

Natural Language Processing for serious illness communications in palliative surgical oncology

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Dear Editor,

Approximately one-fifth of surgeries performed at major cancer centres worldwide are palliative in nature, and one-third of advanced cancer patients receive surgery during their last year of life.^{1,2} Serious illness communication (SIC) is an essential component of palliative care. In the context of palliative surgical oncology, the surgical team will facilitate a shared decision-making with patients who are considered for high-risk palliative surgery or other interventions. This explores the goals of surgery or other proposed interventions and the prognosis; it also clarifies code status, assesses for suitability for hospice care, and explains the associated risks of surgical morbidity and mortality for the advanced cancer patients and their families.³

At present, there remains a paucity of high-quality studies that examine the delivery of palliative care to end-of-life surgical patients.⁴ A significant challenge in measuring the quality of palliative care processes is the need for manual chart reviews of electronic health records (EHR) which can be time- and labour-intensive.⁵ As such, we aim to develop a natural language processing (NLP) algorithm to facilitate the evaluation of SIC in advanced cancer patients undergoing invasive interventions.

We queried a retrospective palliative surgical oncology database in a single tertiary cancer centre—the National Cancer Centre Singapore—and included patients who underwent invasive palliative surgery or other invasive interventions between 2021 and 2022. Unstructured free text in EHR from the index surgical admission was extracted. A multidisciplinary team of surgical oncologists, palliative care physicians, gastroenterologists and interventional radiologists developed a library of key terms to evaluate the 6 components of SIC.⁶ The library was constructed based on concept terms

and phrases commonly used to document SIC in literature⁷; this was further refined based on additional keywords identified through iterative review of EHR. Blinded manual chart reviews were undertaken by 2 surgical oncologists and 1 palliative care physician who identified components of SIC found in unstructured clinical text in the EHR. This manual chart review constituted the gold standard reference against which the NLP algorithm was compared.

We had previously utilised a regular expression-based NLP pipeline to annotate free text radiological reports.⁸ We adapted the same pipeline in Python version 3.11.0 (Python Software Foundation) to examine the frequency and adequacy of SIC components. This study has been approved by the SingHealth Centralised Institutional Review Board, with informed consent obtained from all participants.

There were 98 patients who underwent palliative surgery or other invasive interventions. The final NLP algorithm achieved a sensitivity of 77.8–100%, specificity of 31.6–100%, as well as an agreement of 86.7–100% with the reference standard, together with a Cohen's kappa of 0.43–1.00 in the various components of SIC (Table 1). In the final cohort of patients undergoing palliative surgery or other interventions, the NLP algorithm identified that discussions on goals of care occurred in 16.3%, code status in 2.0%, hospice assessment in 18.4%, disease prognosis in 18.4%, morbidity rates in 93.9%, and mortality rates in 34.7%. Most patients had discussions across several SIC components: 76.6% had 1 or 2 components discussed, and 19.4% had 3 to 5 components discussed. Specialist palliative care referrals were made 38.8% of the time.

Our results highlight the areas of difficulty that clinicians struggle with regard to SIC for advanced

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Table 1. Performance of the Natural Language Processing algorithm in identifying components of serious illness communications in palliative surgical oncology patients (n=96).

Components of serious illness communications	Sensitivity (%)	Specificity (%)	Agreement (%)	Cohen's kappa	Frequency no. (%)
Goals of care	88.9	100.0	98.0	0.93	16 (16.3)
Code status clarification	100.0	100.0	100.0	1.00	2 (2.0)
Assessment for hospice	77.8	95.0	91.8	0.73	18 (18.4)
Discussion of disease prognosis	100.0	100.0	100.0	1.00	18 (18.4)
Discussion of morbidity rates	100.0	31.6	86.7	0.43	92 (93.9)
Discussion of mortality rates	91.9	100.0	96.9	0.93	34 (34.7)

cancer patients undergoing invasive treatments. It was noted that surgical teams are adept at explaining surgical or procedural risks, while discussions on goals of care and other important aspects of SIC are often neglected. In Singapore's ageing population with a growing number of patients diagnosed and living with advanced cancer, ensuring access to palliative care, including SIC is essential to facilitate goal-concordant end-of-life care. Our findings highlight the need to improve surgeon-patient communication in the context of life-limiting cancers.

There has been increasing utilisation of computational methods such as NLP in palliative care research in recent years.^{7,9} However, literature beyond the US remain sparse, with no studies evaluating SIC in the context of a non-American population. In this study, we were able to develop an NLP algorithm that can accurately identify the various components of SIC from EHR in Singapore's context. Given the differences in linguistic parlance across different cultures and populations, establishing the use of NLP in an Asian context is essential to expand its use locally and in the region.¹⁰ The study also represents an important first step towards the use of locally-trained NLP algorithms to measure palliative care processes in Singapore.

Several limitations of the current study should be noted. First, the NLP algorithm was built on a pre-defined key term library which is non-exhaustive. As an extension to the above point, its performance may also be affected by differences in documentation practices and linguistic parlance across departments, institutions and regions. Validation and further optimisation should therefore be undertaken when the algorithm is adopted in different settings. Furthermore, the adequacy of SIC measured is dependent on reliable clinical documentation practices among healthcare providers. Our

evaluation was also limited to index hospitalisation consult notes, and may exclude SIC performed at other care settings. Finally, we acknowledge the relatively low specificity of the algorithm in identifying discussion of morbidity risk at 31.6%, possibly leading to a higher rate of false positives and contributing to the high rates in this domain at 93.9%. This is because the algorithm was unable to differentiate between patient communications regarding complications that have already occurred post-intervention versus those that occur as part of pre-intervention risk counselling.

Overall, while specialist palliative care will continue to play an important role in end-of-life care, it is crucial that the foundational principles of palliative care and SIC are integrated into routine surgical care provided by the surgical team. The current study has demonstrated that advanced computational techniques such as NLP have utility in evaluating and improving on the delivery of care in this aspect. In future works, it is foreseeable that the integration of NLP into EHR pipelines can pave the way for regular review of quality outcome indicators for continued identification of deficiencies in palliative care delivery, which can be translated into development of systems-level quality improvement processes for the betterment of patient outcomes.

Declaration

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Ethics

This study has been approved by the SingHealth Centralised Institutional Review Board (CIRB Reference 2021/2455), with informed consent obtained from all participants.

Keywords: *goals of care, natural language processing, palliative care, palliative interventions, serious illness communications*

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