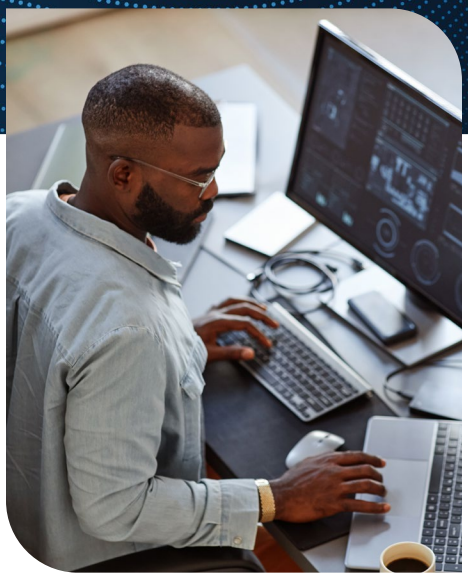
Cognitive



CASE STUDY

AI Machine Learning Revolutionizes Oxygen Delivery in Emergencies:

How Cognitive's Advanced CDS Tool Enhances Respiratory and Ventilator Management in Combat and Crisis

PROJECT DETAIL:

CAPABILITIES:
Custom Software Development, Clinical Knowledge Management, and Analytics

AGENCY:
- U.S. Army Medical Research Acquisition Activity (USAMRAA)
- Defense Health Agency Joint Program 6 (Combat Casualty Care)
- U.S. Army Medical Research and Materiel Command (USAMRMC) Telemedicine and Advanced Technology Research Center (TATRC)
- Office of the Undersecretary of Defense for Research and Engineering (OUSD(R&E)) Program Integration Office

INTRODUCTION

Timely, accurate oxygen delivery is essential for reducing the risk of respiratory distress among vulnerable patients. Administering the appropriate mechanical ventilation strategy, once the responsibility of a physician or anesthesiologist, has increasingly become the domain of residents, respiratory therapists, or nurses due to nationwide physician shortages. Yet without the immediate oversight of a more experienced consultant, these providers run the risk of applying inappropriate settings that can result in poor outcomes.

These risks grow considerably higher in combat situations, where time or conditions may not allow the implementation of a suitable mechanical ventilation strategy.

The U.S. Army and Defense Health Agency recognized that an advanced clinical decision support (CDS) tool could augment a bedside provider's mechanical ventilation skills. Many healthcare systems turn to CDS tools to fill gaps in knowledge. These tools provide valuable patient- and process-specific information to clinicians at the point of care, empowering clinicians with more informed decision-making. Cognitive was tasked with providing this insight for clinicians in combat and at home.

CHALLENGE

Cognitive was contracted to create a simulation laboratory platform to develop, test, and validate the clinical effectiveness of a CDS recommender system able to guide physician extenders on ventilator management decisions in the field. The resulting system would need to provide diagnostic and therapeutic recommendations on the ventilator adjustments required to keep patients within appropriate clinical

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CHALLENGE, CONTINUED

parameters. On the battlefield, the tool would enable clinicians to intubate and safely ventilate wounded soldiers in the most precarious situations.

The challenge in developing this system was the need to address the many parameters governing ventilator adjustment. The multitude of control adjustments available creates a combinatorial explosion of possibilities that can be extremely difficult to model using typical strategies. This eliminated the possibility of following the roadmap set by typical rule-based CDS systems—and prompted the Cognitive team to evaluate the innovative application of machine learning techniques.

SOLUTION

Cognitive determined that machine learning techniques provided the most appropriate foundation for guiding complex ventilation decisions. That's because, as use cases become more complex, machine learning techniques can dynamically adapt to changes and update guidance.

First, Cognitive designed a rule-based expert system able to model ventilator management domain knowledge for select clinical problems and pulmonary characteristics. Next, the team trained predictive models to enable more sophisticated ventilator management recommendations. These predictive models proved ideal for delivering guidance on simultaneous multi-parameter ventilator adjustments. The team also developed an integrated respiratory management application that utilizes both rule-based algorithms and predictive models that can be used in either an advisory mode or in a closed-loop capacity.

To maximize the value of this tool, the development team opted to host it on the Amazon Web Services (AWS) GovCloud and ensured that it could be secured and deployed across any platform or application.

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RESULTS

The evidence-based, computable artifact developed by Cognitive for respiratory and ventilator care represents a significant advancement in clinical decision support. This sophisticated tool is designed to enhance the skills of physician extenders, providing them with a level of expertise comparable to that of experienced physicians or anesthesiologists. By integrating advanced machine learning techniques and rule-based algorithms, the tool offers critical, real-time guidance on ventilator management.

This expert support proves invaluable for residents, nurses, and forward-deployed combat medics, equipping them with the necessary insights to make rapid, informed, and life-saving decisions in high-pressure situations. Whether in combat zones or routine medical settings, the tool ensures that these healthcare providers can administer optimal ventilatory support, ultimately improving patient outcomes and operational efficiency.

WE'RE SIMPLIFYING HEALTHCARE IT FOR BETTER CARE OUTCOMES

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Cognitive Medical Systems is a physician-led Service-Disabled Veteran-Owned Small Business (SDVOSB) committed to elevating the quality, speed, and delivery of today's U.S. government healthcare programs through the application of innovative information technology solutions that bring disparate medical data systems together.

We're driven by a passion for enhancing health outcomes for all beneficiaries of government healthcare programs. Our work is guided by core values that shape how we serve our clients and their customers. And our success is evident in the programs we've implemented to bridge care gaps, enhance interoperability across medical data systems, and achieve a more efficient healthcare ecosystem.

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