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Electricity and generator availability in LMIC hospitals: improving access to safe surgery

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ABSTRACT

Background: Access to reliable energy has been identified as a global priority and codified within United Nations Sustainable Goal 7 and the Electrify Africa Act of 2015. Reliable hospital access to electricity is necessary to provide safe surgical care. The current state of electrical availability in hospitals in low- and middle-income countries (LMICs) throughout the world is not well known. This study aimed to review the surgical capacity literature and document the availability of electricity and generators.

Methods: Using Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines, a systematic search for surgical capacity assessments in LMICs in MEDLINE, PubMed, and World Health Organization Global Health Library was performed. Data regarding electricity and generator availability were extracted. Estimated percentages for individual countries were calculated.

Results: Of 76 articles identified, 21 reported electricity availability, totaling 528 hospitals. Continuous electricity availability at hospitals providing surgical care was 312/528 (59.1%). Generator availability was 309/427 (72.4%). Estimated continuous electricity availability ranged from 0% (Sierra Leone and Malawi) to 100% (Iran); estimated generator availability was 14% (Somalia) to 97.6% (Iran).

Conclusions: Less than two-thirds of hospitals providing surgical care in 21 LMICs have a continuous electricity source or have an available generator. Efforts are needed to improve electricity infrastructure at hospitals to assure safe surgical care. Future research should look at the effect of energy availability on surgical care and patient outcomes and novel methods of powering surgical equipment.

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Introduction

Energy is recognized as a United Nations Sustainable Development Goal and essential prerequisite for achieving the global health and development goals.[1] In addition, the United Nations Secretary-General launched the "Sustainable Energy for All" initiative with the goal to achieve universal energy access by 2030 while doubling the global rate of energy efficiencies and renewable energy.[2] However, 1.2 billion people, 20% of the world population, are without access to electricity. Most of those without access to electricity live in sub-Saharan Africa and Asia. Of those without access to electricity, 85% reside in rural areas. In addition, 2.8 billion people rely on polluting fuels, such as wood, charcoal, dung, and coal for cooking and heating.[3]

Electricity is an essential component of the infrastructure necessary to deliver health services at District Level Hospitals and above.[4] Electricity is used in the basic functioning of hospitals including lighting, the heating and cooling of air, and powering equipment necessary to provide essential and emergency surgery safely. In addition, the World Health Organization's (WHO) highlighted essential medications and health products include those which require electricity to use and deliver care.[5]

The Lancet Commission on Global Surgery defined electricity as one of the 10 needs for the provision of safe surgical and anesthesia care.[6] Surgical care requires sterilization, anesthesia, and recovery services. In low- and middle- income countries (LMICs) this may mean the use of an oxygen concentrator or generators, vital sign monitors, autoclaves, and anesthesia equipment. Other related hospital services, such as imaging and diagnostic laboratory services, also require electricity. Surgical equipment such as electrocautery and suction machine require electricity, as does performing emergency procedures at night.[7] In addition, the Lancet Commission defined electricity and infrastructure broadly, as one of the 10 needs for the provision of safe surgical and anesthesia care globally. Despite the recognition of electricity as central to the work of surgeons in LMICs, there is limited literature on this topic to guide surgeons and policy-makers alike.

Thus, we aimed to systematically review the surgical capacity literature and describe the availability of electricity at hospitals in LMICs where they were performed. In addition, we used data from these assessments to model electricity availability at hospitals in LMICs more broadly. By doing so, the findings might identify fundamental limitations in surgical capacity based on electrical infrastructure and inform targeted capacity development strategies.

Methods

Systematic review

We designed a systematic search strategy to identify all published surgical capacity assessments that reported electricity and generator availability at hospitals in LMICs (see supplementary material). The methods used for the systematic review and data analysis are similar to the one employed in a previous study on water and surgical capacity (Figure).[8] The search strategy included terms for each of the following surgical care capacity assessments:

i. Tool for Situational Analysis to Assess Emergency and Essential Surgical Care of WHO[9]
ii. Personnel, Infrastructure, Procedures, Equipment and Supplies survey[10]; and
iii. the Harvard Humanitarian Initiative's survey tool.[11]

Other terms were used to identify records that did not use these three tools but assessed surgical care capacity, such as "surgical," "surgery," "capacity," "assessment," and "survey" (see supplementary material). The World Bank World Development Report was used to define LMICs.[12]

The titles and abstracts of retrieved records were screened for relevance, and duplicates were removed. Two reviewers (SSC and SG) screened all records; a third reviewer (ALK) resolved disagreements. The remaining full-text reports and their reference lists were reviewed. Reports were included if they described the availability of electricity and generator at one or more hospitals in an LMIC. If multiple reports from one country were found, the report with the most recent study was included.

Systematic review data analysis

A binary score was assigned to electricity availability for each hospital (i.e. electricity reliably available or not reliably

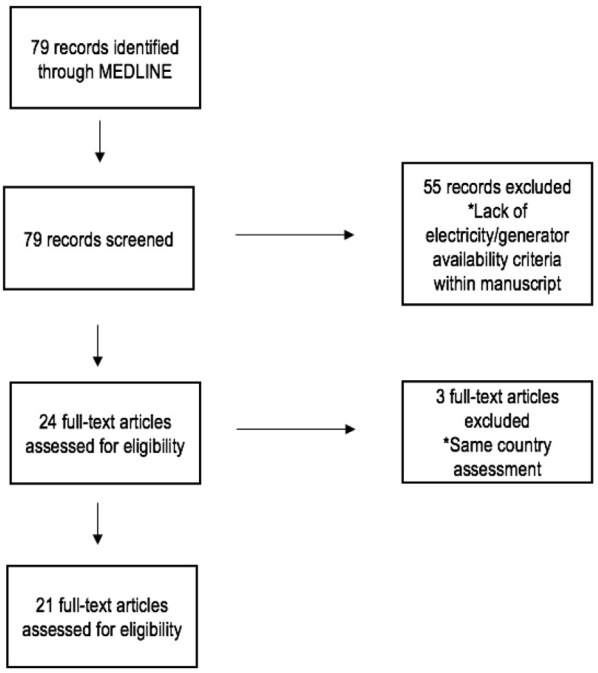

Figure – PRISMA flow diagram for the results forms a systematic search for reports of electricity and generator availability from surgical capacity assessments in low- and middle-income countries. PRISMA = Preferred Reporting Items for Systematic Reviews and Meta-Analyses.