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8 – 12 JULY 2023 | SYDNEY, AUSTRALIA

Designing workforce development to enable the application of AI in healthcare

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University of Manchester & University of Melbourne

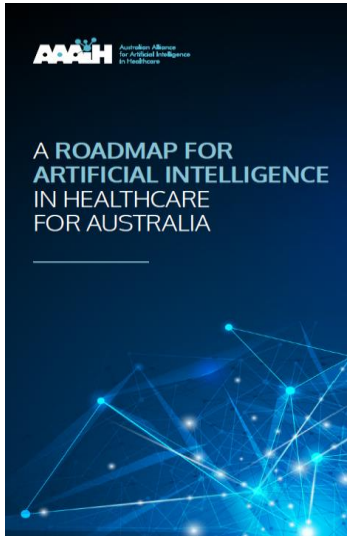
AIDH IMIA

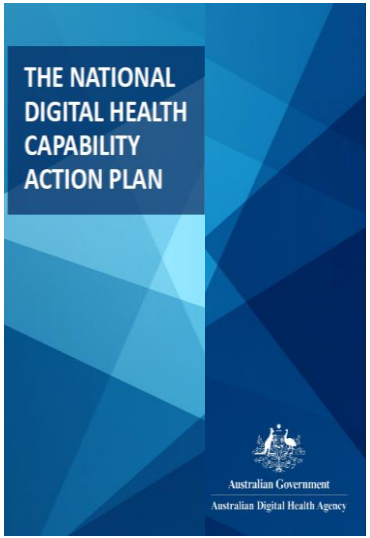
Learning outcomes

- Discuss the current needs of the healthcare workforce in understanding the applications of artificial intelligence in healthcare
- Outline potential skills and concepts to be fostered in an artificial intelligence in healthcare education program
- Review case studies of the various methods and approaches for fostering artificial intelligence and machine learning skills and concepts for health professionals

Various roadmaps in AU

No mention of artificial intelligence





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AI IN HEALTHCARE
ROADMAP AT A GLANCE

VISION

An AI-enabled healthcare system delivering personalised healthcare safely, ethically and sustainably.

MISSION

A fully funded national plan by 2025 designed to create an AI-enabled Australian healthcare system capable of delivering personalised healthcare, safely, ethically and sustainably supported by a vibrant AI industry sector that creates jobs and exports to the world, alongside an AI-aware workforce and AI-savvy consumers.

5. WORKFORCE

Understand knowledge gaps in the workforce and then train the current and future healthcare workforce in the use and implementation of AI-enabled healthcare services.

1. Understand **knowledge and skills gaps** and current capability building efforts. (Timeframe: 1-3 years)
2. Develop a **foundation AI curriculum framework** for health professionals. (Timeframe: 1-3 years)
3. Develop professional **accredited training programs** for specialist AI health professionals. (Timeframe: 1-3 years)
4. **Accelerate training** of the health workforce in AI use by supporting critical common core educational resources, tools and infrastructure. (Timeframe: 3-5 years)

1. SAFETY, QUALITY AND ETHICS	2. PRIVACY AND SECURITY	3. GOVERNANCE AND LEADERSHIP	4. RESEARCH AND DEVELOPMENT
Priorities			
Ensure patients receive safe and ethical care from AI-healthcare services which have been developed in accordance with ethical principles, a safety framework and are appropriately monitored post-implementation.	Ensure the privacy of an individual's healthcare data and the security of data from cybersecurity threats.	Maximise the benefits and opportunities of an AI enabled healthcare system through a whole-of-government and whole-of-nation approach.	Ensure relevant and targeted research and development programs are available and adequately funded to provide expert guidance in AI healthcare development and implementation.
Key Recommendations			
1. Develop a **national ethical framework** to support the development and deployment of values-based clinical and consumer AI in routine practice. (Timeframe: 1-3 years) 2. For healthcare AI to be safe and not harm patients, it needs to be developed and deployed within a **robust safety framework**. (Timeframe: 1-3 years) 3. **Improve the effectiveness of national safety monitoring systems** so that cases of patient risk and harm related to AI use are rapidly detected and communicated to all relevant parties including consumers. (Timeframe: 1-3 years)	1. Healthcare organisations should **meet minimum standards for cybersecurity** to be accredited as healthcare AI users. (Timeframe: 1-3 years) 2. AI systems developers and users must **protect the privacy of individuals** whose data is used to train AI systems. (Timeframe: 3-5 years)	1. **Develop a National AI in Healthcare Strategy** to provide to provide strategic and national governance and leadership. (Timeframe: 1-3 years)	1. **Support the creation and translation of new technologies** through existing funding mechanisms through the Medical Research Future Fund (MRFF), National Health and Medical Research Council (NHMRC), Department of Industry, Science, Energy and Resources (DISER) and the Australian Research Council (ARC), for example, committing to a national AI-health mission. (Timeframe: 1-3 years) 2. Create **targeted funding programs** to support research and development collaborations between industry and academia. (Timeframe: 1-3 years) 3. **Allocate funds** for one or more Centres of Excellence in AI research and translation in healthcare. (Timeframe: 1-3 years)

5. WORKFORCE	6. CONSUMERS	7. ADOPTION	8. INDUSTRY
Priorities			
Understand knowledge gaps in the workforce and then train the current and future healthcare workforce in the use and implementation of AI-enabled healthcare services.	Help all Australians, including vulnerable consumers, navigate the complex healthcare system and be active participants in the management of their own care and wellbeing.	Implement AI seamlessly and successfully across the healthcare system at a local, state and federal level to help create a resilient healthcare system.	Support the development of a local healthcare AI industry to become globally competitive and deliver significant clinical and economic benefits to Australia.
Key Recommendations			
1. Understand **knowledge and skills gaps** and current capability building efforts. (Timeframe: 1-3 years) 2. Develop a **foundation AI curriculum framework** for health professionals. (Timeframe: 1-3 years) 3. Develop professional **accredited training programs** for specialist AI health professionals. (Timeframe: 1-3 years) 4. **Accelerate training** of the health workforce in AI use by supporting critical common core educational resources, tools and infrastructure. (Timeframe: 3-5 years)	5. **Engage consumers** in co-designing AI-healthcare services and systems. (Timeframe: Ongoing) 6. Develop and **support AI healthcare literacy guidelines and resources** for patients and carers. (Timeframe: 1-3 years)	1. **Identify national challenges** where AI can significantly enhance outcomes and effectiveness of current and emerging healthcare services and create national beacon sites where these challenges can be addressed. (Timeframe: 3-5 years) 2. To ensure **cost-effective and appropriate procurement and operation** of AI, support administrators and managers with best-practice guidance on system features (e.g. local calibration, transparency, explainability, implementation, and update). (Timeframe: 1-3 years) 3. **Identify proven AI technology and products** for implementation in healthcare to support procurement decisions. (Timeframe: 3-5 years) 4. **Establish a program** to ensure the nation is able to take advantage of AI to manage future crises and learn from our response to the COVID-19 challenge. (Timeframe: 1-3 years)	1. **Identify new industries, export opportunities, jobs and capabilities** to shape future policy development. (Timeframe: 1-3 years) 2. **Provide support and incentives** where they are needed to ensure local industry is competitive nationally and internationally. (Timeframe: 1-3 years) 3. **Quantify economic benefits, costs and indicators** of AI enabled healthcare in national health priority areas (e.g. ageing, disability, mental health) (Timeframe: 1-3 years) 4. **Develop best practice industry standards** for AI developers and users to comply with regulatory and legislative requirements. (Timeframe: 2-5 years) 5. **Develop mechanisms to allow ethical and consent-based access to clinical data** for industry to support AI development. (Timeframe: 1-3 years)

Why do we need AI education?

- Advancing technology
- Enhanced efficiency
- Improved diagnostics & treatment
- Ethical considerations
- Research & development

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Who do we need to educate?

Health Professionals, Researchers, Health Service Managers

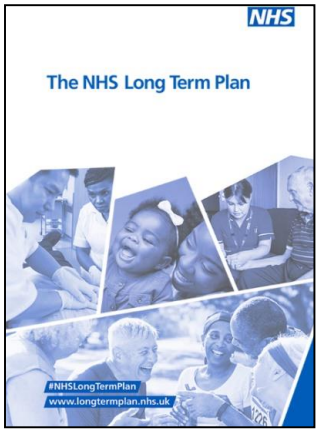
Medical, Nursing, Health Science degree students & trainees

Data Scientists, IT, Business Analysts, EMR Analysts, Software Engineers

Hospital Administration, Hospital CEOs, Hospital decision makers

Policy Makers, Regulators

UK landscape on digital health technologies



NHS Long Term Plan 2019

Topol Review 2019

Goldacre Review 2022

Ives Review 2023

How should we train healthcare professionals in AI?

Educational resources should be developed to educate and train all healthcare professionals in: health data provenance, curation, integration and governance; the ethics of AI and autonomous systems/tools; critical appraisal and interpretation of AI and robotics technologies

AI & Robotics Panel recommendation: Topol Review 2019

How are we using AI in the UK?

Type	Definition	Example
Automation/Service Efficiency	Eliminate or decrease the need for manual tasks	Patient chat-bot
Diagnostic	Supplement & enhance use of medical images	Automated detection of osteoporotic fractures in CAT scans
P4 Medicine	**P**redictive, **p**reventative, **p**ersonalised & **p**articipatory	Tracking of disease transmission in public health surveillance
Remote Monitoring	Monitroing devices that collect data which can be shared with HCPs to monitor patients remotely	Diabetes remote monitoring
Therapeutic	Evidence-based therapeutic intervention, prevent, manage or treat a disorder	Eg mental health chatbot

https://digital-transformation.hee.nhs.uk/binaries/content/assets/digital-transformation/dart-ed/ai-roadmap-march-2022-edit.pdf

Digital Health Education at University of Manchester

Show that digital can work	Simple narratives which show how incremental changes can make a big difference
Develop new career structures – learning from the clinical bioinformatics example	Data Scientist, Data engineer, Research Software Engineer
Embed digital early in training	Work with Royal Colleges/GMC to develop frameworks
Support existing workforce through CPD	MOOCS, Accredited Scientific Practice, Flexible portfolio training
Decision making by people who understand digital and AI	

https://digital-transformation.hee.nhs.uk/binaries/content/assets/digital-transformation/dart-ed/developingconfidenceinai-oct2022.pdf

Designing AI capability frameworks

https://digital-transformation.hee.nhs.uk/building-a-digital-workforce/dart-ed/horizon-scanning/ai-and-digital-healthcare-technologies

Framework: Archetypes

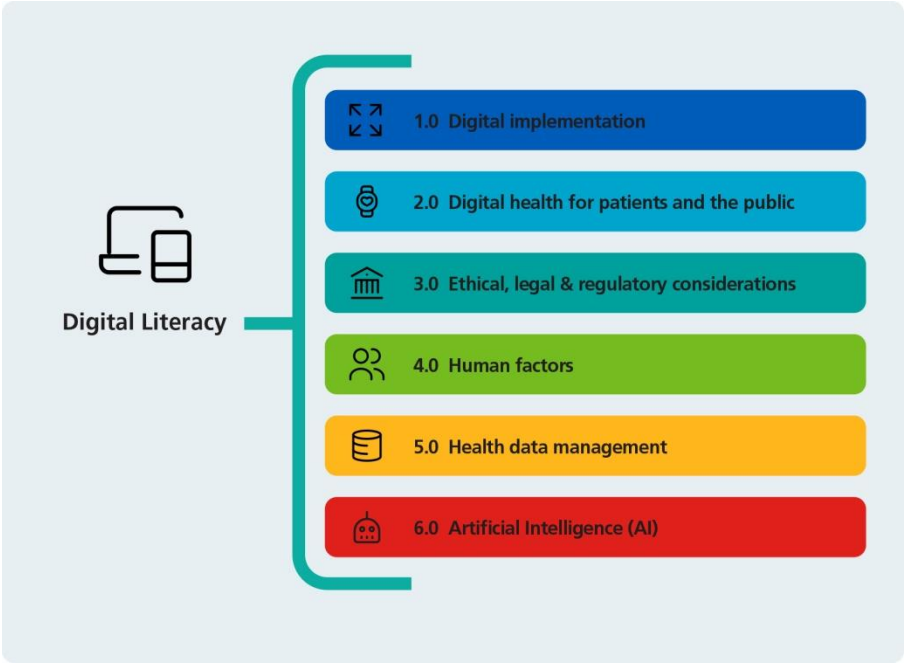
- Mapped to archetypes rather than individual roles
- Individuals may fit into several archetypes
- For example a nurse who works in informatics may be both a ***user*** and ***embedder*** at different times

Framework: Blooms digital taxonomy

- A 'digital' version of the classic taxonomy
- Moves from lower order to higher order thinking skills
- Reflected in the levels of the various capability statements

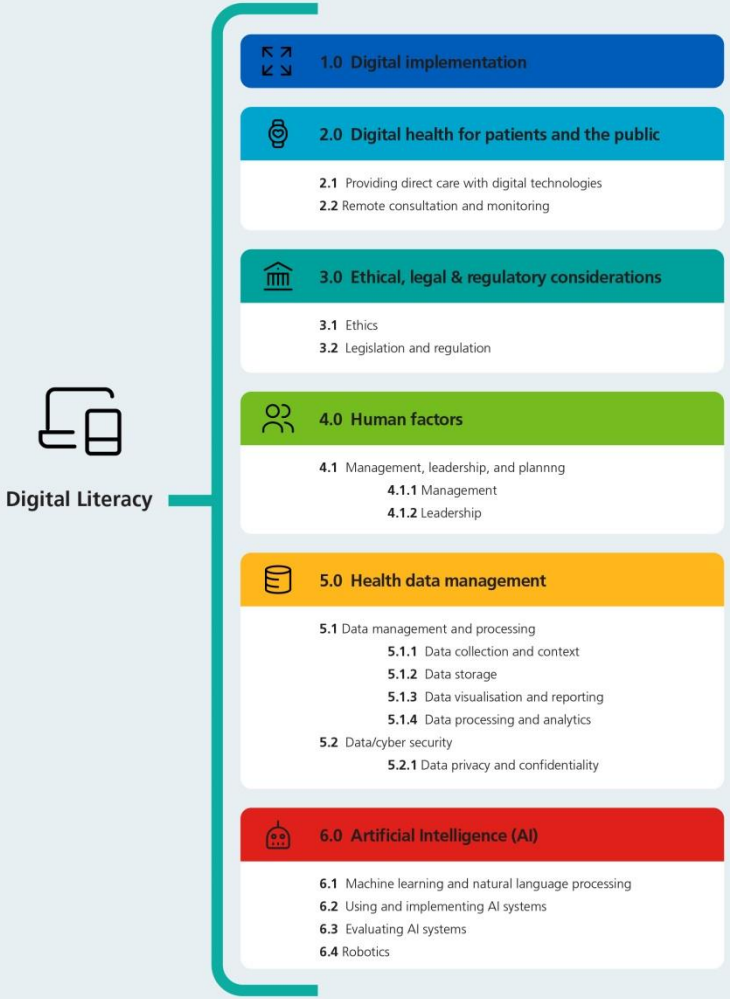
Framework: Domains

- The framework is split into 6 primary domains



Framework: Domains

- Domains also contain various sub-domains



Example:

- Each domain contains a number of individual capability statements split across 4 levels
- Related archetypes are displayed below each statement

6.0 Artificial Intelligence (AI)

AI refers to the ability of machines to mimic human intelligence or behavioural patterns. In practice this often refers to the automation of various activities that involve tasks like finding patterns in data, and making predictions.

LEVEL 1

A. I understand that AI is an umbrella term used to define digital technologies capable of performing tasks commonly thought to require human intelligence. I am aware AI is common in modern technology and can list uses of AI outside healthcare (e.g. voice recognition, recommender systems, self-driving cars, image and video processing)
• S • D • C • E • U

B. I can provide examples of AI systems used in healthcare and understand their potential benefits and risks (e.g. imaging diagnostics and decision support tools)
• S • D • C • E • U

C. I am aware that "machine learning" is a subset of AI and is an umbrella term used to refer to techniques that allow computers to learn from examples/data without being explicitly programmed with step-by-step instructions
• S • D • C • E • U

LEVEL 2

D. I am aware that all AI applications in healthcare are defined as 'narrow' AI that are trained to perform a particular and specific task
• S • D • C • E • U

E. I can identify the contribution that AI could make to healthcare processes in my area of practice and how it has potential to benefit the organization, workforce and patient
• D • C • E • U

F. I can articulate the risks and limitations of AI relevant to my professional area and consider them in my use of AI
• D • C • E • U

NHS Digital Academy

LEVEL 3

G. I can explain intellectual property issues pertaining to AI models and how this impacts on AI algorithms co-developed between the NHS and commercial providers
• D • C • E

H. I can define the sub-fields of AI and machine learning and their key applications (e.g. computer vision, audio processing, knowledge representation, natural language processing, expert systems)
• S • D • C • E • U

LEVEL 4

I. I can describe the main types of bias that could affect AI systems (e.g. reporting, selection, group attribution, implicit)
• D • C • E • U

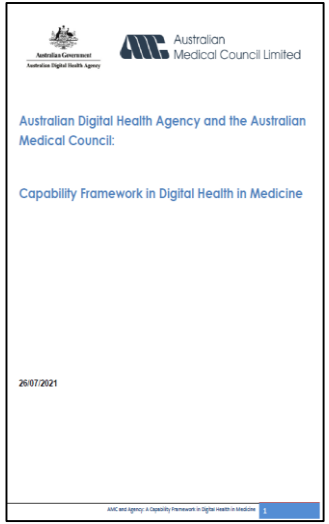
J. I can take steps to identify and mitigate bias in AI systems, such as designing models inclusively (human centred design approaches), training with representative data and testing for bias
• D • C • E

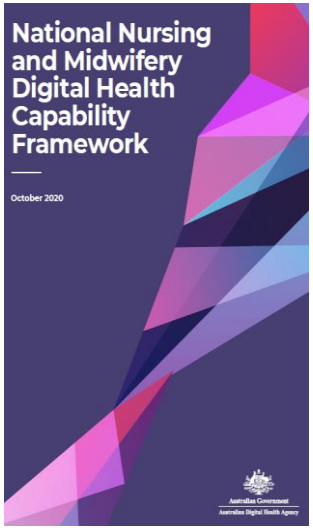
K. I understand the importance of and promote transparency of AI models used within my area of practice. For example, identifying the type of model used, training data, methods and potential model limitations and weaknesses
• C • E

L. I understand the benefits and limitations of AI explainability. I keep abreast of research and developments in this area and am aware of the potential impact on confidence in clinical decision making
• C • E

Various capability frameworks in AU

Barely mentions artificial intelligence





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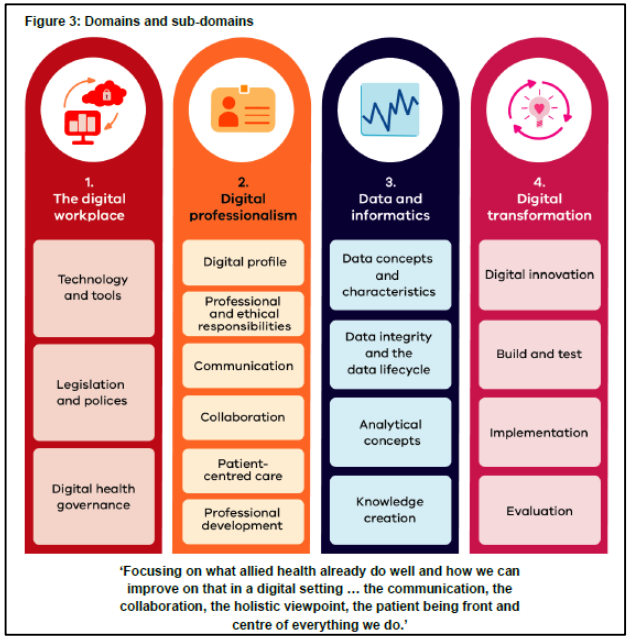
What are the key capabilities for Digital Health/AI in AU



Digital health capability framework for Allied Health AU, 2021

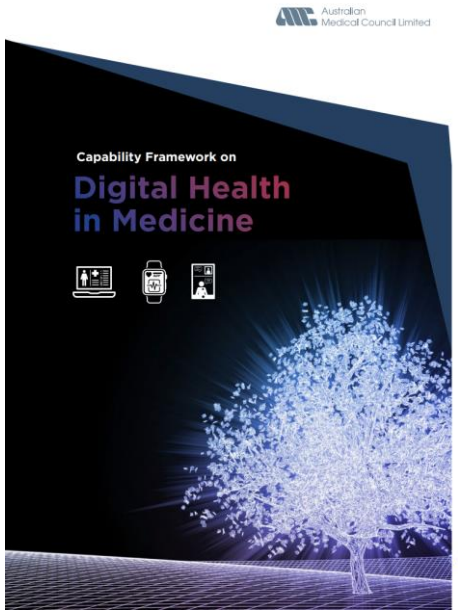
National Nursing and Midwifery Digital Health Capability Framework AU, 2020.

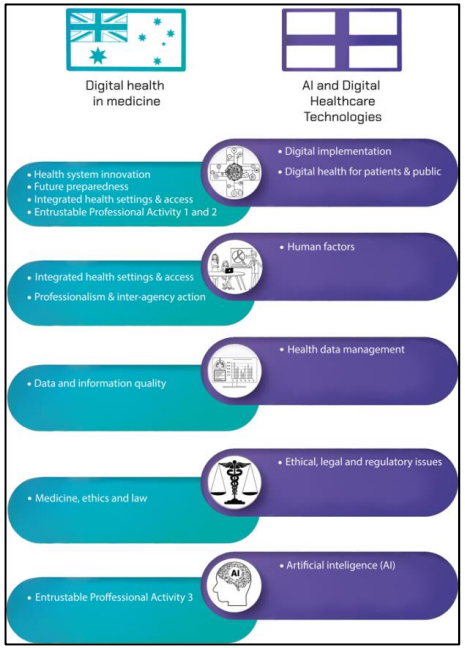
	DOMAIN OF EXPERTISE	DESCRIPTION OF COMPETENCY DOMAIN	DOMAIN LEVEL
A	Health Sciences	Health informaticians interpret *health science* in order to communicate with stakeholders and contextualise their work.	Understanding
B	Information Science	Health informaticians apply *information science* to design, develop, capture, analyse, present and preserve high quality data, information, knowledge, and wisdom.	Applying
C	Information Technology	Health informaticians apply *information technology* concepts to ensure quality information and transaction processing.	Applying
D	Leadership and Management	Health informaticians apply *leadership and management* principles to functions, projects, and programs.	Applying
E	Social and Behavioural Sciences	Health informaticians apply *social and behavioural science* principles for evidence informed decision making.	Applying
F	Core Health Informatics	Health informaticians select relevant *core competencies* for the management of healthcare data, information, knowledge, and wisdom.	Analysing

Australian Health Informatics Competency Framework For Health Informaticians, AIDH, 2022

Capability Building at a global scale

- Australian Medical Council (AMC), NHS England & University of Manchester





NHS Digital Academy

https://www.digitalhealth.gov.au/newsroom/blogs/digital-health-in-medicine-capability-framework

So How Can we Use Capability frameworks?

- Curriculum design: learning outcomes
  - Educators/trainers
- Self diagnosis
  - Learners/HCPs
- Planning the future workforce
  - Professional bodies (Royal Colleges, Informaticians)
  - Accreditation Councils
- Updates and engagement

Acknowledgements: NHS England/University of Manchester

University of Manchester

- Alan Davies
- Iliada Eleftheriou
- Jon Parkinson
- Lamiece Hassan
- Andy Brass

NHS England

- Hatim Abdulhussein
- Adrian Brookes

University of Melbourne

- Mike Conway
- David Kok
- Wendy Chapman
- Douglas Pires

Activity

- Instructions:

  Rank the competencies according to what you think is most important in relation to your own work/place.

- QR code

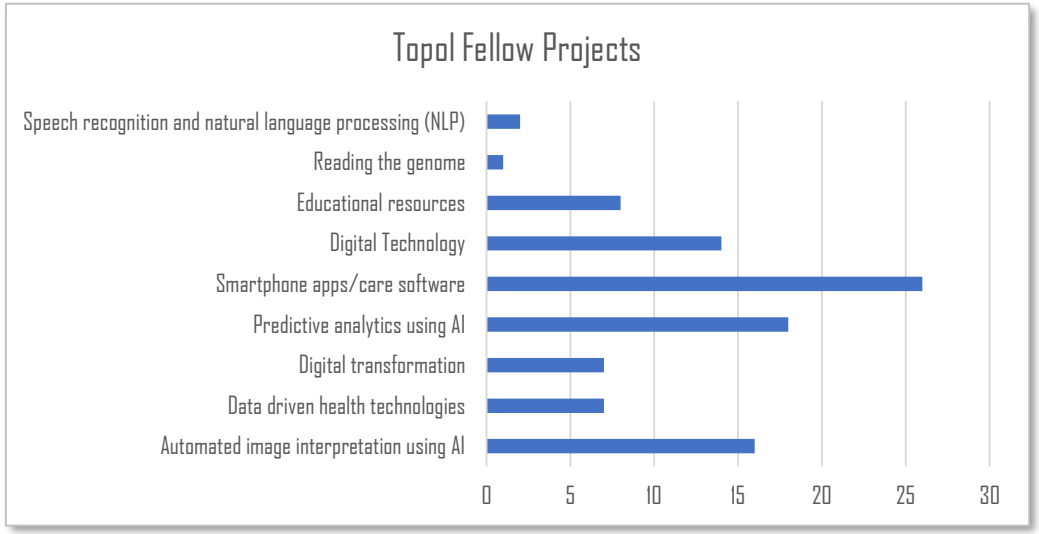
Machine Learning in Service Design & Delivery

> Within 20 years, 90% of all jobs in the NHS will require some element of digital skills Dr Eric Topol

- Aim is for safer, more productive, more effective and more personal care for patients.
- Outlined the skills required. Identifying professions, sub specialisms & consequences on curricula, education, training, development and lifelong learning

About The Topol Review https://topol.hee.nhs.uk/

Topol Programme for Digital Health Fellows
Health Education England



- Four cohorts 2020 to 2023
- Network of digital transformation champions
- 169 fellows
- AI projects grown in latter cohorts (20% of all projects)

About The Topol Review https://topol.hee.nhs.uk/

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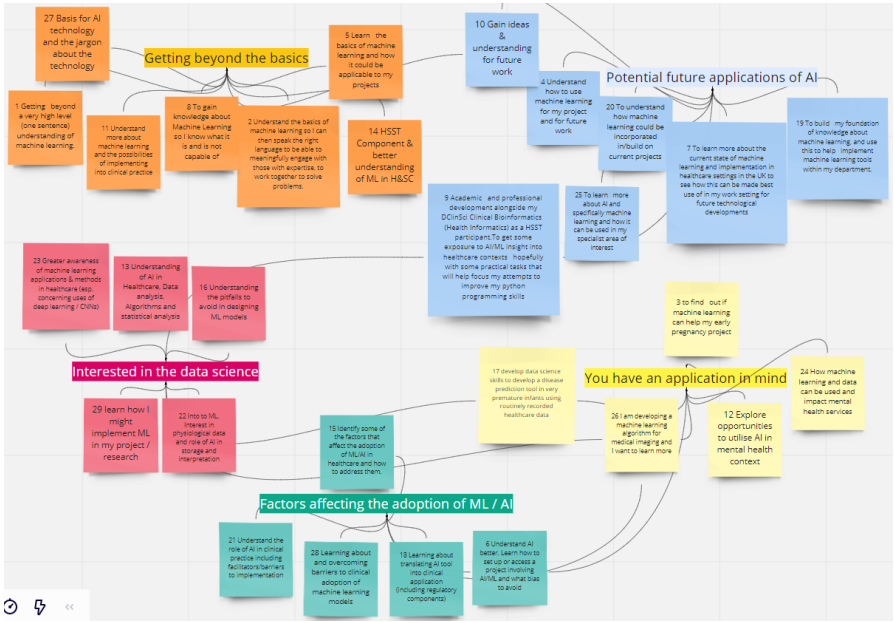
About the course

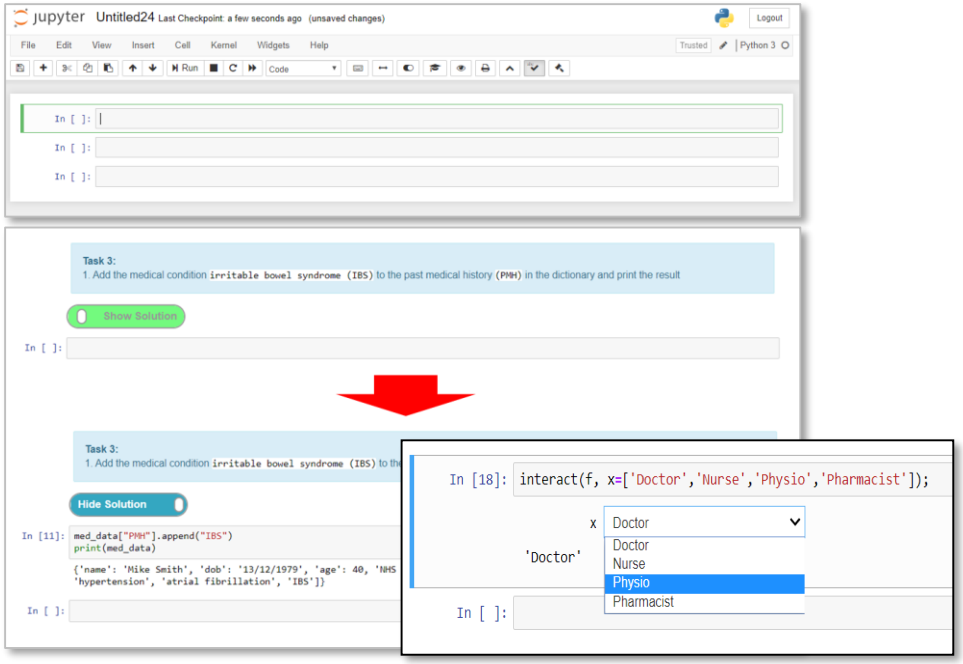
1	2	3	4	5	7	8
Synchronous Face to face welcome & self-assessment	Synchronous Zoom session	Self-led Rise materials	Synchronous Zoom session & Self-led Rise materials	Synchronous Zoom session & Self-led Rise materials	Self-led Jupyter Notebooks	Synchronous Zoom session & Self-led Rise materials
Pre-course / Induction	Workshop launch	Foundations of Machine Learning	Identifying socio-technical barriers to machine learning in practice	CT scan data to predict the risk of fracture in patients with osteoporosis.	Introducing machine learning in health data science	Panel Workshop

Who were our learners?



- Knowledgeability AI capability framework self-check
- Learning objectives focusing on challenges, data and critical engagement

What worked?

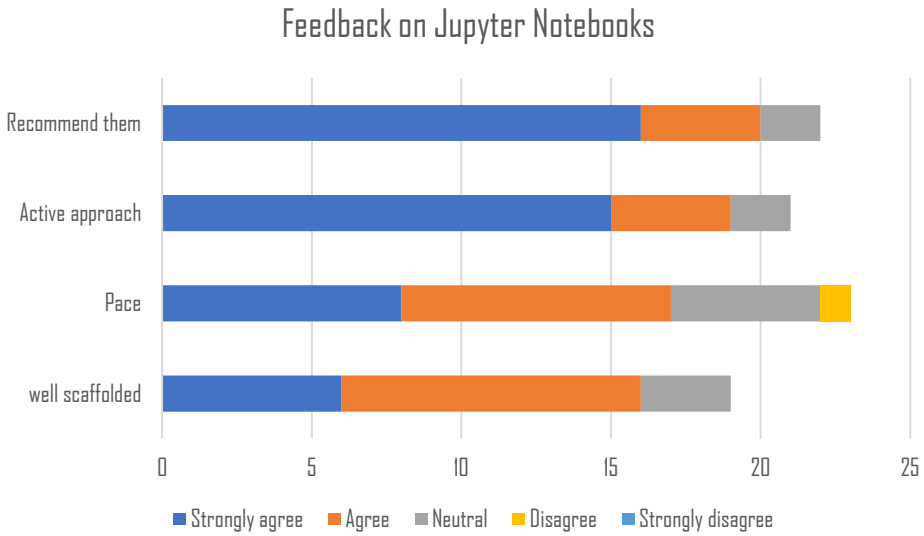


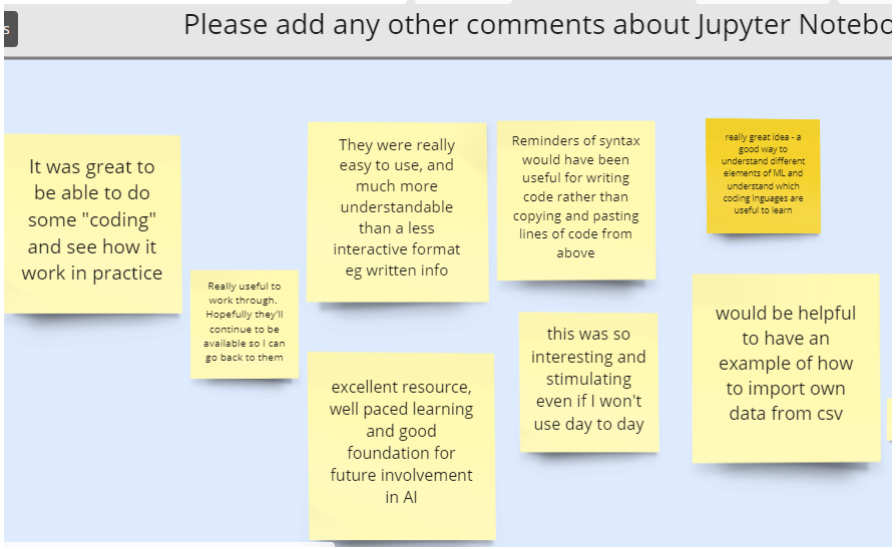
Jupyter Notebooks

- web based interactive notebooks, short blocks of code & instructional content
- build self-paced learning incrementally
- Hide & reveal answers
- Interactive widgets such as dropdown lists

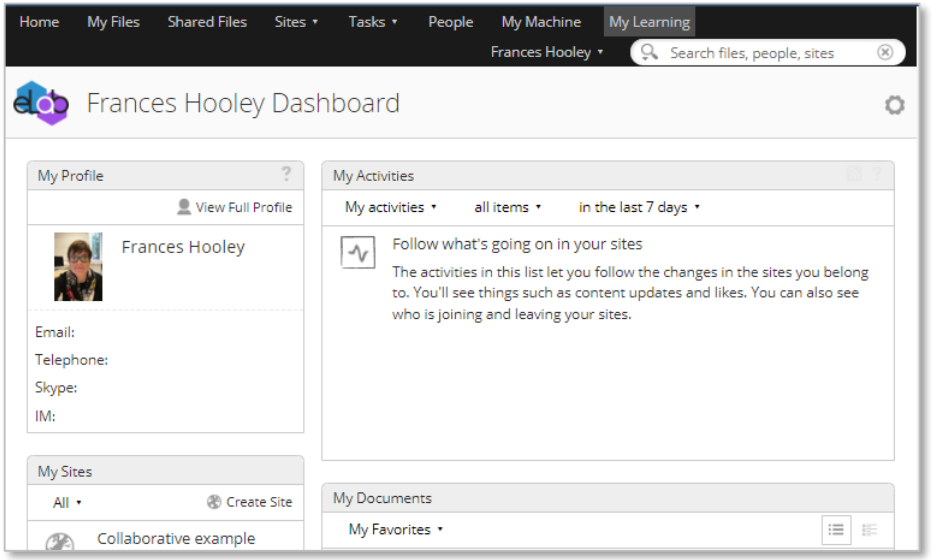
Using interactive digital notebooks for bioscience and informatics education https://doi.org/10.1371/journal.pcbi.1008326

What worked?


Feedback on Jupyter Notebooks
Recommend them
Active approach
Pace
well scaffolded
0
5
10
15
20
25
Strongly agree
Agree
Neutral
Disagree
Strongly disagree


Please add any other comments about Jupyter Notebo
It was great to be able to do some "coding" and see how it work in practice
Really useful to work through. Hopefully they'll continue to be available so I can go back to them
They were really easy to use, and much more understandable than a less interactive format eg written info
Reminders of syntax would have been useful for writing code rather than copying and pasting lines of code from above
really great idea - a good way to understand different elements of ML and understand which coding linguages are useful to learn
excellent resource, well paced learning and good foundation for future involvement in AI
this was so interesting and stimulating even if I won't use day to day
would be helpful to have an example of how to import own data from csv

What worked?



eLab

- Project-based learning
- Secure platform to use different data
- Virtual Learning Environment – Sites self-contained Wikis, Jupyter Hub, data source
- Tackle 21st century health data problems

About eLab - https://assets.bmh.manchester.ac.uk/diids/elab/homepage/index.html

What worked?

eLab

feedback sample

Easily accessed, and easy to use. Thanks!

Easy to navigate and pretty straightforward generally

easy to use. Good to have as a reference rather than looking through loads of emails

Useful for keeping all of the links and resources in one place

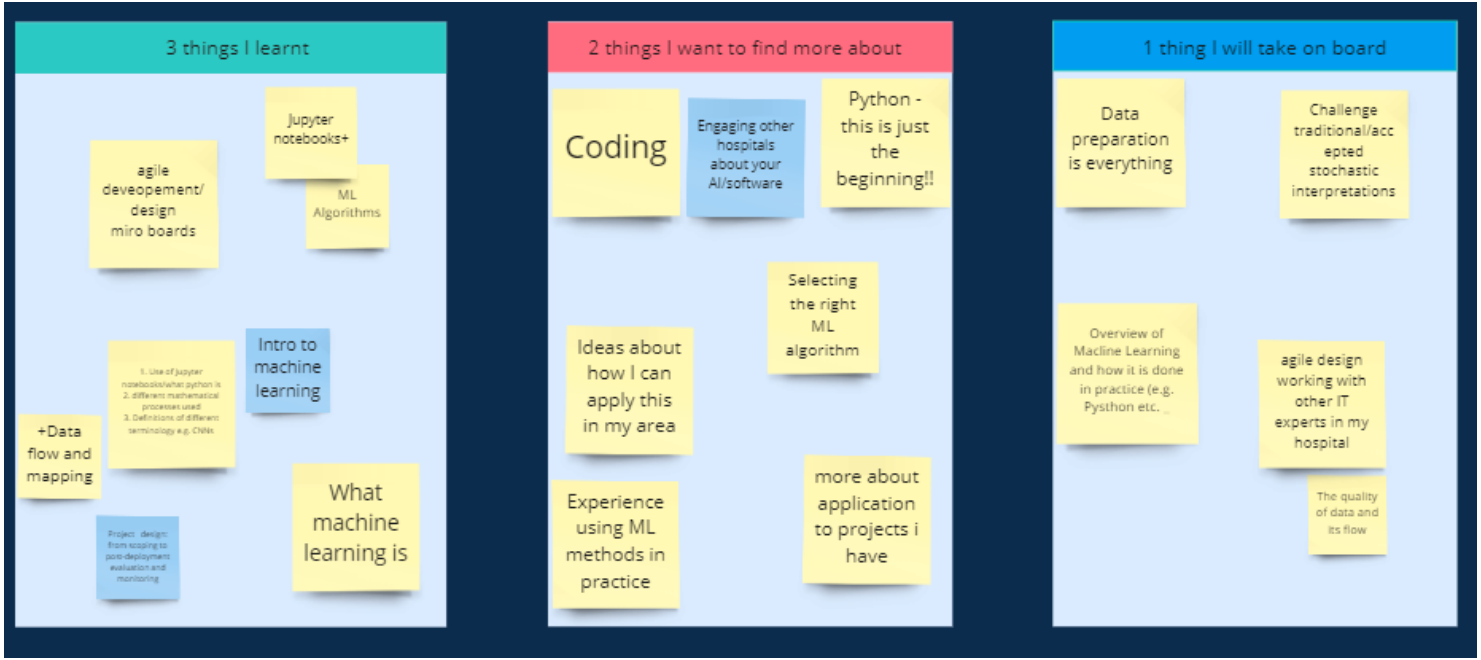
really good, easy to use and guides you through modules nicely

Once I got used to it, it was easy to use with all information in one place

Easy to use and find what I wanted.

great place for all information in one place. I hope I can still access it in the future

What worked?


3 things I learnt
Jupyter notebooks+
agile deveopement/ design miro boards
ML Algorithms
Intro to machine learning
+Data flow and mapping
What machine learning is
2 things I want to find more about
Coding
Engaging other hospitals about your AI/software
Python - this is just the beginning!!
Selecting the right ML algorithm
Ideas about how I can apply this in my area
Experience using ML methods in practice
more about application to projects i have
1 thing I will take on board
Data preparation is everything
Challenge traditional/accepted stochastic interpretations
Overview of Macline Learning and how it is done in practice (e.g. Pysthon etc. _
agile design working with other IT experts in my hospital
The quality of data and its flow

Where next?

- Predict more AI related projects
- More data science skills evident
- Diverse needs still need to be managed
- More personalisation
- Case studies, practical and applied learning

?