digitalhealth



Masterclass: the future of generative AI in health and care

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### General Purpose Al in Modern Healthcare Dr Umang Patel Chief Clinical Information Officer Microsoft

Standing on the shoulders of giants "1. Everything a doctor does should be centered on the needs of the patient. 2. If you do not know of a treatment that will help your patient, invent one."

Prof. Nicolai L. Volodos Prof. Alexander Shalimov



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# Real world use today?

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#### AI-Based Chest CT Analysis for Rapid COVID-19 Diagnosis and Prognosis: A Practical Tool to Flag High-Risk Patients and Lower Healthcare Costs

by 🙉 Giovanni Esposito 1 🖂 🙉 Benoit Ernst 2 🖂 💿 🙉 Monique Henket 3 🖂 🚯 Marie Winandy 3 🖂 💿 😰 Avishek Chatterjee 1 🖂 🙉 Simon Van Eyndhoven 1 🖂 😳 🙉 Jelle Praet 1 🖂 🙆 Dirk Smeets 1 🖂 🙉 Paul Meunier 4 🖂 🙉 Renaud Louis <sup>3</sup> 🖂 🙉 Philippe Kolh <sup>5</sup> 🖂 and 🙉 Julien Guiot <sup>3,\*</sup> 🖂 💿

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#### Diagnostics 2022, 12(7), 1608; https://doi.org/10.3390/diagnostics12071608

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(This article belongs to the Section Machine Learning and Artificial Intelligence in Diagnostics)

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#### Abstract

Early diagnosis of COVID-19 is required to provide the best treatment to our patients, to prevent the epidemic from spreading in the community, and to reduce costs associated with the aggravation of the disease. We developed a decision tree model to evaluate the impact of using an artificial intelligence-based chest computed tomography (CT) analysis software (icolung, icometrix) to analyze CT scans for the detection and prognosis of COVID-19 cases. The model compared routine practice where patients receiving a chest CT scan were not screened for COVID-19, with a scenario where icolung was introduced to enable COVID-19 diagnosis. The primary outcome was to evaluate the impact of icolung on the transmission of COVID-19 infection, and the secondary outcome was the inhospital length of stay. Using EUR 20000 as a willingness-to-pay threshold, icolung is cost-effective in reducing the risk of transmission, with a low prevalence of COVID-19 infections. Concerning the hospitalization cost, icolung is cost-effective at a higher value of COVID-19 prevalence and risk of hospitalization. This model provides a framework for the evaluation of AI-based tools for the early detection of COVID-19 cases. It allows for making decisions regarding their implementation in routine practice, considering both costs and effects.

Keywords: COVID; SARS-CoV-2; Al-based CT-scan analysis; hospital days reduction; infection reduction; patient flow management; PCR test rationalization; incremental cost-effectiveness ratio; COVID-19 infection spread prevention

#### 1. Introduction

Early identification of patients infected with COVID-19 remains a priority for several reasons, regardless of the severity of their symptoms. In-hospital management of patient flow, whether for consultations or stays, is a critical issue in a pandemic situation, as many people arriving at the hospital may be healthy carriers, hence, making identification complex.

The cross-infection question is of utmost importance in the matter of hospital hygiene. Indeed, patients in contact with each other are at high risk of contamination, often due to insufficient individual protection equipment. Considering the fragility of patients, justifying their presence in the heavital, it is important to implement strategies that lower the cross infaction ricks within the heavital

#### \*\*Introduction:\*\*

- Early identification of COVID-19 patients is crucial for managing patient flow and preventing cross-infections in hospitals.

- CT imaging has been a primary diagnostic tool during the pandemic, revealing specific patterns associated with COVID-19.

- Al algorithms, like icolung, have been developed to quickly differentiate COVID-19 from other pneumonias, aiding in rapid detection and clinical decision-making.

- The study aims to evaluate the impact of icolung in a university hospital setting in Belgium, focusing on transmission prevention and hospital stay duration.

#### \*\*Materials and Methods:\*\*

- Jcolung uses deep learning models for automated segmentation of lungs and abnormalities, producing a severity score based on the extent of lung involvement.

- A decision tree model compared routine practice (RP) without COVID-19 screening to RP with icolung for CT scan analysis.

- The primary outcome was the cost per avoided infection, and the secondary outcome was the cost per avoided hospital day.

#### \*\*Results:\*\*

- Icolung can prevent around 18 infections per 1000 patients and reduce hospital days by 0.1 day per 1000 patients.

- The cost to avoid one infection is EUR 8,221, and to avoid one hospital day is EUR 2,047,902.

- Sensitivity analyses showed icolung's cost-effectiveness varies with disease prevalence, reproduction number, and hospitalization risk.

#### \*\*Discussion:\*\*

- Icolung, when added to RP, is cost-effective in preventing community infections, especially at higher disease prevalence and circulation.

- The software's cost-effectiveness in reducing hospital stays is conditional, becoming more viable with higher disease prevalence (>30%) and hospitalization risk (>6%).

- Other studies have utilized AI on chest CT scans for diagnosis or disease progression prediction.

#### \*\*Strengths and Limitations:\*\*

- The study can evaluate a broad range of probabilities due to the dynamic nature of the pandemic.

- It's a unique decision analysis evaluating an AI tool for COVID-19 detection from chest CT scans.
- The model focuses on primary transmission, not considering secondary infections.
- The study is single-center and retrospective, requiring validation with other datasets.

#### \*\*Conclusions:\*\*

- The model offers a novel approach to the pandemic, aiding in hospital policy decisions and resource allocation by weighing both costs and effects.

## Expanding

GPT4, can you give me a summary of this paper in one line?

Certainly!

"Using the AI-based icolung tool for chest CT scans in a Belgian hospital setting can cost-effectively prevent COVID-19 community infections and potentially reduce hospital stays, depending on disease prevalence and hospitalization risk."

OK. I'm a paediatrician in the UK, is there anything from this paper that I can use?

Certainly! As a paediatrician in the UK, here's what you might glean from the paper:

"AI-based tools like icolung can enhance early COVID-19 detection from chest CT scans, potentially preventing community spread and optimizing hospital resource allocation."

While the study focuses on a university hospital setting in Belgium, the principles of using AI for early detection and management could be applicable to paediatric populations, especially if similar tools are developed or adapted for children. It underscores the importance of early detection, not just for patient care but also for broader public health and hospital management.

# Surprising jump

In fact, I'm giving a lecture to a room of vascular surgeons. I'm quite intimidated, do you have any jokes I can break the ice with?

Of course! Humor can be a great way to break the ice. Given your audience of vascular surgeons, here are a few lighthearted, surgery-related jokes:

- 1. "Why did the vascular surgeon break up with the cardiologist? She had too many issues with commitment!"
- 2. "I was going to tell a joke about an artery, but I felt the pressure was too high."
- 3. "Why did the vascular surgeon stay calm during the operation? Because he knew how to keep his veins from popping."

4. "I always wanted to be a vascular surgeon, but I didn't have the guts for it. Instead, I chose paediatrics. At least when my patients kick and scream, it's expected!"

5. "Why did the vascular surgeon go to the beach? To prevent a tide-al wave!"

Remember, the key to delivering a joke is confidence and timing. Even if not everyone finds it hilarious, a light-hearted attempt at humor can still set a positive tone for your lecture. Good luck!

# What is General Purpose AI?



# What impact is Gen AI already having?

Internal Combustion Engine

- 1860 First practical ICE created
- 1901 First Mercedes car
- 1927 15m Model T Fords sold
- 1958 First motorway in England

AI

- 1950 Alan Turing lays the foundation
- 1997 Deep Blue beats Garry Kasparov
- 2014 Siri is launched
- 2022 ChatGPT gets to 100m users

### A&E diagnosis using AI could diagnose patients and cut waiting times

A study found ChatGPT "performed well" in generating a list of patient diagnoses and selecting the most likely health issue.

By HANNA GEISSLER - DAILY EXPRESS HEALTH EDITOR 22:38, Wed, Sep 13, 2023 | UPDATED: 22:38, Wed, Sep 13, 2023

#### News > Health

# ChatGPT diagnoses cause of child's chronic pain after 17 doctors failed

Her son had been experiencing symptoms like pain and difficulty walking for years

laggie O'Neill • 5 days ago • 🦳 Comments

### S JMIR Publications

Assessing the Utility of ChatGPT Throughout the Entire Clinical Workflow: Development and Usability Study

Arya Rao <sup>1,2,3</sup> (a); Michael Pang <sup>1,2,3</sup> (b); John Kim <sup>1,2,3</sup> (c); Meghana Kamineni <sup>1,2,3</sup> (c); Winston Lie <sup>1,2,3</sup> (c); Anoop K Prasad <sup>1,2,3</sup> (c); Adam Landman <sup>1,4</sup> (c); Keith Dreyer <sup>1,5</sup> (c); Marc D Succi <sup>1,2,3,6</sup> (c)



<u>https://www.nejm.org/doi/full/10.1056/NEJMsr2214184</u> <u>https://www.microsoft.com/en-us/research/publication/capabilities-of-gpt-4-on-medical-challenge-problems/</u> : <u>https://arxiv.org/pdf/2305.17364.pdf</u>



Financial Times, September 2023 (Generative AI exists because of the transformer)

## 'Generative Al'





# Time Outcomes Care force

McKinsey & Company, July 2023



# Al you can trust



not

### protected

# **Evaluating**

### Use case ideation

- **Regulatory**: Regulated or not? (e.g., Clinical Decision Support, Software as a Medical Device)
- **Liability**: What could go wrong and who bears responsibility?
- **Reputational**: Building and keeping the trust of industry participants, patients, regulators, and policymakers
- Accuracy vs. creativity: Techniques include Retrieval-Augmented Generation (RAG) and Reinforcement Learning from Human Feedback (RLHF)



Microsoft Responsible AI principles Five-point blueprint for the public governance of AI Transparency Note for Azure OpenAI Service Data, privacy and security for Azure OpenAI Service Microsoft's AI Customer Commitments

### **AI-powered Documentation**



## A new approach to today's challenges

DMO is the basis for DAX<sup>™</sup> Copilot—AI-automated clinical summaries – just launched in the US



# HEALTHCARE HAS CHANGED

1. Everything a doctor does should be centered on the needs of the patient – in this new world.

2. If you do not know of a treatment that will help your patient, invent one – and there are new tools to help us.



This slidedeck was handcrafted by humans

## Delivering Language AI services in healthcare

Dr James Teo Professor of Neurology Director of Data Science and AI Member of HRA Confidentiality Advisory Group

King's London



Guy's and St Thomas' NHS Foundation Trust

# Trying to explain NLP in 2020



ARTIFICIAL INTELLIGENCE

## Digital diagnosis: Why teaching computers to read medical records could help against COVID-19

Oct 21, 2020

https://www.weforum.org/agenda/2020/10/machinelearning-ai-artificial-intelligence-computers-health-recordscovid-19-coronavirus-pandemic/



Information gained from computer models could prove critical in the fight against coronavirus. Image: REUTERS/Yves Herman

#### **James Teo**

Sign in

Neurologist, Clinical Director of Data and Al and Clinical Senior Lecturer,, King's College London

### **Richard Dobson**

**Professor in Health Informatics,** King's College London

 Natural language processing (NLP) algorithms could find patterns across many thousands of patients' records, helping to find effective treatments.

# **An Extended Journey with Language Al**



NHS

NHS England - Transformation Directorat

# A Cambrian explosion of Language Al



## **Building AI on foundation models**



# Language Modelling and Al



# **Deep phenotyping whole hospitals and populations**

### PLOS DIGITAL HEALTH

### RESEARCH ARTICLE

### Hospital-wide natural language processing summarising the health data of 1 million patients

#### Daniel M. Bean<sup>1,2</sup>\*, Zeljko Kraljevic<sup>1,3</sup>, Anthony Shek<sup>1,4</sup>, James Teo<sup>4,5</sup>, Richard J. B. Dobson<sup>1,2,3,6,7</sup>



1 Department of Biostatistics and Health Informatics, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, 2 Health Data Research UK London, University College London, London, United Kingdom, 3 NIHR Biomedical Research Centre at South London and Maudsley NHS Foundation Trust and King's College London, London, United Kingdom, 4 Department of Clinical Neuroscience, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, 5 Department of Neuroscience, King's College Hospital NHS Foundation Trust, London, United Kingdom, 6 Institute for Health Informatics, University College London, London, United Kingdom, 7 NIHR Biomedical Research Centre, University College London Hospitals NHS Foundation Trust, London, United Kingdom

Cluster Details

Cluster number: 13

100.00%

Patients in cluster: 2122 Top 5 SNOMED codes:





## Natural Language being used for Population Health and EHR analytics

N\_sessions\_CBT



### CogStack

### **IMPACT (TO DATE):**

Dashboards used for case-load management of patients with psychosis South East London

Video of live presentation of system by South London Maudsley Medical Director & Caldicott Guardian on https://youtu.be/k6BcDfAJ0R4



**NHS England - Transformation Directorate** 

### Cogstack

#### 24 August 2020



Cogstack is an open source real-time data warehousing tool meeting the need for an efficient way of coding that improves financial and operational efficiencies for NHS providers.

Case study

King's College Hospital NHS Foundation Trust, together with the South London and Maudsley Hospital, have developed an opensource realtime data warehousing tool called 'Cogstack' that improves operational efficiency significantly.

Cogstack meets the acute need for a more efficient way to clinically code to improve financial and operational efficiencies for providers throughout NHS. Reading health text for clinical coding underpins operational, financial and forward planning activity throughout the NHS, but there is a significant source of data quality issues in the NHS (Capita, 2014). This is because 'clinical coding' as a domain is under significant pressure due to the expanding volume of data in the past decade, resulting in incomplete data capture, and manpower shortages of skilled clinical coders.



> Download full PDF

(PDF, 105.2 KB)

- ✓ King's College Hospital London
- ✓ Guy's and St Thomas London
- $\checkmark$  University College London
- $\checkmark$  South London and Maudsley London
- ✓ University Hospital Birmingham
- ✓ Norfolk and Norwich Univ Hospital
- ✓ Manchester University FT
- ✓ Lancashire Teaching Hospital
- ✓ Northern Care Alliance
- ✓ University Medical Center Utrecht
- ✓ University Medical Center Amsterdam
- $\checkmark$  Monash Health, Melbourne
- ✓ Siriraj Hospital, Bangkok



Cogstack.org













Starting from scratch - Delivering impact from Natural Language Processing (NLP) at Guy's and St Thomas' NHS Foundation Trust

Barbara Rafferty, Head of Digital Innovation



- ≻ Our journey
- > Our impact to date
- Delivering impact
- ➢ How you can get involved





### **Our journey**





- > OP procedure coding
- ➢ IP coding
- Pathway management
- Clinical audit
- Safety alerting



#### Our impact



OP procedure coding dropped during COVID and never recovered. Manual process in place to transcribe billable codes from one system to another. Move back to PbR payment system exacerbated this problem for the trust.

Procedure forms recorded on one system but not another were identified using our enterprise search capabilities. Missing codes were then bulk-uploaded to the system used for billing. Trialing using natural language processing to "read" clinical notes and automate assigning codes.



Up to £5.5m in additional income identified to date Forecast for FY23/24: £15m





#### **Our impact**



## **Inpatient Clinical Coding**



Clinical coding is a largely manual process that is prone to error and omission. Review of depth of clinical coding shows up to 25% under coding for common conditions. New EHRs will make some improvements but always pass on the burden of data capture to clinicians.



GSTT are trialling using NLP to identify comorbidities from clinical notes and letters and to transform the coding workflow. Our coding tool will suggest Snomed and ICD10 code for clinical coders to validate.



Enhanced depth of coding and increased income – initial pilots suggest >£0.5m per speciality in opportunity p.a. Workforce transformation opportunities also present





- Multi-professional team
- > Explaining our tech simply
- Building cross-organisational support





### The team



The Guys and St Thomas' CogStack team works closely with King's College London and King's College Hospital teams.

As we start to expand we are organizing the team into thematic areas where their expertise can add most impact:

- Pathway management
- Observational research
- Genomics



## What is CogStack?



- "It's just a tool for researchers"
- "It's a data lake"
- "It's AI that will replace clinical coder's jobs one day"
- "I'm not sure how to use it"



## What is CogStack?



"It's a tool for lots of different staffing groups"

"It's where you go if you need to review lots of clinical letters or reports or find a patient research cohort"

"It makes my job easier"



### Who now understands the value of CogStack?



**Cogstack collaborators** 



Join our community: <a href="mailto:contact@cogstack.org">contact@cogstack.org</a>













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