HARNESSING ARTIFICIAL INTELLIGENCE FOR MEDICAL DIAGNOSIS AND TREATMENT DURING SPACE EXPLORATION MISSIONS

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BACKGROUND

The medical capabilities necessary for long-duration exploration missions (LDEMs) will differ tremendously from those currently available to crew medical officers (CMOs) on the International Space Station (ISS). Ground support will be more challenging due to distance-related communication delays and data transmission, and resource utilization must be optimized given limited ability for resupply. Clinical decision support systems (CDSSs) can help mitigate these limitations. The recent launch of generative artificial intelligence (AI) tools based upon large language models (LLM) support the creation of a smart assistant for onboard triage, diagnosis, and guided treatment of medical conditions during these missions. The Informing Mission Planning via Analysis of Complex Tradespaces (IMPACT) tool can help predict which clinical problems and outcomes are likely to occur for a design reference mission (DRM) and assist Medical Operations and systems engineering teams in creating a medical system that may optimally mitigate the predicted risks. The purpose of this study was to identify AI tools currently available or in development for the assistive diagnosis and care of medical conditions predicted for an extended duration Lunar mission.

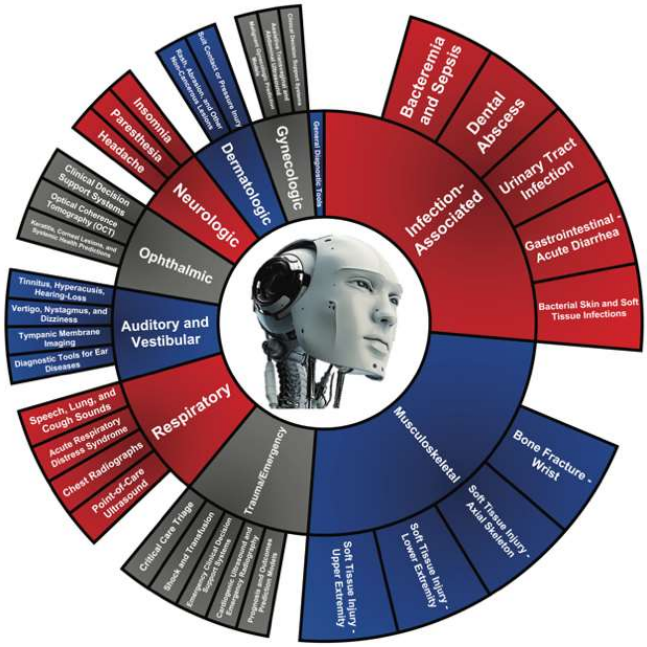

Figure 1: **Sunburst hierarchy representing the number of AI tools surveyed for inclusion in each systems-based category.**

METHODS

The 119 medical conditions currently built into the IMPACT suite were categorized into systems, and these diagnoses were used as keywords for our literature search. Using PubMed and Google Scholar, we performed a literature survey of AI tools applicable to these conditions. Article inclusion criteria included publication between the years 2017-2023, as the sentinel paper discussing the "selective attention" driving ChatGPT and other generative transformer models was published in June 2017. Where applicable, we reviewed only the top 1000 research articles (based on relevance) for each of the keywords/phrases. AI tools whose training sets were exclusive to a pediatric patient population were excluded. We also excluded any medical diagnostic tools (such as CT, MRI, mass spectrometry) or procedures (such as endoscopy, surgery) that are unlikely to be available during LDEMs due to mass and volume constraints, CMO knowledge, skills, and abilities, and/or inherent procedural risks.

RESULTS

Our survey highlighted several AI-driven tools for the triage, diagnosis, and management of those medical conditions highlighted by IMPACT. Selected publications for each medical condition were then screened for inclusion within ten systems-based categories including: general diagnostic tools (25), tools to diagnose and manage respiratory (40), dermatologic (34), neurologic (28), auditory and vestibular (30), ophthalmic (34), musculoskeletal (104), infection-associated (92), and gynecologic (19) conditions, as well as tools that could be deployed in the setting of trauma and emergency (34).

CONCLUSIONS

Numerous AI-driven tools were highlighted within this literature survey, ranging from chatbot assistants that triage knee pain to vision transformer models for diagnosis of ophthalmic conditions using ocular surface images captured with a mobile phone. Remaining challenges include optimizing connectivity and integration of existing and developing systems into the vehicles or habitats. Notably, findings from this survey could help guide the initial design of an all-encompassing, onboard medical AI assistant for use during future LDEMs.