8) received ≤6 months of formal training. Of those formally trained, 57% (4/7) trained in India, 28% (2/7) trained in Egypt, and 14% (1/7) trained in Malaysia. The median years of clinical experience was five (range 1–22). The median annual case load by perfusionist was 54 (range 0–100). Respondents reported on the approximate number of annual cardiac procedures done with CPB at their center. Eighteen percent (2/11) reported that an annual case load of less than 10 cases/year are done at their center. Eighteen percent (1/11) reported that an annual case load of 11–15 procedures per year is done at their primary center. Forty-five percent (5/11) reported that they do 51–99 cases/year at their primary center and only 18% (2/11) reported that their primary center performs 100 or more cases/year. Forty-two percent (5/12) of the respondent reported working at more than one hospital. Respondents reported on the various types of procedures are done at their centers (see Figure 2).

Seventy-five percent (9/12) reported working with a staffing model where two perfusionists were in the operating room during CPB and 25% (3/12) reported a staffing model of three perfusionists in the operating room during an open-heart procedure. Use of safety devices was

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*In the Kenya Health System, a clinical officer is an alternative practitioner who is trained and authorized by law to perform any technical, administrative, or legal duties that require a medical doctor.
which of the following safety devices are routinely used at your center?

<table>
<thead>
<tr>
<th>Device</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Arterial O2</td>
<td>33%</td>
</tr>
<tr>
<td>Continuous Venous O2</td>
<td>25%</td>
</tr>
<tr>
<td>Gas line Oxygen Analyser</td>
<td>33%</td>
</tr>
<tr>
<td>One-Way Purge Arterial Line Filter</td>
<td>75%</td>
</tr>
<tr>
<td>One-way Vent Valve</td>
<td>67%</td>
</tr>
<tr>
<td>Air Bubble Detector</td>
<td>17%</td>
</tr>
<tr>
<td>Level Detector</td>
<td>75%</td>
</tr>
</tbody>
</table>

Figure 1. Respondents reported that they worked at one or more of 10 centers in Kenya.

Figure 2. The most often reported safety devices used were level detectors and one-way purge lines on the arterial line filter and one-way valves on the left ventricular vent tubing.
in Kenya have a background as a either a certified nurse anesthetist or a clinical officer. Two-thirds of the respondents indicated that they had formal training of between 1 month and 2 years. Since there were no formal perfusion training programs in Kenya at the time of this survey, all the formally trained Kenyan perfusionist had to go abroad to receive their training. These programs also reported varying amounts of observation, didactic instruction, and actual hands on training. The various pathways to training, some as brief as a few months, undoubtedly lead to broad blend of clinic approaches to perfusion care. For example, the reported use of all types of safety devices was quite low compared to North America and Europe (12). Since there is no licensure or certification of perfusionist in Kenya, there is no benchmark or minimal standard of what is included in the curriculum, how much clinical education is provided in the training, and how carefully students are evaluated to determine if they are competent. One-third of the respondents did not receive formal training. Their training was strictly clinical training in perfusion, sometimes referred to as “on-the-job-trained,” a pathway that is even more uncertain since this type of training lacks structure and external oversight.

Recognizing the need for perfusionist education in Kenya, an intramural perfusion training program was started at Tenwek Hospital. The current program is offered to candidates who have experience as anesthesia clinical officers or anesthesia nurses. The program is comprised of 80 hours of lecture, completion of 80 proctored clinical cases and successful completion of a written and oral examination. In 2022, high-fidelity clinical simulation using the Califia Perfusion Simulator (Biomedical Simulation Inc., San Diego, CA) will be added to the curriculum.† Clinical simulation offers


The trainee exposure to a vast array of clinical situations and is particularly advantageous in a setting where actual clinical training opportunities may be limited. The simulator will also be used for team-based simulations and to improve the performance of currently practicing perfusionists.

The history of perfusion education in the United States followed a similar pathway. In the United States before 1975, many perfusionists were trained on-the-job. With the growth in cardiac surgery programs in the United States and need for more clinicians, formal training programs were established and accredited (8). During the mid-1970s, a certification process for perfusionists was established that required perfusionists to receive training at an accredited school, document 80 proctored cardiac procedures, and satisfactorily complete a written and oral exam (13).

The driving force behind the establishment of schools and a certification process was to improve the quality and safety of care provided to patients. During the transition period 1973–1975, on-the-job trained perfusionists were “grandfathered” into the certification process. “On-the-job” trained perfusionists who were able to document clinical activity as a perfusionist by submission of a log of cases, were permitted to take the certification exam and those that completed the exam with a passing score were awarded certification. “On-the-job” training for perfusionists in the United States came to an end in 1981 (13). In countries such as Kenya, efforts should be made to move away from an “on-the-job” clinical training model as soon as possible. This should be coupled with a well-established standard for what constitutes effective formal perfusion education that includes curriculum, physical resources, faculty competency, requisite classroom education, hours of clinical education, and measurement of competency.

In his review of the first 10 years of heart surgery in Kenya, Odhiambo stated that the infrequency of cases.
contributed to a “lack of rhythm” resulting in an increased mortality (6). Numerous studies from the United States and Europe have demonstrated statistically significant relationships between hospital and surgeon annual case volume and mortality (14–16). In a multinational study, Gutaker reported that, for coronary artery bypass surgery, hospitals that perform 415 cases per year or more have much lower mortality rates (15). In this survey, 36% of the respondents reported that the caseload at the primary center where they worked was 25 or less procedures per year. In Kenya only two of the 10 programs, only two do more than 100 open-heart procedures per year.

While volume is associated with outcome, one recent study showed that adherence to guideline for practice may be more important than center procedural volume (17). In the United States, regional consortia have been developed across cardiovascular subspecialties to improve quality and patient outcomes. The Northern New England Cardiovascular Disease Study Group (NNECDSG) was the first regional consortium focused on quality improvement in cardiac surgery (18). They developed patient registries to evaluate the results of care and improve quality. Regional registries have been used to improve perfusion practice and measure adherence to evidence-based guidelines in perfusion practice (19,20). The NNECDSG started a perfusion registry in 1996 to collect procedural specific information related to the conduct of CPB. The perfusion registry led to the discovery of a number of important findings. For example, an association between nadir hematocrit during CPB and mortality was reported by the group in 2001 (21). This work has been cited more than 450 times and was the catalyst to a large number of subsequent studies on blood management during cardiac surgery. The registry has also been used to measure the extent to which the centers in the NNECDSG followed the published guidelines (20).

Standards are designed to be used as a blueprint to evaluate and improve practice locally. Standards and guidelines have a vital role in the delivery of the best care and the
most cost-effective care to patients. The 2012 Institute of Medicine Report-Best Care at Lower Cost (22) stated that “Research organizations, advocacy organizations, professional specialty societies, and care delivery organizations should facilitate the development, accessibility, and use of evidence-based and harmonized clinical practice guidelines.” Anesthesiologist, surgeon, and perfusionist professional societies in several countries have developed and published standards and guidelines for perfusion. Standards are practices that “should” be adopted and will improve safety. An example of a standard is the use of a procedural checklist. Guidelines are practices that “may be considered.” As evidence expands, guidelines may become standards. It is no small task to establish guidelines. Establishing guidelines will require scrutiny of the evidence, recruitment of local multidisciplinary expert opinion, and collaborative debate by the experts. The equally arduous task of dissemination and subsequent widespread adoption requires forums for discussion and methods of measuring adoption. Established standards and guidelines require periodic review. Standards and guidelines are a journey and not a destination. The American Society of ExtraCorpororeal Technology has published a description of their society’s pathway to the development of standards and guidelines (23).

At this time, perfusion is not recognized as a healthcare specialty in Kenya. There is no specific license or certifications specific for perfusionists in Kenya currently. Recognition and licensure are important for providing governance of a profession but more importantly, protection for the public.

CONCLUSIONS

This survey provides contextual information about current perfusion practice in Kenya and the sentiments of Kenya perfusionists about standards and guidelines. Future work should focus on the review of currently published standards from other countries with the aim of establishing a regional standard of practice for Kenya.

REFERENCES

Kenya Perfusion Survey  #1 January 4,2020

Perfusionists at Tenwek Hospital are conducting a survey to learn about perfusion practice in Kenya. The purpose of this first survey is to obtain demographic information from perfusionists.

The individual information you provide will be handled as confidential. A summary report of the results will be provided to all participants.

* 1. I agree to provide accurate responses to all of the questions. I understand that my individual responses will be treated as confidential. I consent to the use of this information in summary form
   - Agree
   - Disagree
   Other (please specify)

* 2. When do you use an ultrafiltration device?(check all that apply)
   - Never
   - Pre-bypass to buffer and concentrate the prime
   - During bypass
   - Post-bypass by arteriovenous method (A-V MUF)
   - Post-bypass by venovenous method (V-V MUF)
   - Used to concentrate the pump circuit only after CPB
   - Other (please specify)
3. Which of the following Safety devices are routinely used at your center?
- Level detector
- Air bubble detector
- One-way valve in vent/sucker lines
- One-way purge line (arterial filter)
- Oxygen analyzer in the gas line
- Continuous Venous Line Saturation
- Continuous Arterial Line Saturation
- Other (please specify)

4. Do you use a written pre-bypass checklist?
- Yes
- No

5. Which of the following BEST describes your cardioplegia system?
- Recirculating
- Single-pass (i.e., 4:1 ratio blood to crystalloid)
- Syringe or pressurize IV bag
- Do not use cardioplegia
- Other

6. What is your medical background?
- Medical Doctor
- Registered Nurse
- Certified Nurse Anesthetist
- Clinical Officer Anesthetist
- Respiratory therapy
- Cardiovascular technician
- Clinical Officer
- Other (please specify)
7. Which best describes your perfusion training?
- Trained “on the job” where I work
- Fellowship Training which comprised only clinical observation
- Fellowship Training which comprised clinical observation and didactic instruction
- Fellowship Training which comprised clinical observation, didactic instruction and supervised operation of the heart-lung machine
- Other (please specify)

8. What was the duration of your perfusion training?
- Did not receive formal training (I trained on the job)
- Two weeks
- Greater than two weeks but less than 1 month
- One month to six months
- Greater than six months but less than a year
- One year to two years
- Greater than two years

9. How many years have you been a perfusionist?

10. How many CPB cases did you participate in during the last 12 months?

11. What types of CPB cases are done at the primary center where you work?
- Congenital heart repairs
- Valve replacement surgery
- Aortic aneurysm repair
- Coronary artery bypass surgery
- Other (please specify)
* 12. At the primary hospital where you practice, how many perfusionists are in the operating room during a case?

- 1 in the room no back-up
- 1 and one available in the hospital if needed
- 2 in the room
- Other (please specify)

* 13. What is the name of the primary hospital where you work as a perfusionist?

- Mater
- Aga Khan
- Karen
- Tenwek
- Eldoret MTRH
- Nairobi West
- MP Shah
- Children's Hospital Nairobi
- Other (please specify)

* 14. What are the names of other hospitals where you work as a perfusionist?

- N/A (not applicable)
- Kenyatta (Nairobi)
- Mater
- Aga Khan
- Karen
- Tenwek
- Eldoret MTRH
- Nairobi West
- MP Shah
- Children's Hospital Nairobi
- Other (please specify)
15. At the primary hospital where you practice, how many CPB cases were done in the last 12 months?

- [ ] 0-10
- [ ] 11-25
- [ ] 26-50
- [ ] 51-99
- [ ] ≥100

16. Please enter any questions or comments that you may have in the space provided
Copy of Copy of Kenya Perfusion Survey #2

1. I agree to provide accurate responses to all of the questions. I understand that my individual responses will be treated as confidential. I consent to the use of this information in summary form
   - Strongly agree
   - Disagree

2. If you attended a formal training program, where did you go for training
   - I did not have formal training. Only Clinical Training
   - India
   - Egypt
   - Other
   - Other (please specify)

3. If you had formal training which of the general topics were part of your training
   - Anatomy
   - Physiology and Pathophysiology
   - Pharmacology
   - Coagulation Management
   - Adult Perfusion Techniques
   - Pediatric Perfusion Techniques
   - Research Methods
   - Other

4. Are you in favor of organizing a national perfusion conference for Kenyan perfusionists
   - Yes
   - No

5. If a national conference were organized, list three topics you would like to be included in the program
6. If a national conference were organized what would be your preferred location

☐ Nairobi
☐ Nakuru
☐ Eldoret
☐ Bomet
☐ The above location and virtual
☐ Virtual only
☐ Other (please specify)

7. When you were the primary perfusionist during a cardiac procedure, did you ever experienced any of the following:

☐ An oxygenator failure requiring change over of the oxygenator
☐ Iatrogenic Aortic dissection (cannulation site or ascending aorta)
☐ Heparin resistant patient (requiring more than 8mg/kg of heparin)
☐ Empty venous reservoir and entrainment of air into the circuit tubing and oxygenator
☐ Air embolism to the patient’s circulation
☐ Other (please specify)

8. Are you aware of the European Standard and Guidelines for Cardiopulmonary bypass published last year?

☐ No
☐ Yes, I heard about European standards and guidelines for CPB published last year but have not read them
☐ Yes, I have read the European standards and guidelines for CPB published last year


☐ No
☐ Yes, I have heard of the AMSECT Standards and Guidelines CPB but have not read them
☐ Yes, I have read the AMSECT standards and guidelines for CPB
10. Do you think that Standards and Guidelines for Cardiopulmonary Bypass are needed in Kenya?

- Yes
- No
- Not sure if they are needed.