

Roadmap to Device Connectivity in Neurocritical Care

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Abstract— Neurocritical care is a complex discipline, where a high volume of disparate data is produced. Advanced informatics is needed to enable a meaningful and efficient use of the data, but its adoption has been hindered by the difficulty of seamlessly collecting and integrating data from various sources. This paper outlines a roadmap to improve medical device connectivity, one of several obstacles to the creation of an integrated informatics infrastructure for neurocritical care.

I. INTRODUCTION

Neurocritical care is the medical discipline that deals with complex neurosurgical, neurological and medical problems in critically ill patients who suffered acquired brain injuries. In neurocritical care, multiple physiologic and neurophysiologic parameters are monitored simultaneously with the goal of avoiding or mitigating secondary brain insults [1]. In 2014, the Neurocritical Care Society published a consensus statement in support of multimodal neuromonitoring, emphasizing the essential need for systems to integrate data in meaningful ways to support decision making in patient care [1, 2]: without such a comprehensive integration multimodal monitoring might see limited clinical utility. Neurocritical care is however still in its infancy in terms of informatics: powerful informatics tools (visualization, analytics, decision support, etc.) are only used in institutions that have developed their own unique data infrastructure and the tools are rarely scaled or adapted for routine care. Among the multiple barriers that must be overcome, poor medical device connectivity is the most prominent one. A recent survey of device interfaces encountered in neurocritical care revealed a cacophony of communication protocols among device vendors and models [3]. The widespread lack of adherence to manufacturer's protocols poses a significant barrier to the development of connected systems. It was also confirmed only few vendors have adopted medical device communications standards that have been developed and refined over the years (e.g. IEEE 11073). Overall, this imposes a technological overhead for institutions and middleware manufacturers that want to implement informatics tools targeting neurocritical care. Additionally, poor medical device connectivity increases the hidden costs of data collection and management for clinical studies, often determining their failure or success.

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II. PROPOSED ROADMAP

At the center of our efforts will be the production of a formal set of recommendations for medical device connectivity specific to neurocritical care. These recommendations will provide guidance to medical device manufacturers designing a communication protocol to be used by external systems (such as data aggregators, repositories, etc.). Our group recommends the adoption of standard communication protocols when applicable. In the absence of a standard, we recommend the adoption of digital communications. Meaningful use has actually increased the number of new devices supporting analog outputs so they can feed their data into the vital signs monitors and thus into the medical record. In doing so, they increase the potential for errors when connecting more than one medical device to an external system. We also outline the type of content that should be transmitted by the device. The desirable information content includes, but is not limited to, device identification, protocol version identification, patient identifier, events, and alarm conditions. The transmitted data should also include data labels and units. Finally, in order for a communications protocol to be successfully used, it must be thoroughly documented and verified by the manufacturer. We also propose creating a community-driven repository of information about neurocritical care medical devices. This repository will include information specific to their communication protocols and potential pitfalls encountered when using said devices in the context of multimodal data collection. These tools will provide clinicians, researchers and institutions with initial guidance in the selection of devices for the purpose of data collection in neuroICUs. Concurrently, we recommend users of medical devices to report their concerns to the manufacturers, since FDA regulations require manufacturers to address customer complaints. The goal of the roadmap proposed in this paper is to bridge the gap between the current status of medical device connectivity and the needs of neurocritical care for an efficient data collection and management.

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