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TRANSFORMING HEALTHCARE

AI APPLICATIONS IN HEALTHCARE AND STATE OF THE ART

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AGENDA

01. INTRODUCTION

AI is a concept difficult to define:

"the designing and building of intelligent agents that receive precepts from the environment and take actions that affect that environment"
(Russell, S. J., Norvig, P., Davis, E. & Edwards, D. Artificial intelligence: a modern approach. Pearson, 2016).

"a cross-disciplinary approach to understanding, modeling, and replicating intelligence and cognitive processes invoking various computational, mathematical, logical, mechanical, and even biological principles and devices"

"the science of making machines do things that would require intelligence if done by people"

Joshi, I., Morley, J.,(eds) (2019). Artificial Intelligence: How to get it right. Putting policy into practice for safe data-driven innovation in health and care. London, United Kingdom: NHSX.

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AUTOMATION VS. AI

WHAT AI IS

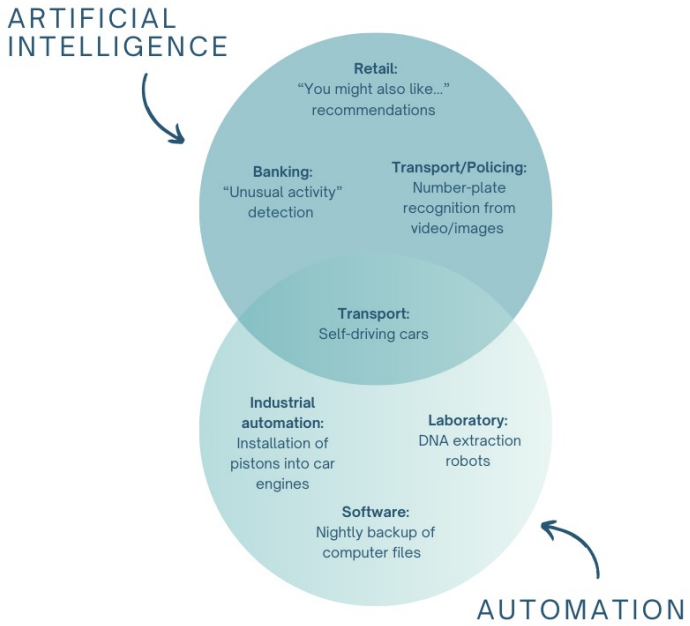
- ✓ Natural language processing
- ✓ Image analysis, e.g. facial recognition
- ✓ Predictions based on machine learning

WHAT AI IS NOT?

- Digitalisation
- Automation
- X

LEARNING COMPONENTS?

- ✓ Deep learning
- ✓ Representation learning
- ✓ Classic machine learning
- X Rule-based systems



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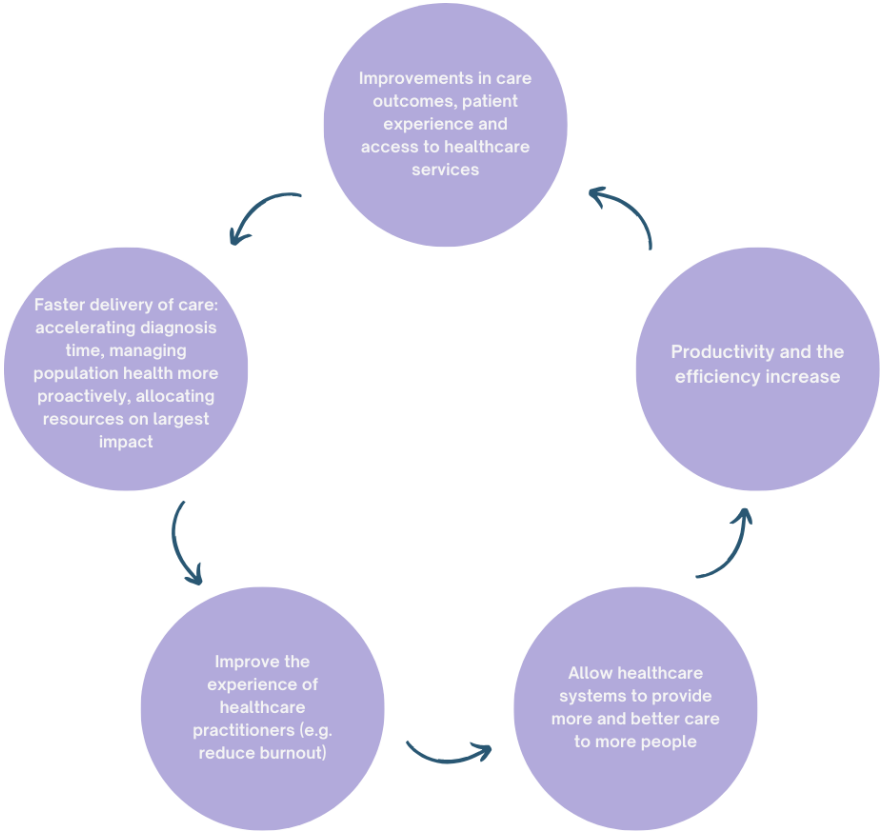
WHY?



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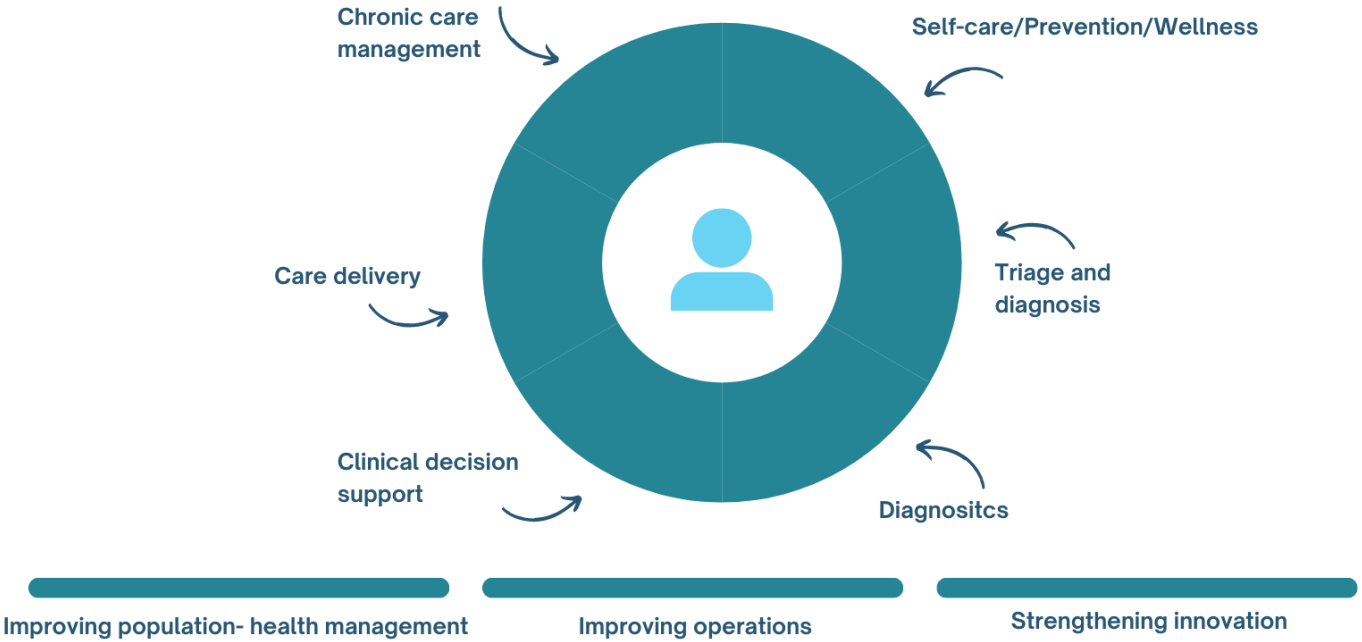
AREAS OF IMPACT FOR AI IN HEALTHCARE



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OPPORTUNITIES

DIAGNOSTICS	KNOWLEDGE GENERATION	PUBLIC HEALTH	SYSTEM EFFICIENCY	P4 MEDICINE
• Image recognition e.g. Symptoms Checkers and Decision Support • Risk Stratification	• Drug Discovery • Pattern Recognition • Greater knowledge of rare diseases • Greater understanding of causality	• Digital epidemiology • National screening programmes	• Optimisation of care pathways • Prediction of Do Not Attends • Identification of staffing requirements	• Prediction of deterioration • Personalised treatments • Preventative advice

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CHALLENGES

Leadership and society
creating a strong dialogue between industry, academia, and Government

Skills & Talent
developing the right skills that will be needed for jobs of the future and that will contribute to building the best environment for AI development and deployment

Access to Data
facilitating legal, fair, ethical, and safe data sharing that is scalable and portable to stimulate AI technology innovation

Supporting Adoption
driving public and private sector adoption of AI technologies that are good for society

International engagement
securing partnerships that deliver access to scale the needs

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02. THE CONTEXT

01

Availability of low-cost and powerful computing power

02

The economic impact of AI is expected to be extraordinarily high in all sectors, worldwide, and by 2030, estimates indicate a total global impact of 14.23 trillion euros

03

The growth in the health AI market is about 40% and, only in the USA, AI applications in Medicine can save $150 billion in annual health costs by 2026. Only one sector, the genetic testing market, will reach $22 billion in 2024

Gómez-González, E. and Gómez, E., Artificial Intelligence in Medicine and Healthcare: applications, availability and societal impact, EUR 30197 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-18454-6, doi:10.2760/047666, JRC120214.

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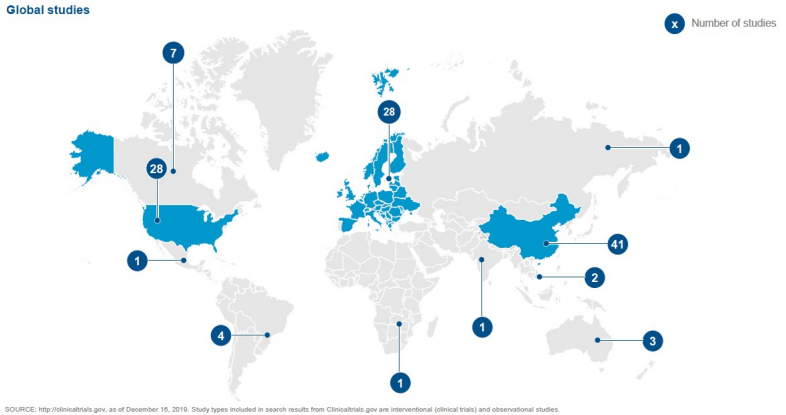
IMPLEMENTATION AROUND THE WORLD

- Government → National strategy documents on AI → Investing strategically in AI
- Private sector investments → VC funding
- Research



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03. WHERE ARE WE NOW?

Better understanding of:

a) The current state of AI in the health and care system i.e. hype vs reality

b) The challenges faced by innovators in developing AI systems

c) The issues faced by policy-makers and regulators in governing both the development and deployment of AI systems in health

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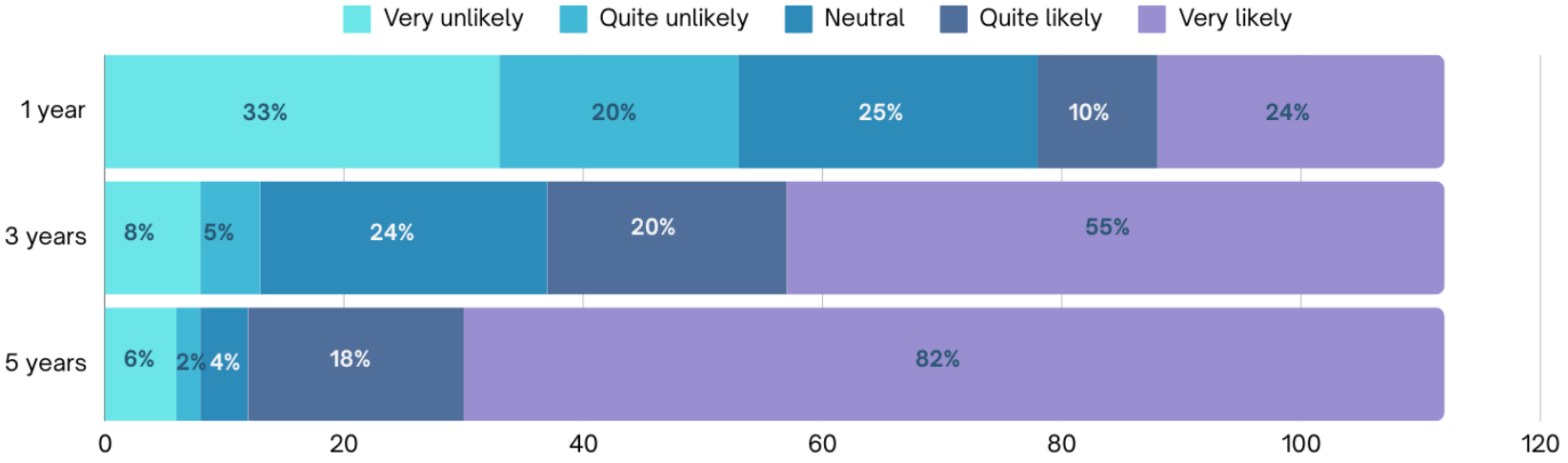
PROPORTION OF PRODUCTS LIKELY OR VERY LIKELY TO BE READY FOR AT SCALE DEPLOYMENT IN 1,3 OR 5 YEARS (122 PRODUCTS)



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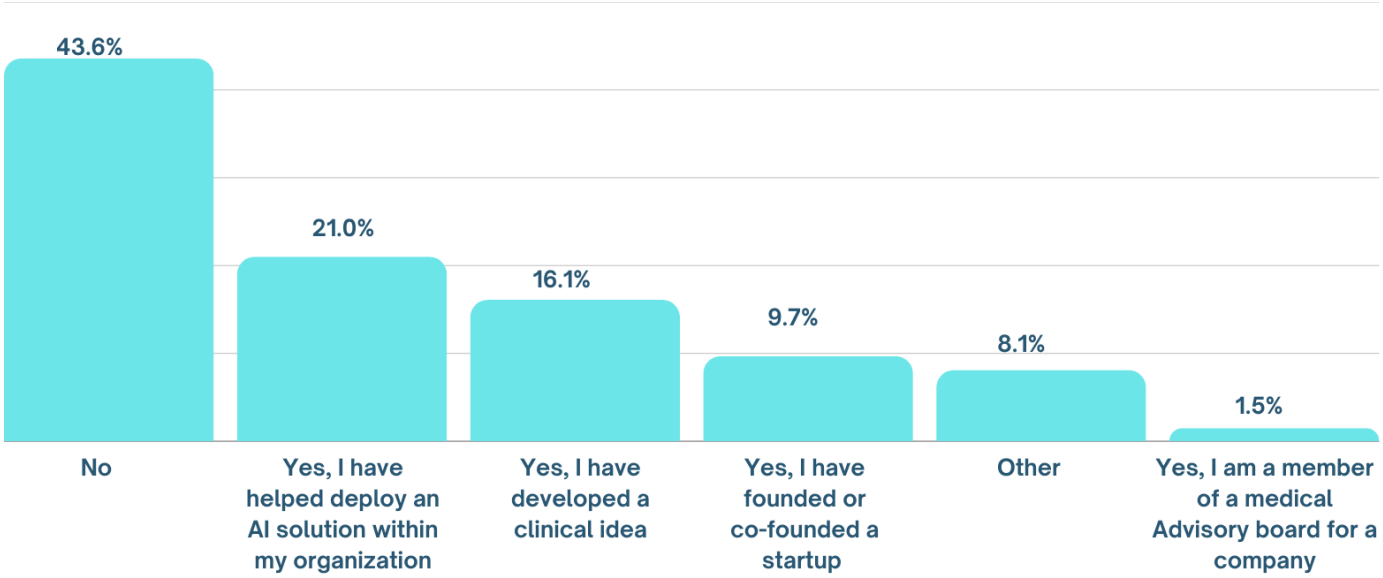
HAVE YOU EVER BEEN INVOLVED IN THE DEVELOPMENT AND/OR DEPLOYMENT OR USE OF AN IA SOLUTION?

Healthcare professional responses



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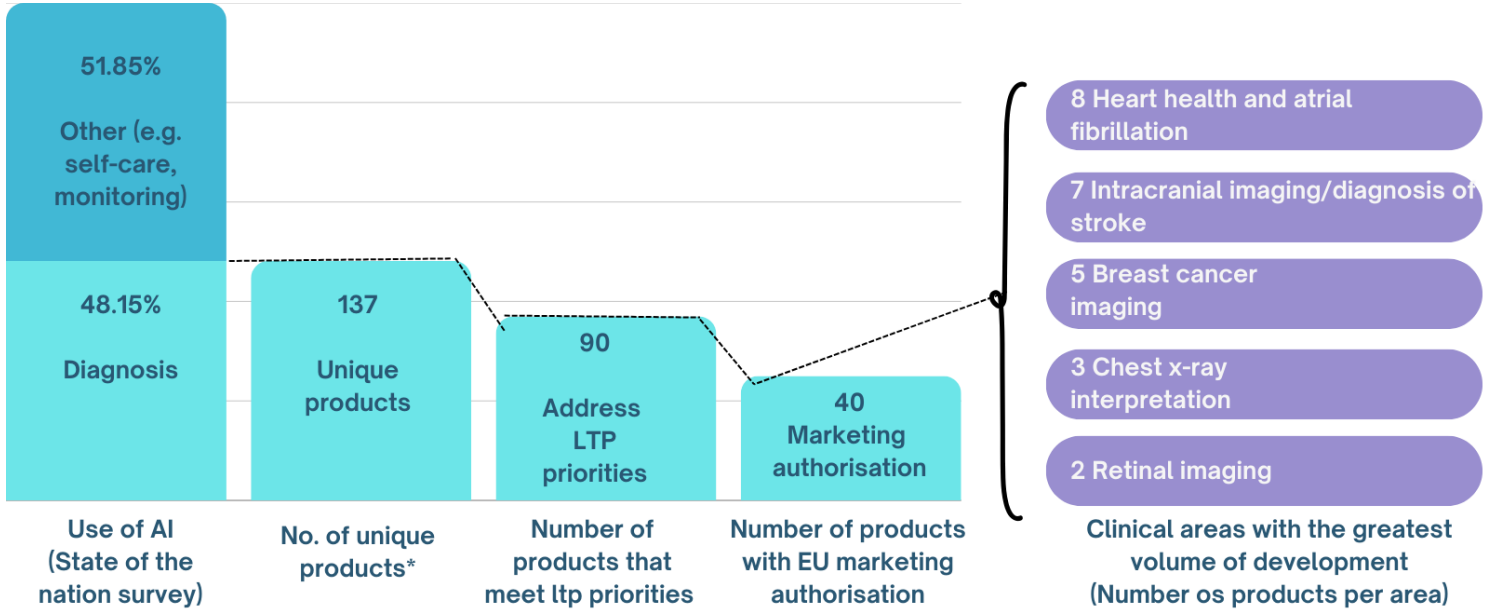
AREAS OF GREATER DEVELOPMENT IN AI OR DATA-DRIVEN TECHNOLOGIES



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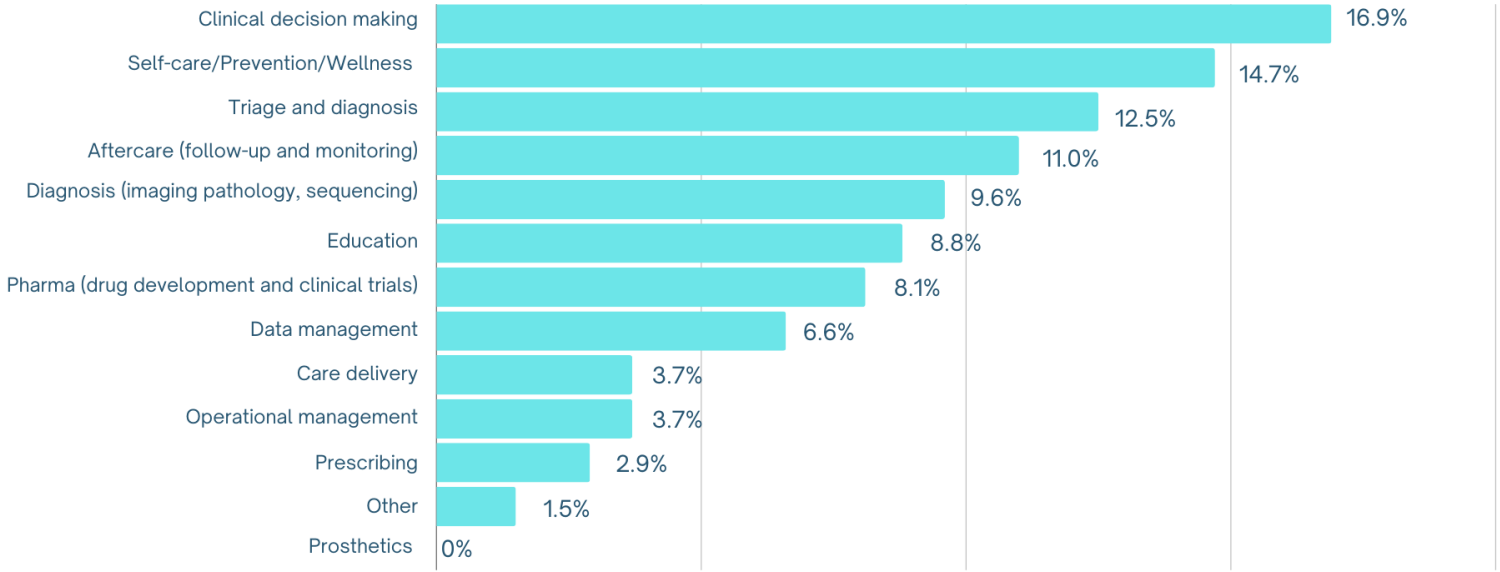
WHICH OF THE FOLLOWING AREAS IS YOUR SOLUTION GOING TO AFFECT?

Startup executive responses



Source: Survey of healthcare professionals, healthcare investors, and startup executives across European countries, conducted in December 2019 and January 2020

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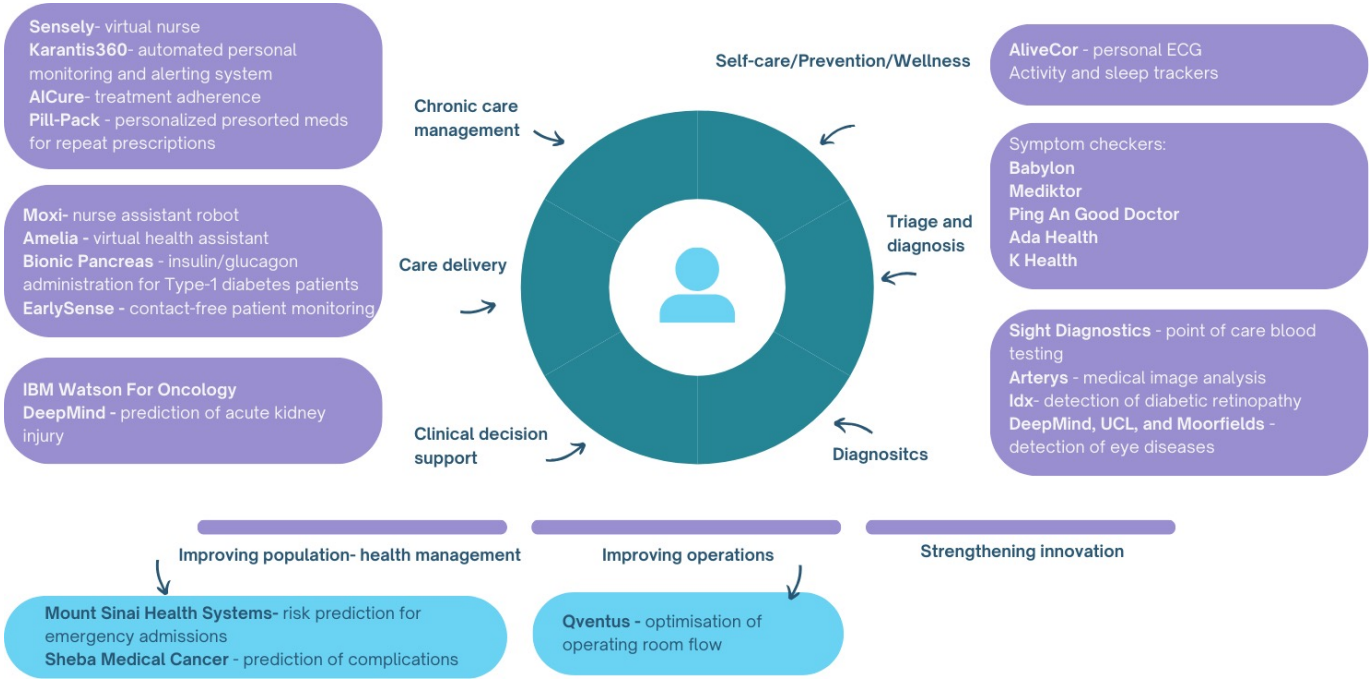
04. AREAS OF IMPACT FOR AI IN HEALTHCARE



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A FOCUS ON HEALTHCARE OPERATIONS

The use of AI in healthcare may be more readily accepted when it helps free up practitioners
from routine, low value-add administrative tasks, to increase direct time with patients.

Potential areas for **improving healthcare operations** include:

- scheduling
- hospital admissions
- discharge and capacity management
- optimising processes in the operating room and the emergency department
- moving patients between diagnostics and the ward

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..AND HEALTHCARE INNOVATION

AI is being applied to many pharmaceutical R&D activities although, as in clinical practice, the opportunities identified are often far ahead of the impact on the ground.

Early applications include:

- disease state and target understanding
- lead selection and optimisation
- clinical dose and endpoint selection
- therapeutic tailoring
- portfolio management

Applications in development, regulatory and safety support include:

- protocol optimisation
- adaptive development plans
- trial planning and execution
- portfolio management
- active safety surveillance

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HOWEVER, THE SYSTEM NEEDS TO FACE SOME CHALLENGES:

How to validate the results of individual studies – to check, for example, whether the algorithm is equally capable of recognising malignancy in mammography scans of people with different ethnicities.

How to model the impact on individual pathways and the system as a whole - for example, we need to assess whether speeding up the rate at which people are 'diagnosed' could lead to longer anxious waits for treatment if the capacity of the system to treat is not increased as well.

How to ensure consistently good public engagement with the concept of AI as a whole and with specific technologies

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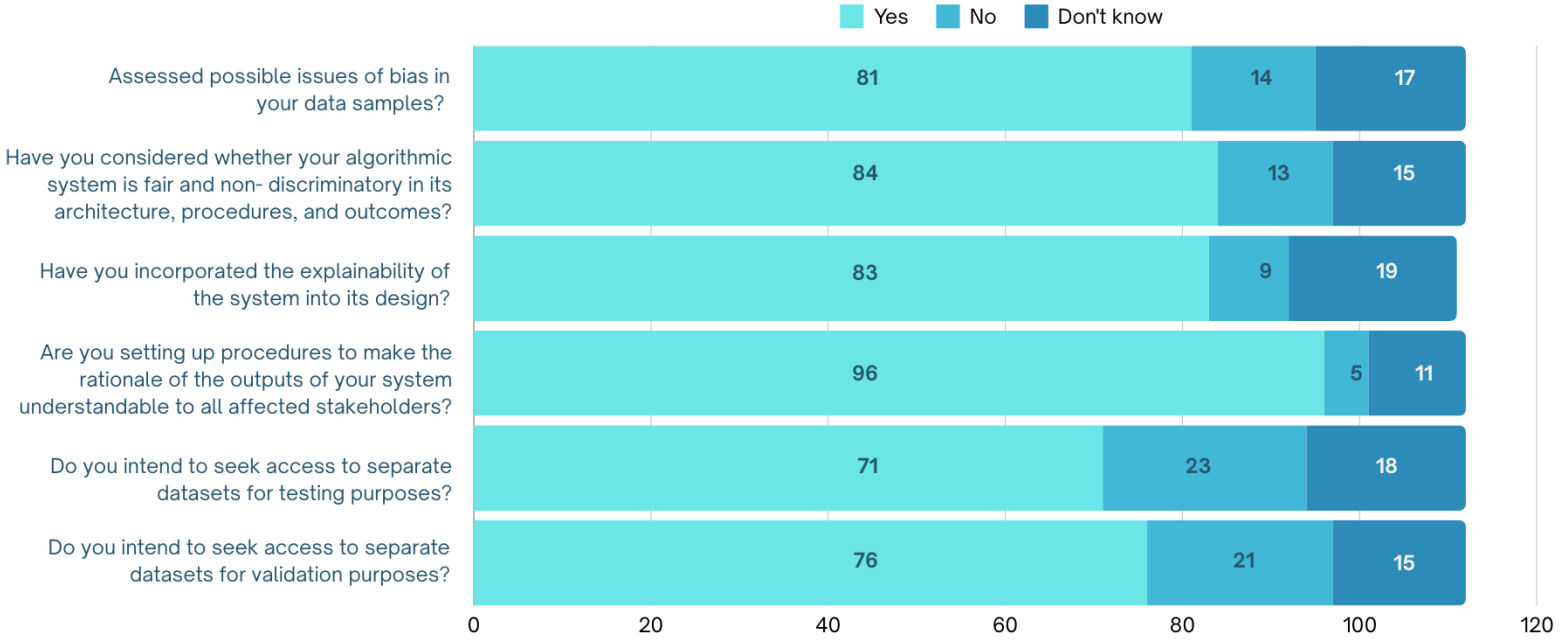
CONSIDERATION OF ETHICAL ISSUES ASSOCIATED WITH ALGORITHMS DURING THE DEVELOPMENT PROCESS



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SOME POSSIBLE SOLUTIONS?

- Working together to deliver quality AI in healthcare
- Further developing the Governance (ethics and regulation) Framework
- Providing more clarity around data access, quality, governance, security, and interoperability
- Supporting the spread of 'good' innovation & monitoring its impact
- Rethinking education and skills
- Upskilling the workforce
- Investing in new talent and creating new roles
- Managing change
- Developing International Best Practice Guidance
- Working at scale
- Funding

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TRENDS IN AI APPLICATIONS IN HEALTHCARE

Phase 1: Near term	Phase 2: Midterm	Phase 3: Longer term
AI solutions to pick up pace in areas with low-hanging fruit – these are likely to be administrative, repetitive, and operational tasks. Medical areas: radiology, pathology, ophthalmology, and dermatology	AI solutions embedded into clinical workflows, supporting the shift from hospital-based to home-based or remote healthcare, and more applications that help patients take ownership of their own health. Medical areas: oncology, cardiology or neurology	AI solutions in clinical practice that drive improvements in quality of care, with approaches demonstrated in clinical trials. Longitudinal datasets, improved and scaled CDS tools

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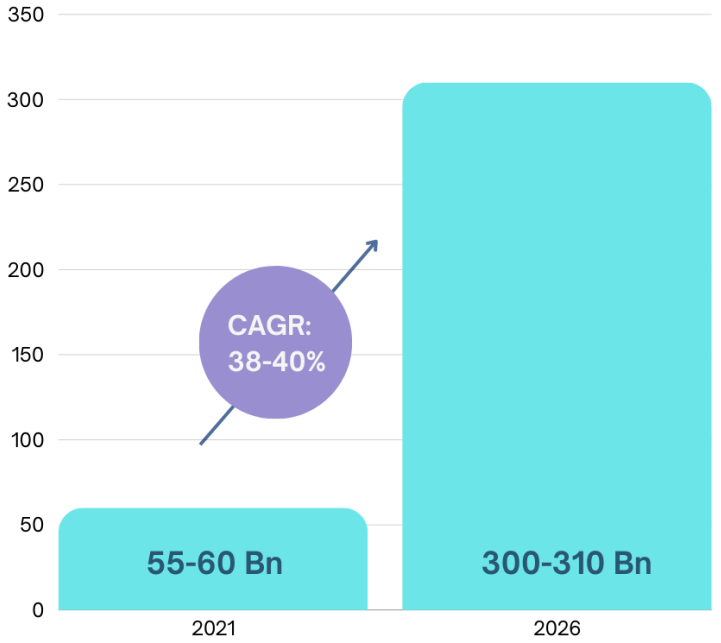
05. FINANCIAL IMPACT

AI market is estimated to grow at a **CAGR of 38-40%** in the 2021-2026 years, compelled by the technological shift towards data-driven AI, AI-driven automation and applications, increased investments in AI and start-ups



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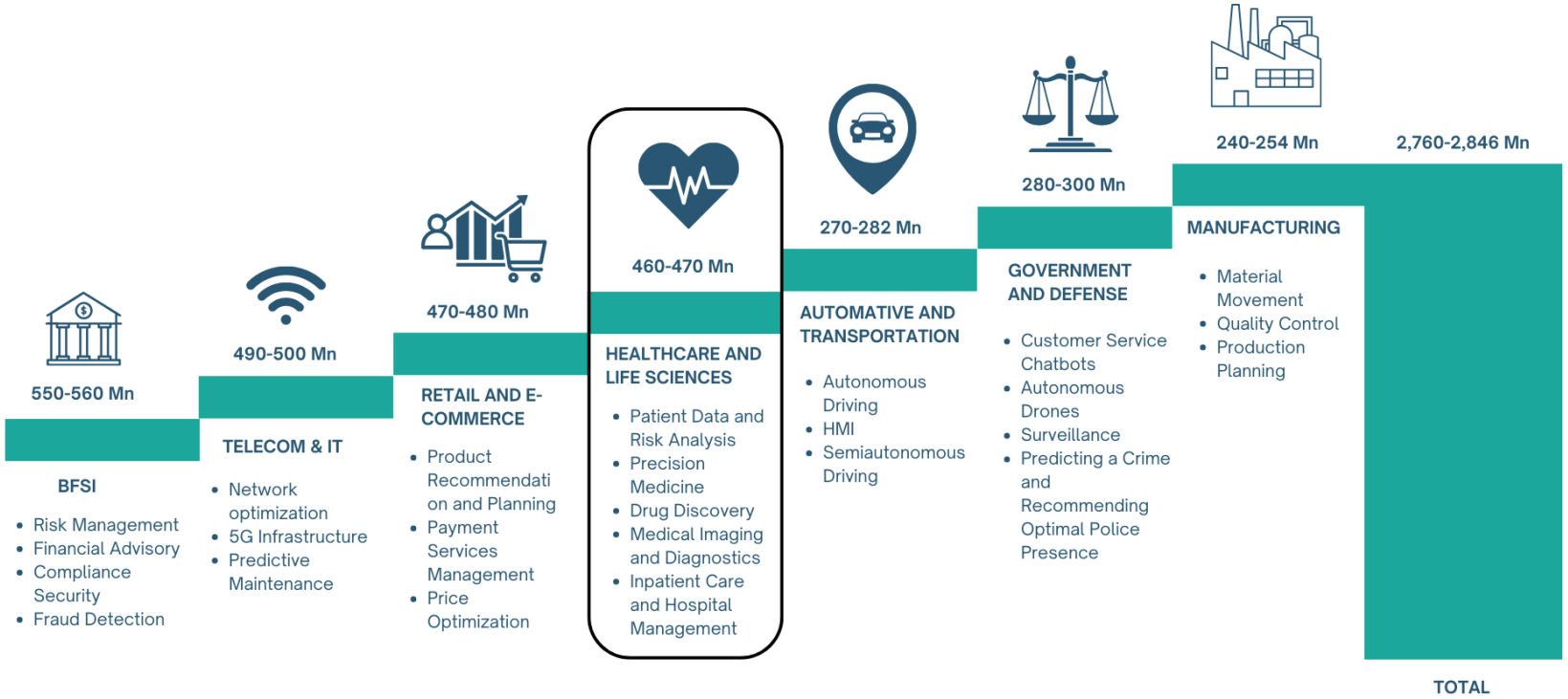
MARKET OPPORTUNITY WITHIN AI MARKET



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MARKET UNCERTAINTIES

01 What AI services will be relevant and redundant in the next 5 years?

02 Can genetic sequencing become affordable for routine testing, or will it continue being used for specific diseases?

03 What is the level of sensitivity that will be required for advanced genetic sequencing?

04 How can companies optimize the manufacturing processes to be more agile and efficient to achieve a more seamless workflow?

05 What regulatory policies can help strategize and achieve volumetric scale-up?

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