

Determining Causes of Death with ChatGPT: A Case Study of Verbal Autopsy Data in Sierra Leone from 2019-2022

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Abstract

The abstract serves both as a general introduction to the topic and as a brief, non-technical summary of the main results and their implications. Authors are advised to check the author instructions for the journal they are submitting to for word limits and if structural elements like subheadings, citations, or equations are permitted.

Keywords: keyword1, Keyword2, Keyword3, Keyword4

1 Background

In 2019, 41 million people die prematurely from noncommunicable diseases every year, accounting for 74% of all deaths globally [1]. Most of these deaths are preventable, but require resources, interventions, and policies that are guided by evidence [2]. Thus, reliable counts and diagnoses of deaths provide decision makers with evidence to save lives and reduce premature deaths worldwide [3–6]. However, most low-income countries do not have data on deaths or have registered less than half of the deaths in their country, with an even fewer 8% of these registered deaths having a Cause of Death (COD) recorded [7]. To fill this gap in death registrations, an alternative method known as Verbal Autopsy (VA) is used to collect data on deaths and determine their likely causes at scale [8–10], outside of traditional healthcare facilities where over half of deaths occur at home [11].

VA involves two major components: survey and COD assignment [12, 13]. In the survey component, trained lay surveyors interview those familiar with the deceased (e.g. living spouse, children, family, friends) to gather information using standardized questionnaires and open narratives. In the COD assignment component, physicians evaluate information available from the questionnaires and open narratives to assign probable CODs. Although the survey component has been an effective alternative to collect mortality data at scale, the COD assignment component has been criticized to be expensive and difficult to reproduce due to reliance on physician assigned CODs [14, 15]. As an alternative to physician assignment, computer algorithms have recently been studied to automatically assign CODs with performances close to physicians at the population level, but poor performances at the individual level [16–19]. Many computer algorithms have utilized the structured questionnaire portion of the surveyed data, but often omit the free-text open narrative, which misses latent information, such as chronology or health-seeking behaviors, that may potentially help algorithms perform better than using the questionnaire alone [20–22].

Recently, Large Language Models (LLM), leveraging massive datasets and deep learning approaches, have made advances in performing a variety of Natural Language Processing (NLP) tasks using free-text [23]. Examples of these tasks include. A widely known LLM called ChatGPT developed by OpenAI. Generative Pre-trained Transformer (GPT), GPT-1 to GPT-4 [24].

2 Methods

x.

3 Results

x.

4 Discussion

Discussions should be brief and focused. In some disciplines use of Discussion or ‘Conclusion’ is interchangeable. It is not mandatory to use both. Some journals prefer a section ‘Results and Discussion’ followed by a section ‘Conclusion’. Please refer to Journal-level guidance for any specific requirements.

5 Conclusion

Conclusions may be used to restate your hypothesis or research question, restate your major findings, explain the relevance and the added value of your work, highlight any limitations of your study, describe future directions for research and recommendations.

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Acknowledgments. Acknowledgments are not compulsory. Where included they should be brief. Grant or contribution numbers may be acknowledged.

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Declarations

Some journals require declarations to be submitted in a standardised format. Please check the Instructions for Authors of the journal to which you are submitting to see if you need to complete this section. If yes, your manuscript must contain the following sections under the heading ‘Declarations’:

- Funding
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- Authors’ contributions

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Appendix A Section title of first appendix

An appendix contains supplementary information that is not an essential part of the text itself but which may be helpful in providing a more comprehensive understanding of the research problem or it is information that is too cumbersome to be included in the body of the paper.

References

- [1] World Health Organization.: Non Communicable Diseases: Key Facts. Available from: <https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases>.
- [2] Benziger CP, Roth GA, Moran AE. The Global Burden of Disease Study and the Preventable Burden of NCD. *Global Heart*. 2016 Dec;11(4):393–397. <https://doi.org/10.1016/j.ghart.2016.10.024>.
- [3] Lawn JE, Kerber K, Enweronu-Laryea C, Cousens S. 3.6 Million Neonatal Deaths—What Is Progressing and What Is Not? *Seminars in Perinatology*. 2010 Dec;34(6):371–386. <https://doi.org/10.1053/j.semperi.2010.09.011>.
- [4] Lassi ZS, Bhutta ZA. Community-based Intervention Packages for Reducing Maternal and Neonatal Morbidity and Mortality and Improving Neonatal Outcomes. *Cochrane Database of Systematic Reviews*. 2015;(3). <https://doi.org/10.1002/14651858.CD007754.pub3>.
- [5] Liu NH, Daumit GL, Dua T, Aquila R, Charlson F, Cuijpers P, et al. Excess Mortality in Persons with Severe Mental Disorders: A Multilevel Intervention Framework and Priorities for Clinical Practice, Policy and Research Agendas. *World Psychiatry*. 2017;16(1):30–40. <https://doi.org/10.1002/wps.20384>.
- [6] Ewig S, Torres A. Community-Acquired Pneumonia as an Emergency: Time for an Aggressive Intervention to Lower Mortality. *European Respiratory Journal*. 2011 Aug;38(2):253–260. <https://doi.org/10.1183/09031936.00199810>.
- [7] World Health Organization. SCORE for Health Data Technical Package: Global Report on Health Data Systems and Capacity, 2020; 2021. Available from: <https://www.who.int/publications/i/item/9789240018709>.
- [8] de Savigny D, Riley I, Chandramohan D, Odhiambo F, Nichols E, Notzon S, et al. Integrating Community-Based Verbal Autopsy into Civil Registration and Vital Statistics (CRVS): System-Level Considerations. *Global Health Action*. 2017 Jan;10(1):1272882. <https://doi.org/10.1080/16549716.2017.1272882>.
- [9] Thomas LM, D'Ambruoso L, Balabanova D. Verbal Autopsy in Health Policy and Systems: A Literature Review. *BMJ Global Health*. 2018 May;3(2):e000639. <https://doi.org/10.1136/bmjgh-2017-000639>.

- [10] Rampatige R, Mikkelsen L, Hernandez B, Riley I, Lopez AD. Systematic Review of Statistics on Causes of Deaths in Hospitals: Strengthening the Evidence for Policy-Makers. *Bulletin of the World Health Organization*. 2014 Sep;92:807–816. <https://doi.org/10.2471/BLT.14.137935>.
- [11] Adair T. Who Dies Where? Estimating the Percentage of Deaths That Occur at Home. *BMJ Global Health*. 2021 Sep;6(9):e006766. <https://doi.org/10.1136/bmjgh-2021-006766>.
- [12] World Health Organization. Verbal Autopsy Standards: 2022 WHO Verbal Autopsy Instrument; 2023. Available from: <https://www.who.int/publications/m/item/training-curriculum-for-the-training-of-verbal-autopsy-master-trainers-and-supervisors>.
- [13] Chandramohan D, Fottrell E, Leitao J, Nichols E, Clark SJ, Alsokhn C, et al. Estimating Causes of Death Where There Is No Medical Certification: Evolution and State of the Art of Verbal Autopsy. *Global Health Action*. 2021 Oct;14(sup1):1982486. <https://doi.org/10.1080/16549716.2021.1982486>.
- [14] McCormick TH, Li ZR, Calvert C, Crampin AC, Kahn K, Clark SJ. Probabilistic Cause-of-Death Assignment Using Verbal Autopsies. *Journal of the American Statistical Association*. 2016 Jul;111(515):1036–1049. <https://doi.org/10.1080/01621459.2016.1152191>.
- [15] Morris SK, Bassani DG, Kumar R, Awasthi S, Paul VK, Jha P. Factors Associated with Physician Agreement on Verbal Autopsy of over 27000 Childhood Deaths in India. *PLoS one*. 2010;5(3):e9583.
- [16] Jha P, Kumar D, Dikshit R, Budukh A, Begum R, Sati P, et al. Automated versus Physician Assignment of Cause of Death for Verbal Autopsies: Randomized Trial of 9374 Deaths in 117 Villages in India. *BMC Medicine*. 2019 Jun;17(1):116. <https://doi.org/10.1186/s12916-019-1353-2>.
- [17] Leitao J, Desai N, Aleksandrowicz L, Byass P, Miasnikof P, Tollman S, et al. Comparison of Physician-Certified Verbal Autopsy with Computer-Coded Verbal Autopsy for Cause of Death Assignment in Hospitalized Patients in Low- and Middle-Income Countries: Systematic Review. *BMC Medicine*. 2014 Feb;12(1):22. <https://doi.org/10.1186/1741-7015-12-22>.
- [18] Desai N, Aleksandrowicz L, Miasnikof P, Lu Y, Leitao J, Byass P, et al. Performance of Four Computer-Coded Verbal Autopsy Methods for Cause of Death Assignment Compared with Physician Coding on 24,000 Deaths in Low- and Middle-Income Countries. *BMC Medicine*. 2014 Feb;12(1):20. <https://doi.org/10.1186/1741-7015-12-20>.
- [19] Tunga M, Lungo J, Chambua J, Kateule R. Verbal Autopsy Models in Determining Causes of Death. *Tropical Medicine & International Health*.

- 2021;26(12):1560–1567. <https://doi.org/10.1111/tmi.13678>.
- [20] Jeblee S, Gomes M, Jha P, Rudzicz F, Hirst G. Automatically Determining Cause of Death from Verbal Autopsy Narratives. BMC Medical Informatics and Decision Making. 2019 Jul;19(1):127. <https://doi.org/10.1186/s12911-019-0841-9>.
 - [21] Blanco A, Pérez A, Casillas A, Cobos D. Extracting Cause of Death From Verbal Autopsy With Deep Learning Interpretable Methods. IEEE Journal of Biomedical and Health Informatics. 2021 Apr;25(4):1315–1325. <https://doi.org/10.1109/JBHI.2020.3005769>.
 - [22] King C, Zamawe C, Banda M, Bar-Zeev N, Beard J, Bird J, et al. The Quality and Diagnostic Value of Open Narratives in Verbal Autopsy: A Mixed-Methods Analysis of Partnered Interviews from Malawi. BMC Medical Research Methodology. 2016 Feb;16(1):13. <https://doi.org/10.1186/s12874-016-0115-5>.
 - [23] Chang Y, Wang X, Wang J, Wu Y, Yang L, Zhu K, et al.: A Survey on Evaluation of Large Language Models. arXiv. Available from: <http://arxiv.org/abs/2307.03109>.
 - [24] Wu T, He S, Liu J, Sun S, Liu K, Han QL, et al. A Brief Overview of ChatGPT: The History, Status Quo and Potential Future Development. IEEE/CAA Journal of Automatica Sinica. 2023;10(5):1122–1136. <https://doi.org/10.1109/JAS.2023.123618>.