# Artificial Intelligence and emerging technologies in palliative and end of life care – opportunities and challenges?

**Hospice UK Conference, Liverpool 06/11/23**


**Dr Amara Nwosu**

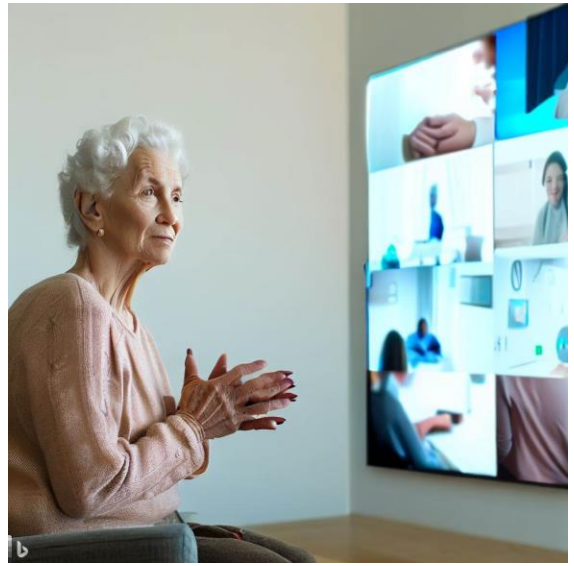
**MBChB FRCP PhD**

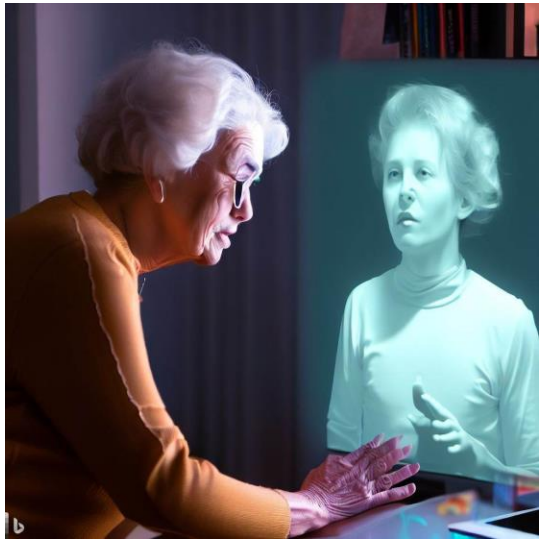
**@amaranwosu**

**a.nwosu@lancaster.ac.uk**

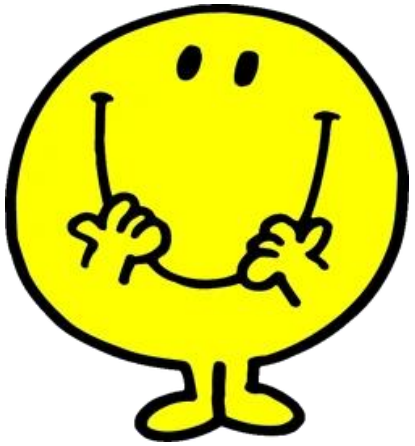
# Imagine the future in 2060…

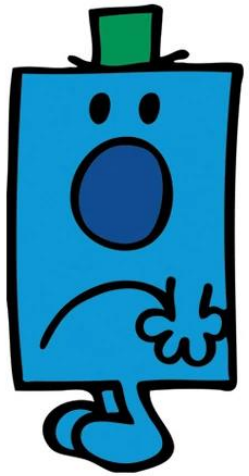
# Emma in 2060

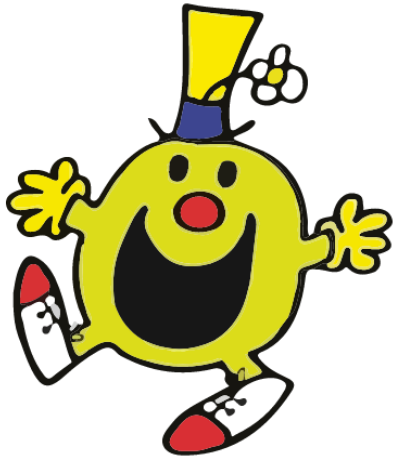




# How does this make you feel?







# Aims

- To provide an overview of my Churchill Fellowship to research palliative care technology

- Discussion of opportunities and challenges for artificial intelligence (AI) in palliative care
  - *Population level*
  - *Clinical management*
  - *The individual and digital legacy*

# My interest in palliative care technology

Blog | BMJ Supportive & Palliative Care

## Improving Palliative Care Through Digital Health Technology

Posted on May 26, 2020

**Dr Amara Callistus Nwosu**

*Lancaster University Faculty of Health and Medicine*
*International Observatory on End of Life Care*

**Opportunities**

- Innovation
- Remote care
- More choice

**Challenges**

- Does it work?
- Loss of human connection
- Inequalities

**Published on 21.3.2022 in Vol 5, No 1 (2022): Jan-Mar**

Preprints (earlier versions) of this paper are available at , first published July 14, 2021.

# Identification of Digital Health Priorities for Palliative Care Research: Modified Delphi Study

Amara Callistus Nwosu [1, 2, 3]; Tamsin McGlinchey [4]; Justin Sanders [5, 6, 7]; Sarah Stanley [2]; Jennifer Palfrey [8]; Patrick Lubbers [9]; Laura Chapman [2]; Anne Finucane [10]; Stephen Mason [4]



## Citation

**Please cite as:**

Nwosu AC, McGlinchey T, Sanders J, Stanley S, Palfrey J, Lubbers P, Chapman L, Finucane A, Mason S
Identification of Digital Health Priorities for Palliative Care Research: Modified Delphi Study
JMIR Aging 2022;5(1):e32075
doi: 10.2196/32075
PMID: 35311674

# Priority Topics

- Telehealth & Telemedicine
- Big Data
- Mobile Devices & Wearables
- Virtual Reality
- Smart home
- Biotechnology
- Artificial Intelligence
- Digital Legacy

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- Telehealth & Telemedicine
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the CHURCHILL fellowship

- Overseas travelling fellowship for UK citizens to find innovative solutions for important problems.

- In 2020, I was awarded a Churchill Fellowship to visit the U.S.A and the Netherlands to research how technology, data and design can support palliative care.

# Countries visited

The Netherlands

USA

TU Delft

Delft University of Technology

Dana-Farber Cancer Institute

IKNL Netherlands comprehensive cancer organisation

Erasmus MC University Medical Center Rotterdam

HARVARD MEDICAL SCHOOL

Massachusetts Institute of Technology

# Artificial Intelligence (AI)

- Artificial intelligence (AI) describes the science and engineering of developing intelligent machines
  - Algorithms or a set of rules
  - Machine follows rules to mimic human cognitive functions

- Increasingly used in healthcare
  - For example; large datasets to recognise patterns and relationships, to identify proactive treatment solutions.
  - Electronic healthcare records (EHR)

# Types of Artificial Intelligence

**REACTIVE**

Has no memory, only responds to different stimuli

**LIMITED MEMORY**

Uses memory to learn and improve its responses

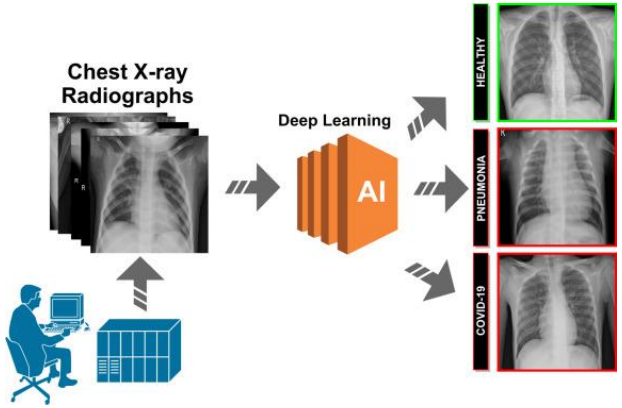
**THEORY OF MIND**

Understand the need of other intelligent entities

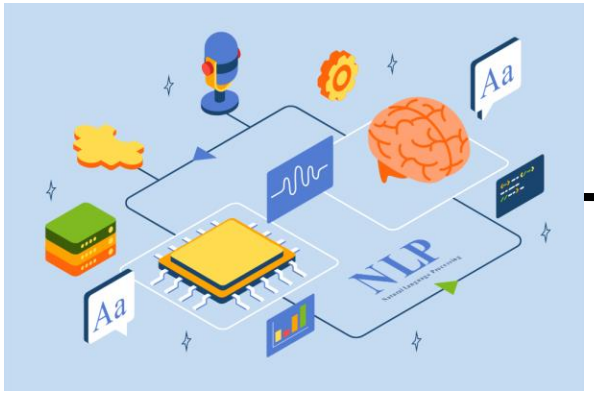
**SELF AWARE**

Has human-like intelligence and self awareness

# Examples of AI methods




**Learning**

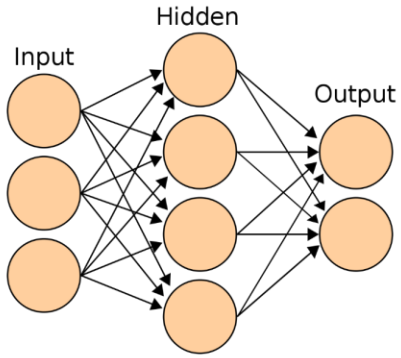



**Natural language processing**

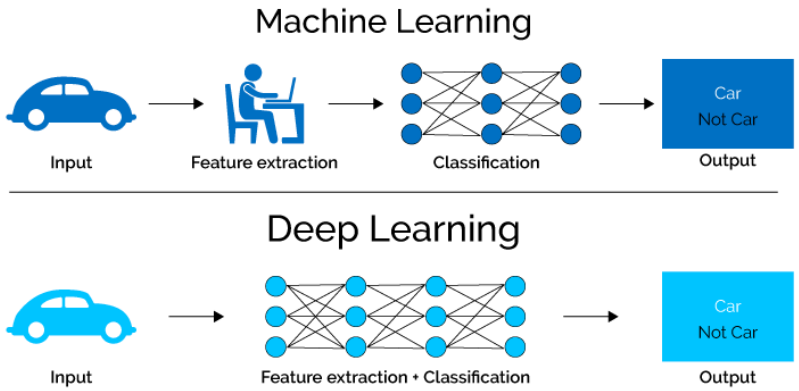
**2019:** Generative pre-trained transformer (GPT) language models generate coherent text.

**2023:** ChatGPT achieves human level scores in professional exams

**Perception**

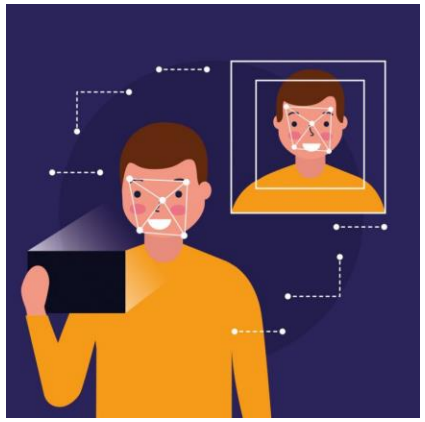



**Artificial neural network**




**Deep learning**

# Day to day examples of AI



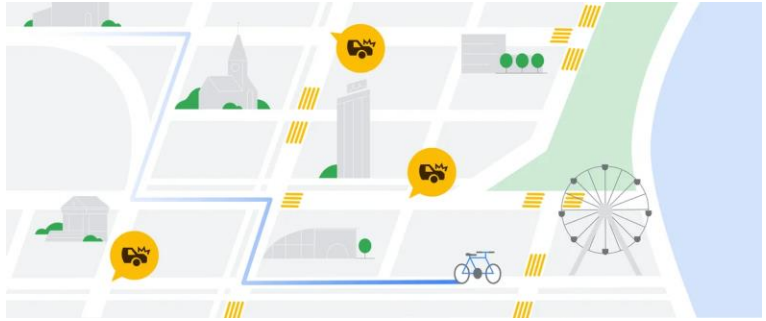
Facial recognition

Social media


Email

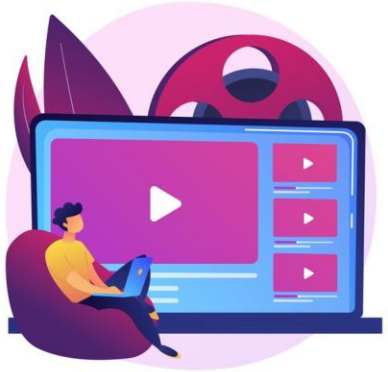

Web search

Voice assistants



Navigation apps


Banking



Streaming services

# AI for Population level analysis


North Sea
UNITED KINGDOM
GERMANY
Amsterdam
The Hague
NETHERLANDS
BELGIUM



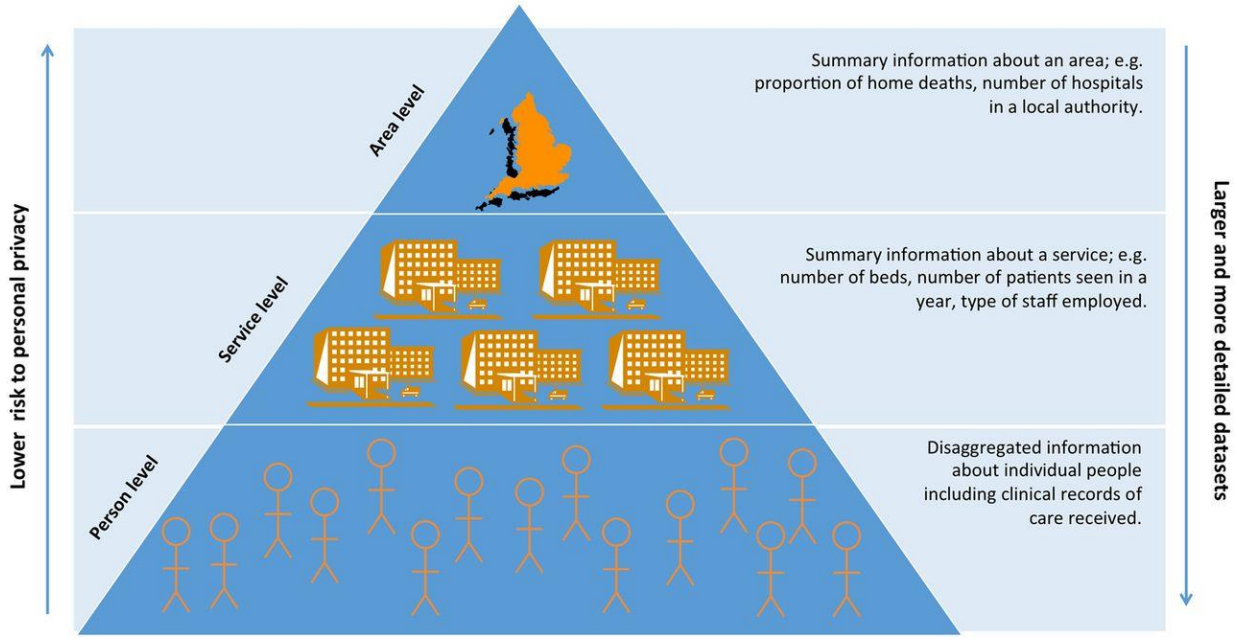
The Hague

NETHERLANDS



# Big Data in Palliative Care

Big data describes large amounts of (previously unmanageable) data that can now be processed by modern computer analysis techniques.




Davies JM, Gao W, Sleeman KE*, et al*
Using routine data to improve palliative and end of life care
*BMJ Supportive & Palliative Care* 2016;**6:**257-262.

# Big Data has important potential in palliative care - EAPC 2022

**Professor Joachim Cohen**
End-of-Life Care Research Group of the Vrije Universiteit Brussel.

1. Population needs assessment and monitoring.
2. Health care system and quality of care evaluations.
3. Addressing causality.
4. Evaluate policies interventions, programs in the real world.
5. Efficient data collection methods for palliative care trials.
6. Prediction and prospective decision support.

# Using national data for healthcare decisions

**Netherlands Cancer Registry (NCR)**

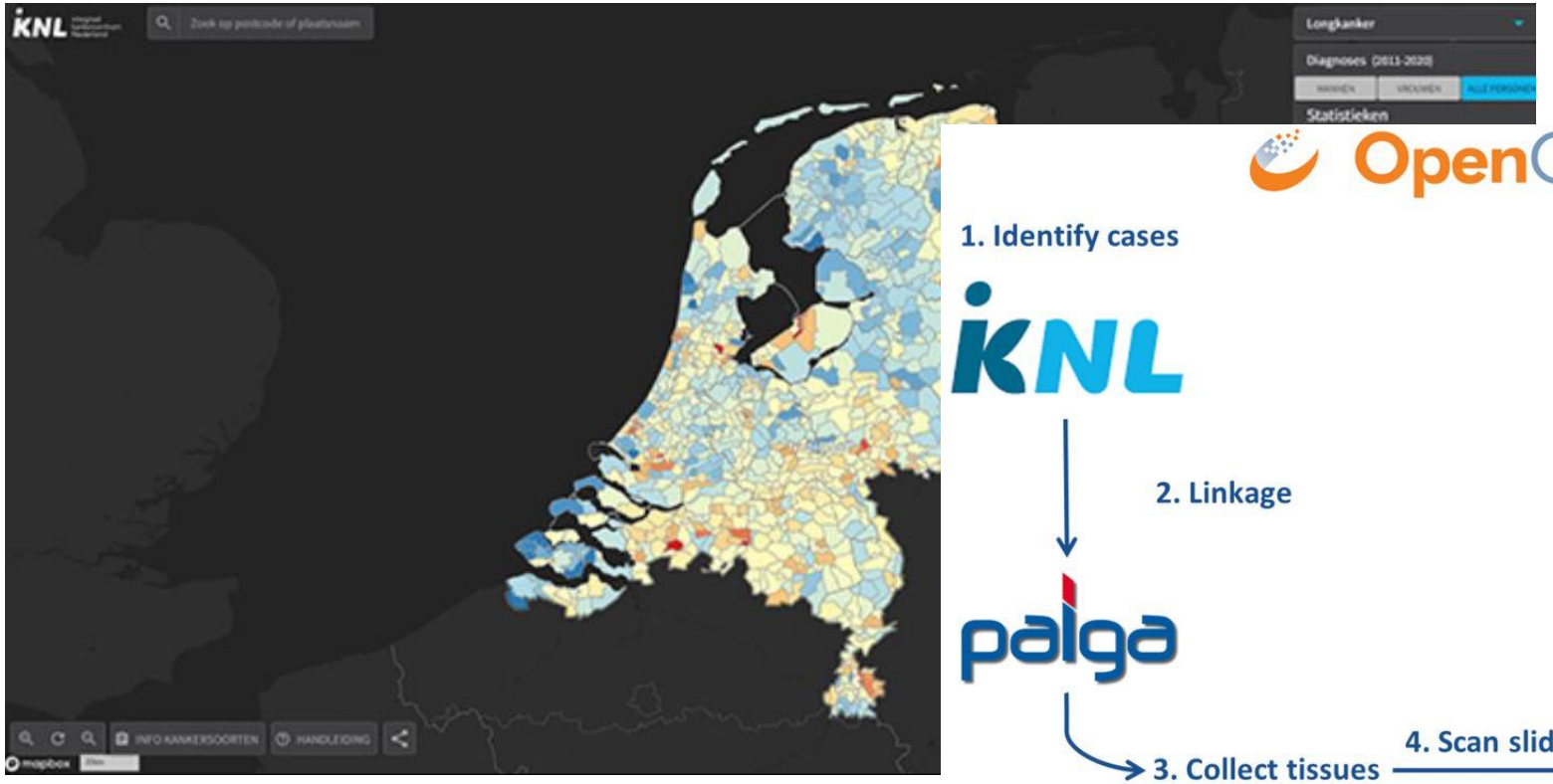
- Data of all Dutch cancer patients
- 2.7 million patients
- Open, international, anonymous dataset
- Netherlands Comprehensive Cancer Organization (IKNL)

**Palliative care**

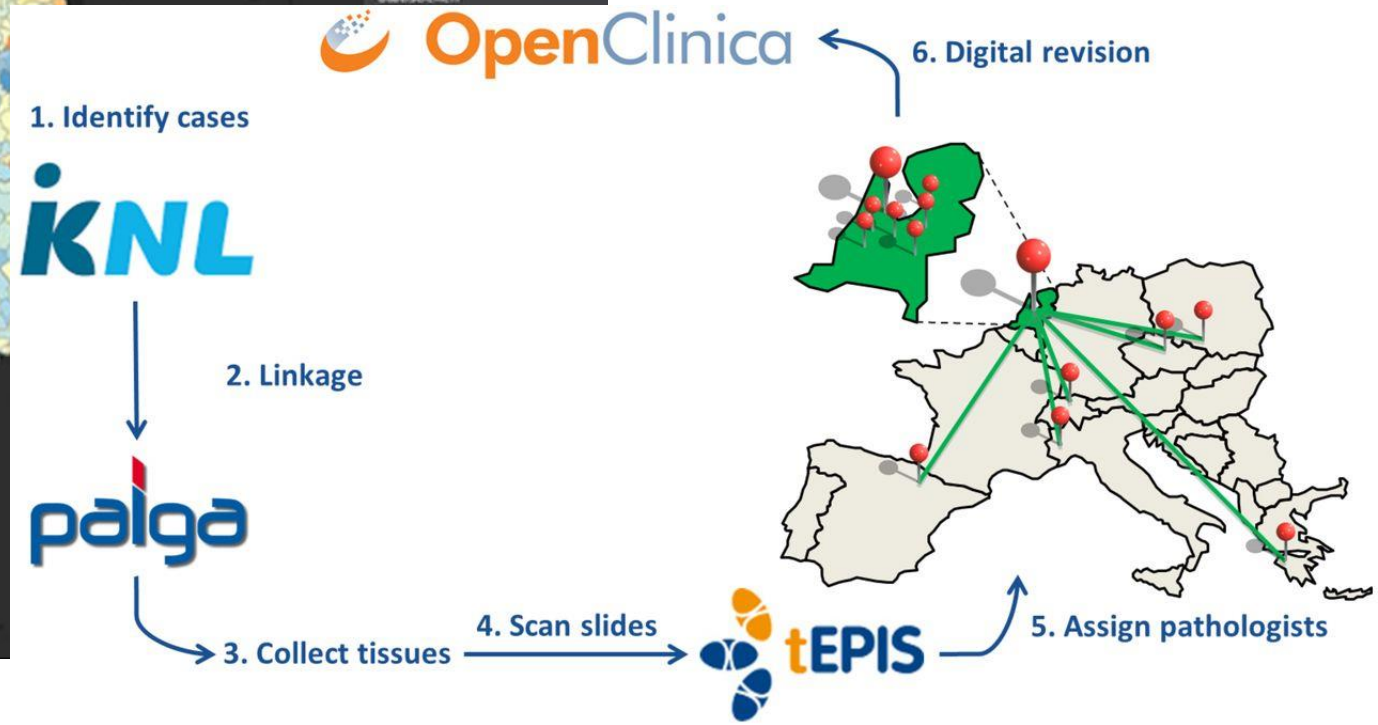
- Realtime guidelines
- Cancer data on Google maps
- Visualising data in real-time
- Research and federated learning

IKNL Netherlands comprehensive cancer organisation

# Using national and international data to inform care




Mapping out cancer data for analysis and comparison



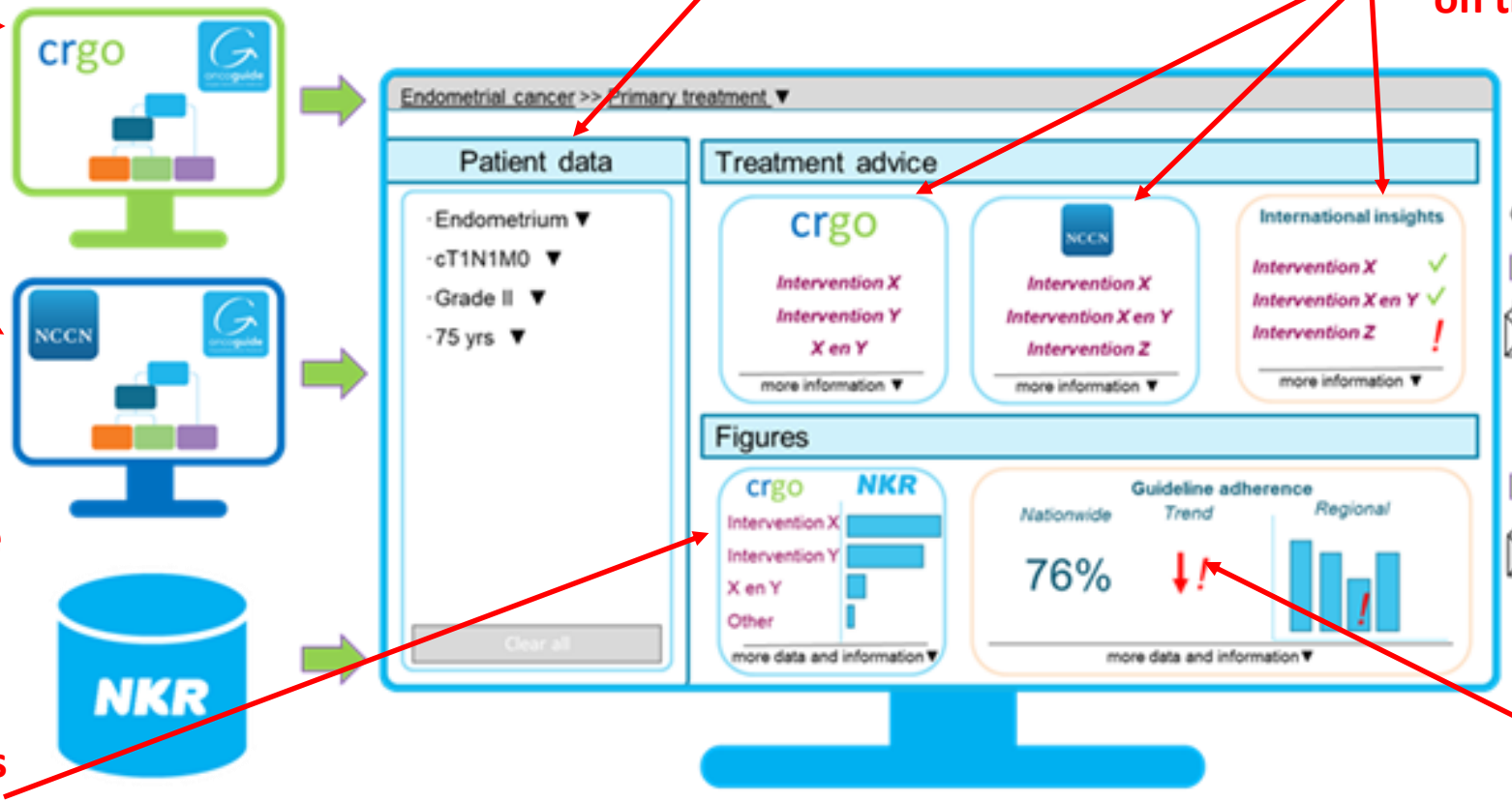

Sharing data to use international expertise

*Dackus GM et al. Long-term prognosis of young breast cancer patients (≤40 years) who did not receive adjuvant systemic treatment: protocol for the PARADIGM initiative cohort study. BMJ Open 2017;7:e017842. doi: 10.1136/bmjopen-2017-017842*

# Using AI to visualise clinical outcomes

AI pulls different guidelines about specific cancers

The guidelines are applied to the patient and treatment recommendations are compared automatically based on the data




The guideline data is fed into electronic patient records on real or dummy patients

Guideline committee review all data to see how guidelines work in practice


The guidelines are applied to the patient and treatment recommendations are compared automatically based on the data

Dashboard shows guideline adherence nationally and locally

# Federated Learning

Federated Learning addresses the problem of data governance and privacy, by training algorithms collaboratively without exchanging the data itself.

**What is the survival data for adults with renal failure with metastatic cord compression after they receive radiotherapy?**

**Algorithm sent to local electronic healthcare database**

**Answer returned with no exchange of patient data**

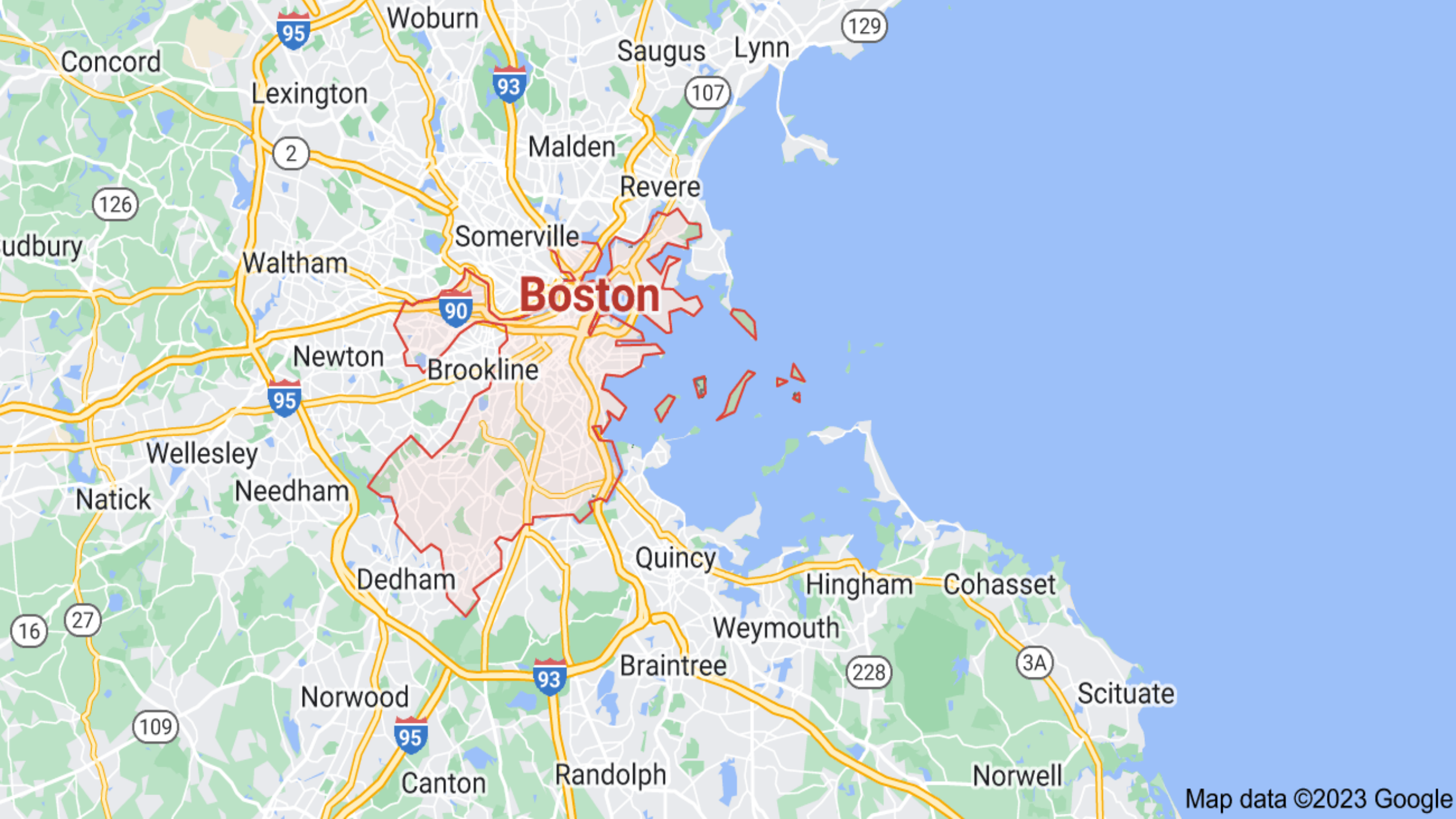
**Analysis done rapidly on data recorded on standardized datasets**


Liverpool


Rotterdam


Boston


# AI for clinical care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Concord
Lexington
Saugus
Lynn
Malden
Revere
Somerville
Boston
Waltham
Newton
Brookline
Wellesley
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Needham
Dedham
Quincy
Hingham
Cohasset
Weymouth
Braintree
Norwood
Canton
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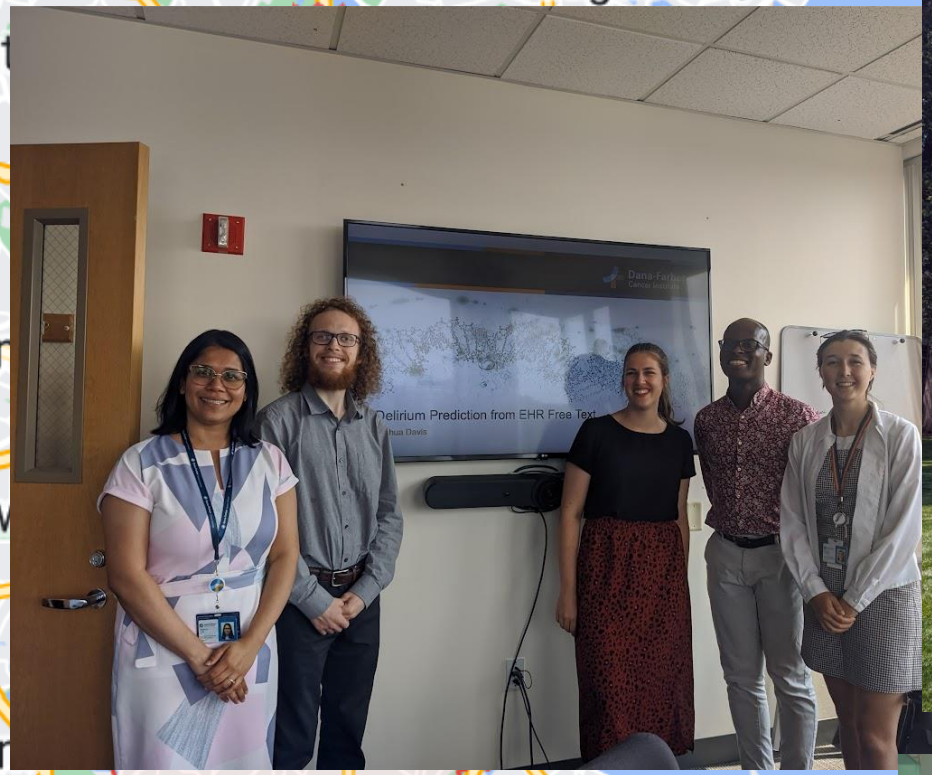
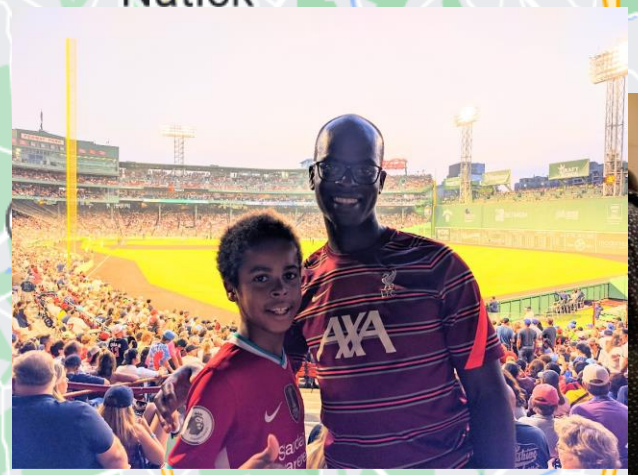
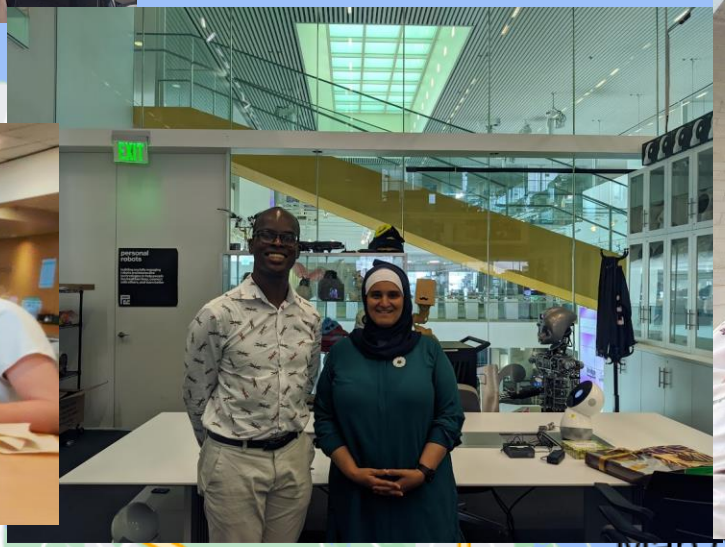
3A
Map data ©2023 Google



# AI to identify palliative care need & estimate survival

ELSEVIER

Journal of Pain and Symptom Management

Volume 63, Issue 5, May 2022, Pages 879-880

## Randomized Trial of a Novel Artificial Intelligence/Machine Learning Model to Predict Palliative (

Alisha Morgan DO, Jor
Jacob Strand MD FACP
Curtis Storlie PhD

Show more

CrossMark

## Development and Validation of Machine Learning Models for Prediction of 1-Year Mortality Utilizing Electronic Medical Record Data Available at the End of Hospitalization in Multicondition Patients: a Proof-of-Concept Study

*Nishant Sahni, MD, MS[1], Gyorgy Simon, PhD[2], and Rashi Arora, MD[1]*

[1]Division of General Internal Medicine, University of Minnesota, Minneapolis, MN, USA; [2]Institute of Health Informatics, University of Minnesota, Minneapolis, MN, USA.

# AI to analyse symptoms

Published in final edited form as:
*Adv Data Min.* 2015 July ; 9165: 56–68. doi:10.1007/978-3-319-20910-4_5.

## Predictive Modeling for End-of-Life Pain Outcome using Electronic Health Records

**Muhammad K. Lodhi[1], Janet Stifter[1], Yingwei Yao[1], Rashid Ansari[1], Gail M. Kee-nan[2], Diana J**

Research and applications

OPEN ACCESS

## Longitudinal analysis of pain in patients with metastatic prostate cancer using natural language processing of medical record text

Norris H Heintzelman,[1] Robert J Taylor,[2] Lone Simonsen,[2] Roger Lustig,[2] Doug Anderko,[1] Jennifer A Haythornthwaite,[3] Lois C Childs,[1] George Steven Bova[4,5,6]

# Natural Language Processing of healthcare records in palliative care

**Lindvall Lab – Dana Farber Cancer Institute (DFCI)**

Computational palliative care research

**Dr Charlotta Lindvall**

Developing and testing novel NLP-based approaches to capture palliative care quality measures.

Dana-Farber Cancer Institute

HARVARD MEDICAL SCHOOL

# Evaluating interventions

Ann Surg Oncol (2019) 26:4204–4212
https://doi.org/10.1245/s10434-019-07757-2

Annals of SURGICAL ONCOLOGY
OFFICIAL JOURNAL OF THE SOCIETY OF SURGICAL ONCOLOGY

ORIGINAL ARTICLE – HEALTH SERVICES RESEARCH AND GLOBAL ONCOLOGY

## Deficits in the Palliative Care Process Measures in Patients with Advanced Pancreatic Cancer Undergoing Operative and Invasive Nonoperative Palliative Procedures

Brooks V. Udelsman, MD, MHS[1], Elizabeth J. Lilley, MD, MPH[2-3], Motaz Qadan, PhD[1], David C. Chang, PhD, MBA, MPH[1], Keith D. Lillemoe, MD[1], Charlotta Lindvall, MD, PhD[4,5],

**Analysis of administrative data to determine palliative care quality.**



*Brief Methodological Report*

## Identifying Goals of Care Conversations in the Electronic Health Record Using Natural Language Processing and Machine Learning

Robert Y. Lee, MD, MS, Lyndia C. Brumback, PhD, William B. Lober, MD, MS, James Sibley, BS, Elizabeth L. Nielsen, MPH, Patsy D. Treece, RN, MN, Erin K. Kross, MD, Elizabeth T. Loggers, MD, PhD, James A. Fausto, MD, Charlotta Lindvall, MD, PhD, Ruth A. Engelberg, PhD, and J. Randall Curtis, MD, MPH
*Cambia Palliative Care Center of Excellence (R.Y.L., L.C.B., W.B.L., J.S., E.L.N., P.D.T., E.K.K., E.T.L., J.A.F., R.A.E., J.R.C.), University of Washington, Seattle, Washington; Division of Pulmonary, Critical Care, and Sleep Medicine (R.Y.L., E.L.N., P.D.T., E.K.K., R.A.E., of Psychosocial Oncology and Palliative Care (C.L.), Dana-Farber Cancer Institute, Boston, Massachusetts, USA*

**Identification of goals-of-care discussions for people with serious illness.**

JOURNAL OF PALLIATIVE MEDICINE
Volume 22, Number 2, 2019
© Mary Ann Liebert, Inc.
DOI: 10.1089/jpm.2018.0326

## Natural Language Processing to Assess End-of-Life Quality Indicators in Cancer Patients Receiving Palliative Surgery

Charlotta Lindvall, MD, PhD,[1,2] Elizabeth J. Lilley, MD, MPH,[3,4] Sophia N. Zupanc,[1] Isabel Chien, BS,[1,5] Brooks V. Udelsman, MD, MHS,[6] Anne Walling, MD, PhD,[7,8] Zara Cooper, MD, MSc,[4] and James A. Tulsky, MD[1,2]

**Abstract**

***Background:*** Palliative surgical procedures are frequently performed to reduce symptoms in patients with

**Identification of cancer patients receiving palliative gastrostomy and end-of-life documentation.**



*Original Article*

## Natural Language Processing Accurately Measures Adherence to Best Practice Guidelines for Palliative Care in Trauma

Check for updates

Katherine C. Lee, MD, MSc, Brooks V. Udelsman, MD, MHS, Jocelyn Streid, BA, David C. Chang, PhD, MPH, MBA, Ali Salim, MD, David H. Livingston, MD, Charlotta Lindvall, MD, PhD, and Zara Cooper, MD, MSc
*The Center for Surgery and Public Health (K.C.L.), Brigham and Women's Hospital, Boston, Massachusetts; Department of Surgery (K.C.L.,*

**Identification of trauma patients receiving palliative care input.**

*Boston, Massachusetts, USA*

# NLP of automatic transcription in consultations for Advance Care Planning

npj | Digital Medicine

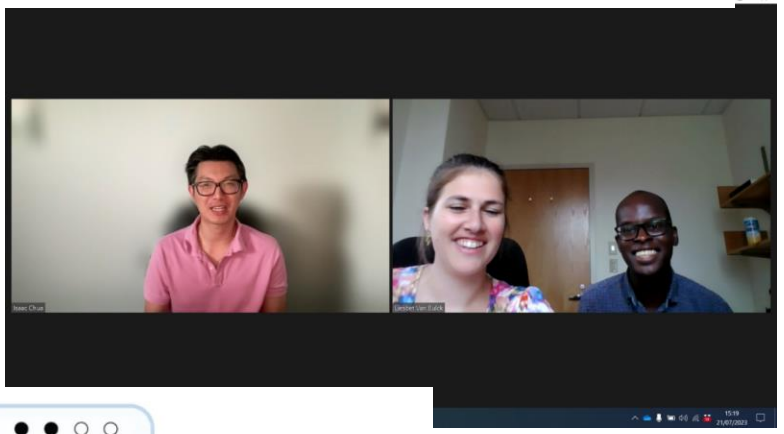
COMMENT OPEN

## Enhancing serious illness communication using artificial intelligence

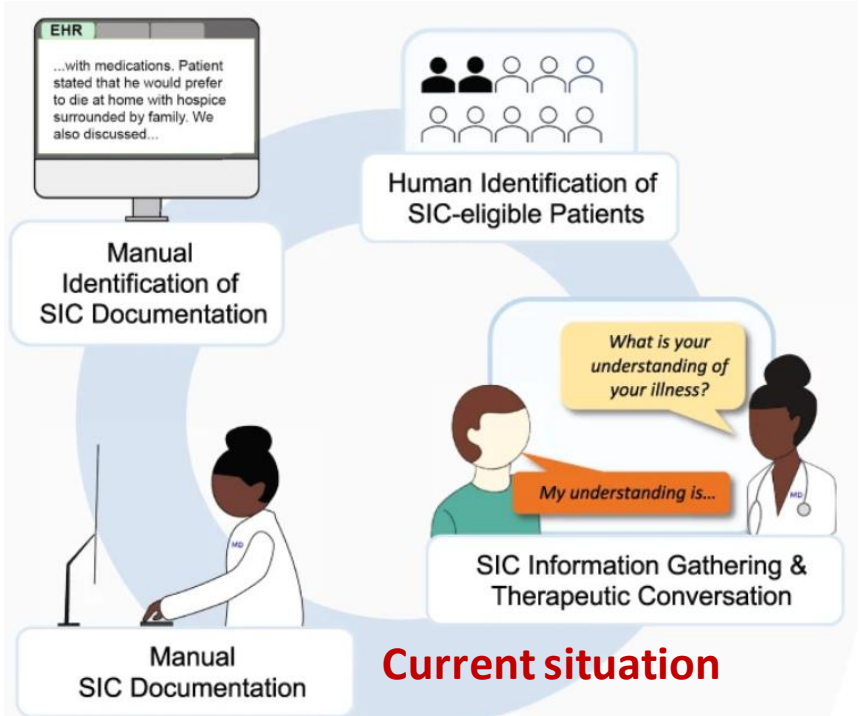
Isaac S. Chua[1,2,3]✉, Christine S. Ritchie[3,4] and David W. Bates[1,3]

Delivery of serious illness communication (SIC) is necessary to ensure that all seriously ill patients receive goal-concordant care. However, the current SIC delivery process contains barriers that prevent the delivery of timely and effective SIC. In this paper, we describe the current bottlenecks of the traditional SIC workflow and explore how a hybrid artificial intelligence-human workflow may improve the efficiency and effectiveness of SIC delivery in busy practice settings.

*npj Digital Medicine* (2022)5:14; https://doi.org/10.1038/s41746-022-00556-2

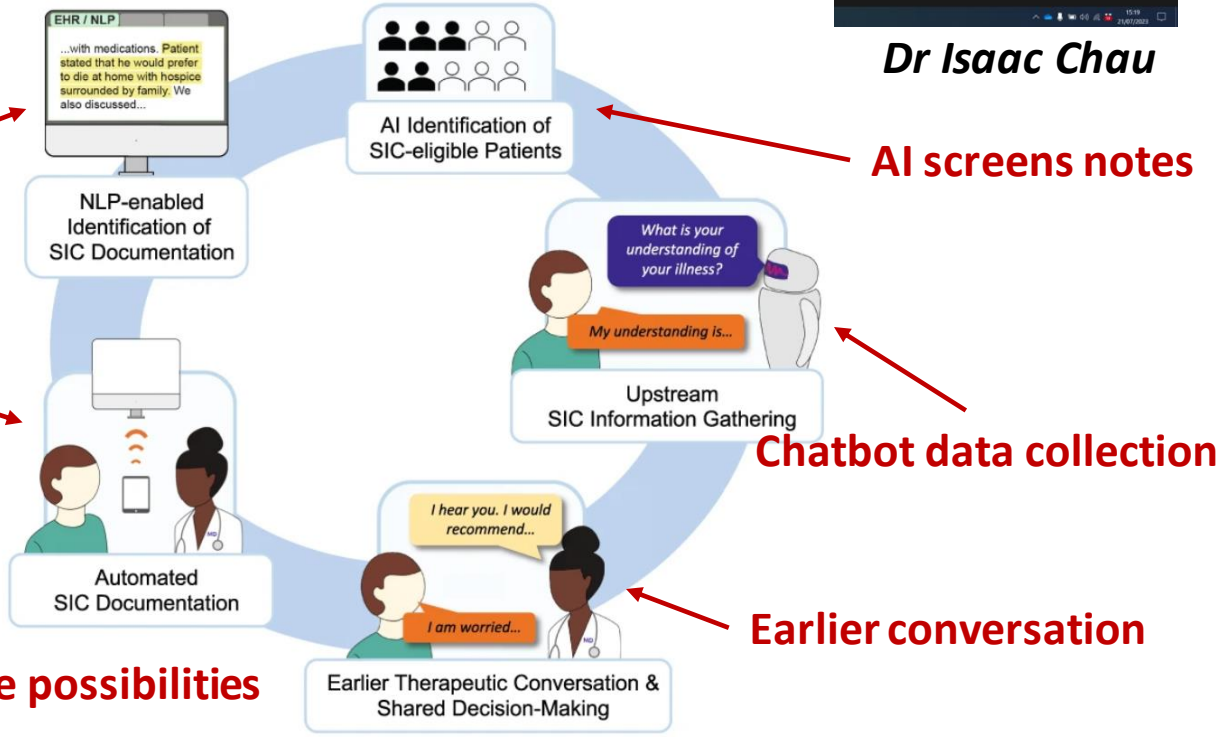


***Dr Isaac Chau***




**NLP analysis, documentation and ACP sharing**

**Speech analysis – automatic transcription**

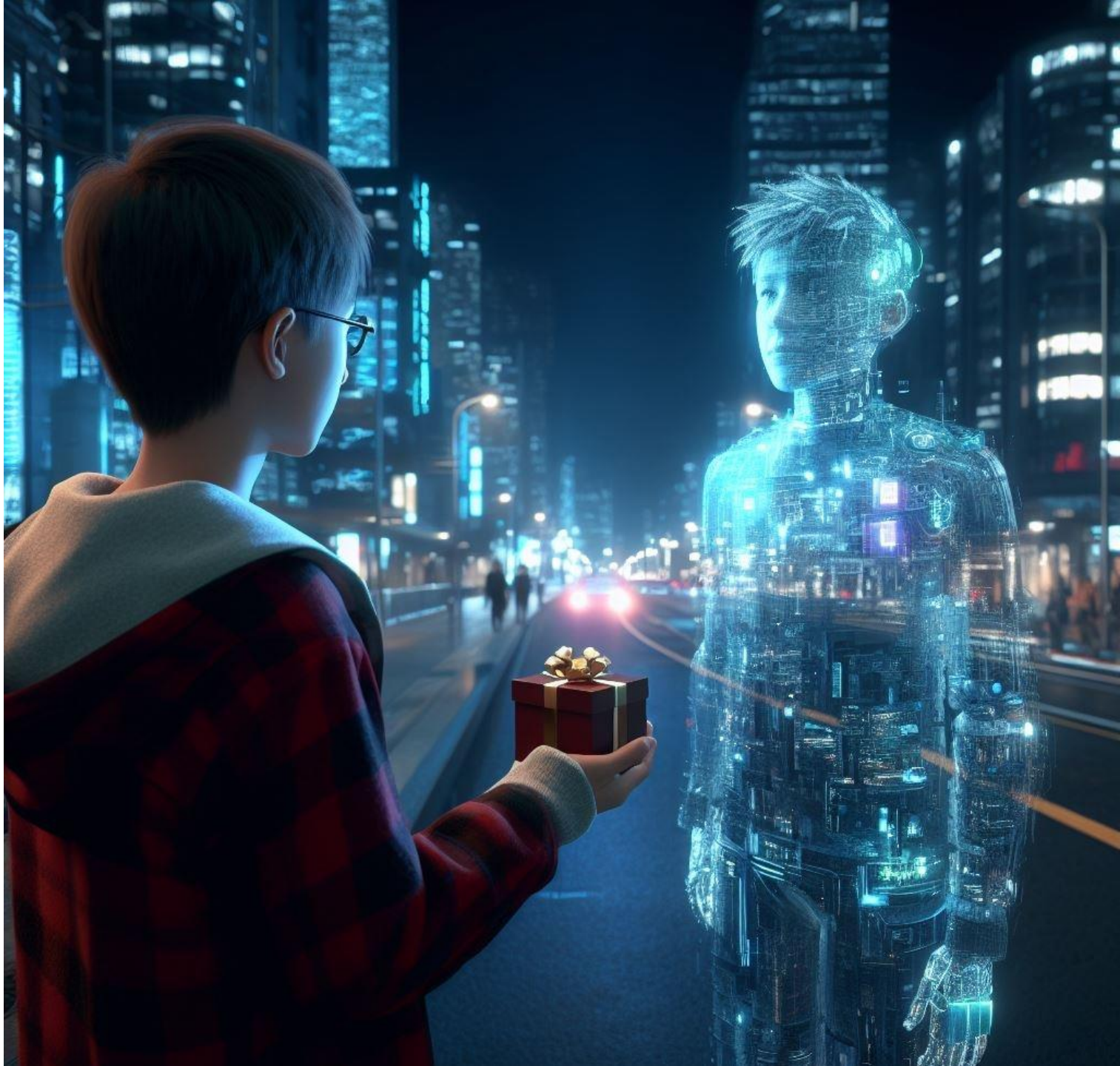



**AI screens notes**

**Chatbot data collection**

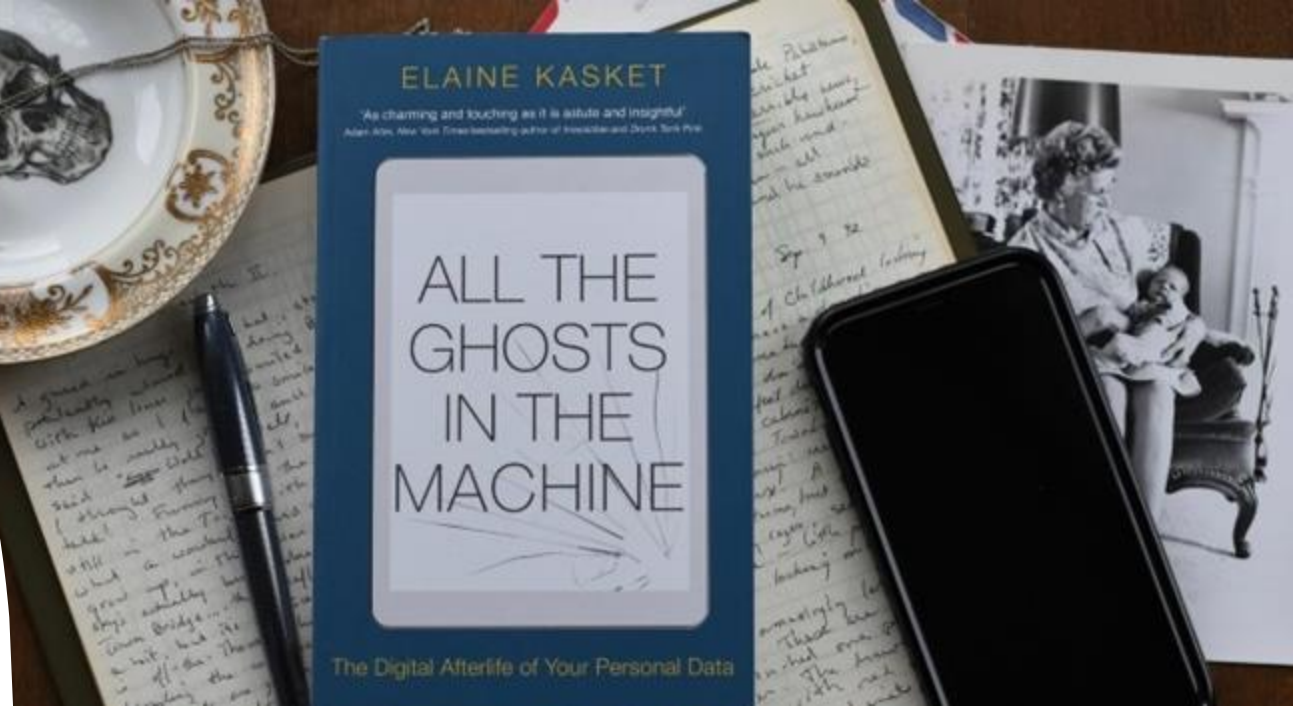
**Earlier conversation**

# AI to support the individual and their digital legacy



# Increasing number of deceased users on social media

- Professor Elaine Kasket
- Who controls data of the dead?
- Expected 4.9 billion accounts of dead people on Facebook in the next century.
- How will you control your data?
- Opportunities & challenges?




# Digital Legacy is increasingly important in Palliative Care


https://digitallegacyassociation.org/




**James Norris**

*Original Article*

PALLIATIVE MEDICINE

**A grounded theory study exploring palliative care healthcare professionals' experiences of managing digital legacy as part of advance care planning for people receiving palliative care**

*Palliative Medicine*
2023, Vol. 37(9) 1424–1433

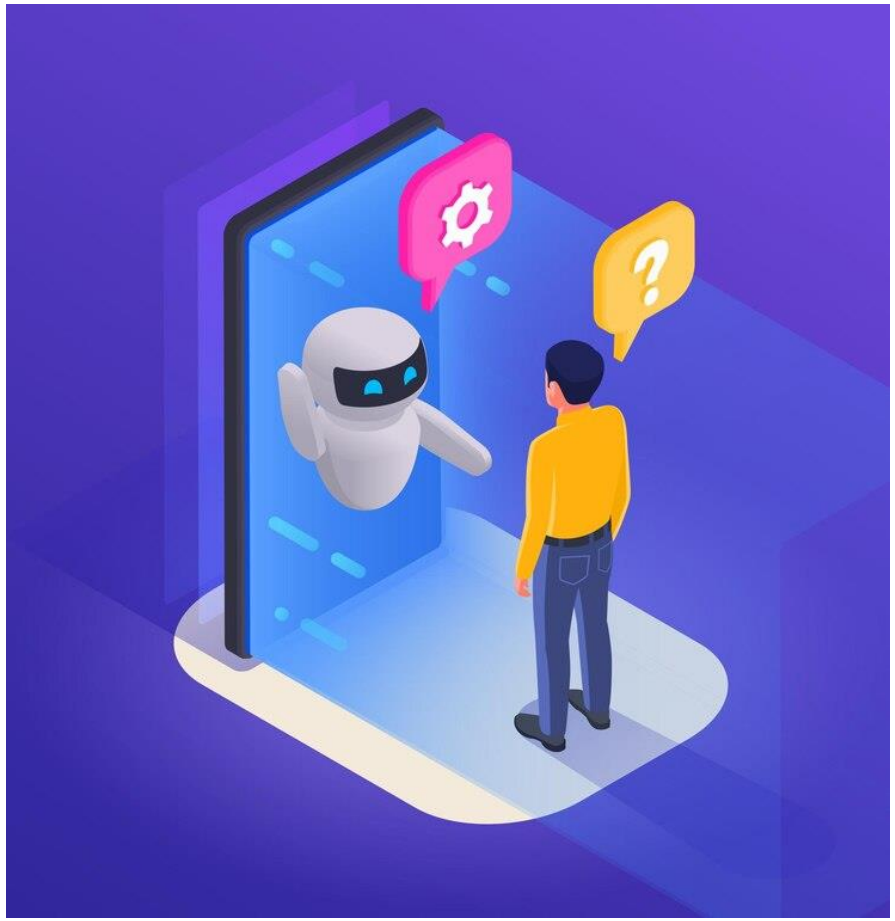
DOI: 10.1177/02692163231194198
journals.sagepub.com/home/pmj
Sage

Sarah Stanley[1,2], Karen Higginbotham[2], Anne Finucane[3,4] and Amara Callistus Nwosu[1,5,6]

**Sarah Stanley**

# Examples of AI technologies to influence digital legacy

- AI chatbots
- Holograms and avatars
- AI assistants



# Chatbots in Palliative Care

mit media lab

Massachusetts Institute of Technology

*Dr Nathan Whitmore & Dr Ruby Liu*
*MIT researchers*

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☰ Article Navigation

## Living Memories: AI-Generated Characters as Digital Mementos


Pat Pataranutaporn, MIT Media Lab, MIT, United States, patpat@mit.edu
Valdemar Danry, MIT Media Lab, MIT, United States, vdanry@mit.edu
Lancelot Blanchard, MIT Media Lab, MIT, United States, lancelot@mit.edu
Lavanay Thakral, MIT Media Lab, MIT, United States, f20160566@goa.bits-pilani.ac.in
Naoki Ohsugi, NTT DATA Corporation, Japan, naoki.ohsugi@nttdata.com

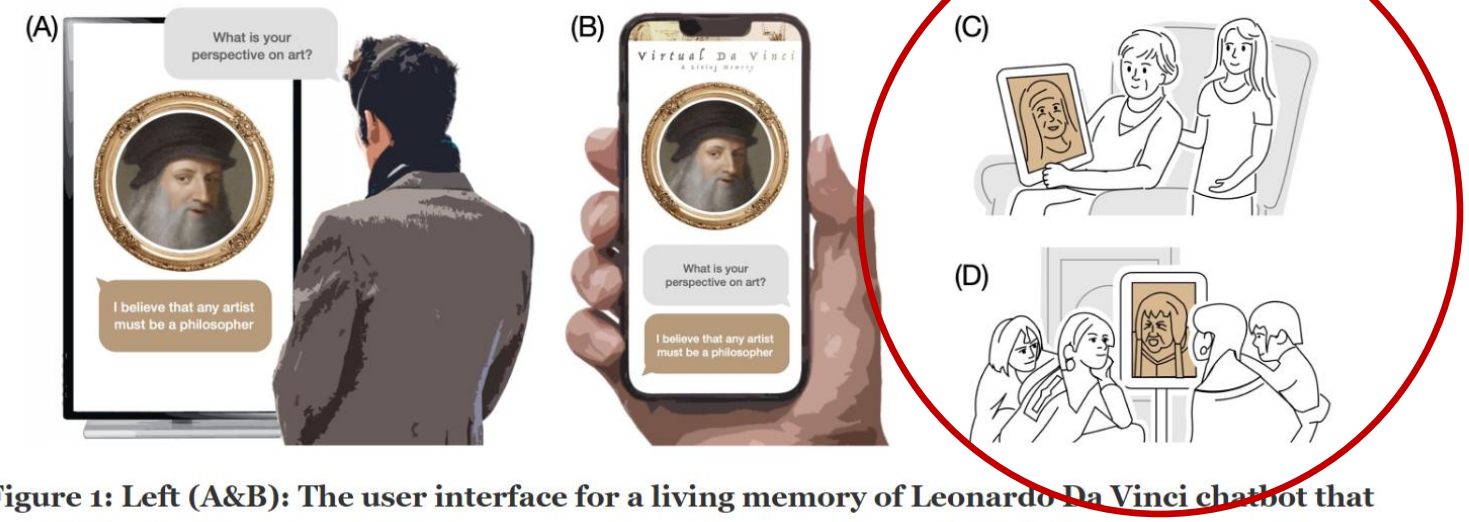




**Figure 1: Left (A&B): The user interface for a living memory of Leonardo Da Vinci chatbot that participants interacted with using our system. The experience started with a 40 second long animated video of Leonardo Da Vinci introducing himself generated using an open-source AI-generated character pipeline. Right: Potential applications of Living Memories to (C) help people remember and mourn, and (D) preserve culture and learn about people from the past.**

# Dame Cicely Saunders recreated as an AI chatbot

# Holograms of the dead

Copyright: 2014 Kevin Winter/Billboard Awards 2014

Copyright: Christopher Polk/Getty Images for Coachella 2012


Copyright: X, formerly Twitter, 2020

# Designers & ethics in Palliative care AI

Professor Judith Rietjens

Dr Euiyong Kim

Student Erasmus Research Master team

- Human centred design
- Decision-making
- Evaluation
- Ethics

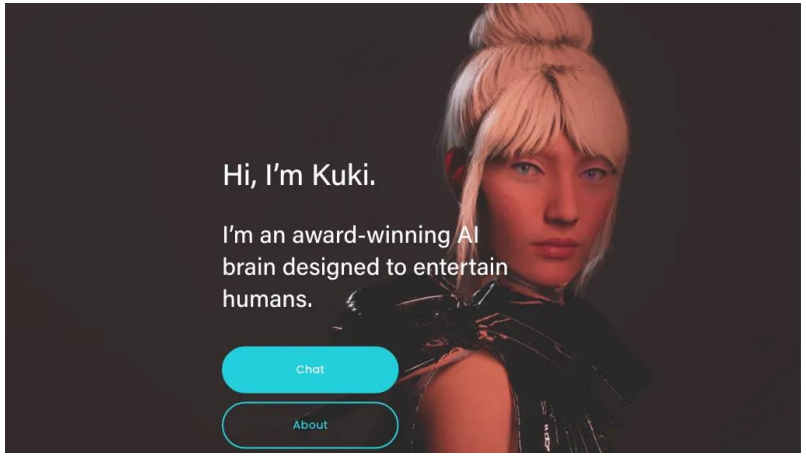
Dr Jiwon Jung


Ethical seminar about AI in palliative care

TU Delft Delft University of Technology

Erasmus MC

# Imagine your funeral in the future







# Some opportunities…

- Personalised care to individuals and populations
- Improved efficiency
- Real-time data & analysis
- New interventions
- New forms of research
- Develop and curate digital legacies

*Copyright -Bryan Lee O'Malley*

# Some challenges…

- Bias
- Risk of inequalities if not used well
- Lack of expertise
- Infrastructure
- Cost and maintenance issues
- Issues with trust/governance/ethics/ownership of data

*Copyright -Bryan Lee O'Malley*

# Current work…

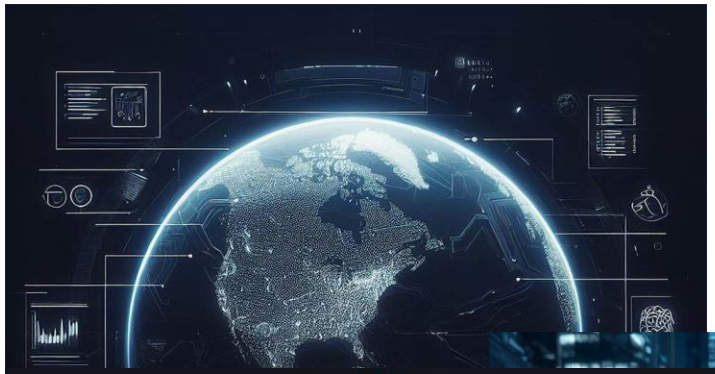
Digital Legacy
Design
&
Technology
Network

Next meeting:

- **Wednesday 20th March 2024 in Liverpool Science Park.**

- Contact me if you want further information.

# Final thoughts – AI is already here





# Conclusions

- AI is already present in various forms and there is potential to influence palliative care from population, clinical care level and individual & digital legacy level.
- Focus on the practical applications of AI in palliative care, rather than binary debates of its virtue.
- Interdisciplinary research is needed to explore how AI can be best used in palliative care.
- *More research is needed about the generic publicly available AI tools (e.g. ChatGPT)

# Attributions - Images

- Google
- Freepik
- Chest X-Ray Ai image (de Moura, Joaquim, Jorge Novo, and Marcos Ortega. "Fully automatic deep convolutional approaches for the analysis of COVID-19 using chest X-ray images." *Applied Soft Computing* 115 (2022): 108190.)
- Perception AI image: By JonMcLoone at English Wikipedia, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=44894482
- 2014 Kevin Winter/Billboard Awards 2014
- Christopher Polk/Getty Images for Coachella 2012
- X, formerly, Twitter
- Google
- ImagineMe
- KukiAI
- Scott Pilgrim - Bryan O'Malley


# Thank you!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