

**DIGITIZATION OF PERIOPERATIVE SURGICAL FLOWSHEETS**

**UNDERSTANDING HOW LANGUAGE BARRIERS INHIBIT PATIENT CARE IN  
EMERGENCY SITUATIONS**

An Undergraduate Thesis Portfolio  
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By

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## **SOCIOTECHNICAL SYNTHESIS**

The World Health Organization apportions funding to low and middle income countries based on the mortality and disability rates reported by hospitals. However, medical systems in some underdeveloped countries do not receive funding because they lack the infrastructure to collect and report mortality rates. The technical project seeks to digitize the handwritten surgical data collected by anesthesiologists at University Teaching Hospital in Kigali, Rwanda so that perioperative mortality rate, the percent of patient deaths due to surgery in a given hospital, can be effectively reported to international agencies. The STS project seeks to characterize how language barriers impede effective communication between patients and caregivers in emergency situations. The projects are tightly coupled in their objective to facilitate better patient data collection practices in low and middle income countries.

Anesthesiologists at the University Teaching Hospital manually record perioperative patient data such as heart rate, blood pressure and medications administered, on flowsheets and store them in binders. This method of data collection is highly inefficient, as doctors cannot easily track a patient's health over time or conduct research studies on health factors contributing to perioperative mortality. Thus, the technical project team devised a digitization system where doctors in Rwanda can upload a completed flowsheet as an image to a web application which encrypts the image and sends it to the University of Virginia Health System. The image is then decrypted at the University of Virginia and segmented into three sections: administered medications, graph of patient vitals, and logistic details. Each section is interpreted by an image processing algorithm, which extracts the data and inserts it into a PostgreSQL database for future use.

The medication detection algorithm recognizes administered medications with a 90.21% accuracy, while the checkbox detection program recognizes checked and unchecked boxes with an accuracy of 82.2%. The graph reading algorithm recognizes the symbols with a mean squared error of 3.28, 24.41, and 18.48 for heart rate, systolic blood pressure, and diastolic blood pressure, respectively. The image recognition algorithms reject unreadable data points and flag them for review in the database. Doctors can then address these flags by verifying results and correcting misinterpreted data points. The outcome of the project indicates that the digitization system is fully functional in a research environment despite requiring some oversight from doctors. Ultimately, the system allows doctors to maintain their workflow by facilitating perioperative data digitization for research purposes.

The STS project studies the impact of language barriers on prehospital care in low and middle income countries by using Pacey's Triangle to examine the organizational, technical and cultural aspects of the problem. Languages and dialects tend to vary by region in many countries around the world, and this diversity in language leaves patients and healthcare workers vulnerable to misunderstandings. Due to the time constraints inherent in emergencies, language barriers can result in discrimination and mistreatment, which in turn, lead patients to mistrust healthcare systems in their countries. Along with many research studies conducted across Asian and African countries, personal accounts from doctors working in underdeveloped countries elucidate how diversity in language can inhibit proper patient care. Such sources inform the organizational, technical and cultural contexts of emergency medicine, and identify the role of language in each context.

Organizationally, many countries have taken governmental action to establish emergency care services for all their constituents and to prevent discrimination in medical treatment on the

basis of language. Considering the technical aspect of prehospital care, ambulances were reportedly understaffed and overworked in countries such as Morocco and Sudan, and workers' lack of basic training left them unprepared in the face of communication barriers. Finally, in the cultural context, traditional beliefs and customs in some countries led populations to misinterpret the purpose of ambulances and deterred them from seeking emergency care. Healthcare personnel were unable to dispel such misconceptions because they did not speak the same language as patients and bystanders. Therefore, language barriers penetrate all aspects of prehospital care, signifying that emergency care personnel should be better trained to manage misunderstandings and build trust with patients.

Both the technical and STS projects aim to improve data collection practices and patient outcomes in low and middle income countries. Healthcare facilities can effectively evaluate their quality of care with patient data at their disposal. Ultimately, training healthcare professionals to be more culturally aware and providing them with access to crucial data are first steps for building a robust medical infrastructure in low and middle income countries.

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