

THE FUTURE OF MEDICINE

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LIFE REQUIRES EXCELLENCE

and

Γνώθι σαυτόν (Gnothi s'afton)

Knowing Yourself



The UK population is predicted to increase in size, from 65.6 million in 2016 to over 74 million by 2039.

Without a significant change to existing fertility rates and migration patterns, **older people will increasingly outnumber people of working age.**

Office for National Statistics (ONS) estimate that around a quarter of the population will be aged 65 and over in 2046.

A 2017 study into forecasted trends in **disability will increase by 25% between 2015 and 2025, reaching 2.8 million, reflecting an ageing population.**

NHS Long Term Plan

- As medicine advances, health needs change and society develops, so the NHS has to continually move forward so that in 10 years' time we have a service fit for the future.
- The NHS Long Term Plan will do just that. Drawn up by those who know the NHS best – frontline health and care staff, patients and their families and other experts – the Long Term Plan is ambitious but realistic.
- It will give everyone the best start in life; deliver world-class care for major health problems, such as cancer and heart disease, and help people age www.longtermplan.nhs.uk.

The NHS 10 year Plan

- 75% of cancers will be diagnosed at stage 1 and 2 by 2028
- 55.000 more people each year will survive > 5 years
- ----- lower threshold for referral
- ----- accelerate access to diagnosis and treatment
- Maximize screen detected cancers
- -----*Personalised and risk stratified screening*
- -----*Test family members of cancer patients if at increased risk .*
-

Commission on the Future of Surgery

The Commission on the Future of Surgery was set up in October 2017 by the Royal College of Surgeons to look at the future of surgical care and advise on how best to prepare for its opportunities and challenges.

It is an independent group of 14 experts who were tasked with identifying likely advances in medicine and technology in the next twenty years, and their implications for patients, the surgical workforce and the healthcare system.

The Commission received over 70 written contributions, held four days of oral evidence sessions and conducted several meetings with experts from numerous areas of medicine and technology.

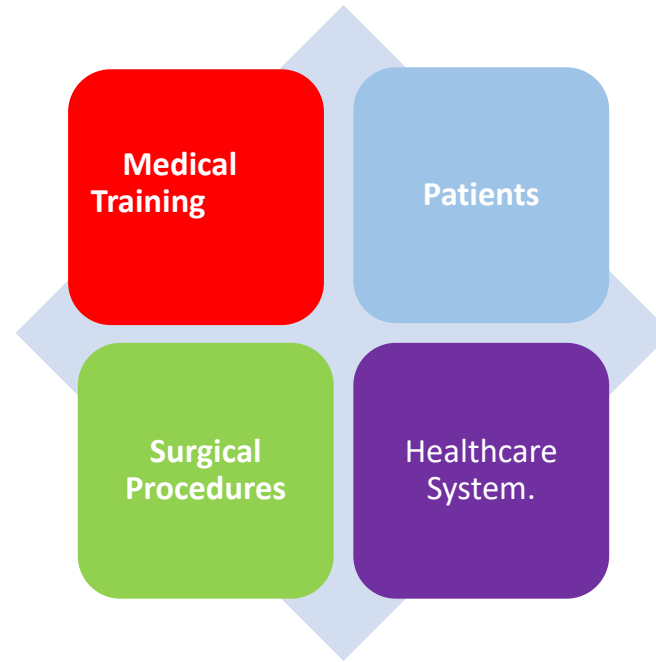


Royal College
of Surgeons
ADVANCING SURGICAL CARE

Which technologies will deliver the greatest impact?

- Minimally invasive surgery
- Imaging, virtual reality, and augmented reality
- Big data, genomics and artificial intelligence
- Specialized interventions

We Should Analyse Evidence and Assess the Implication of Developments for the:



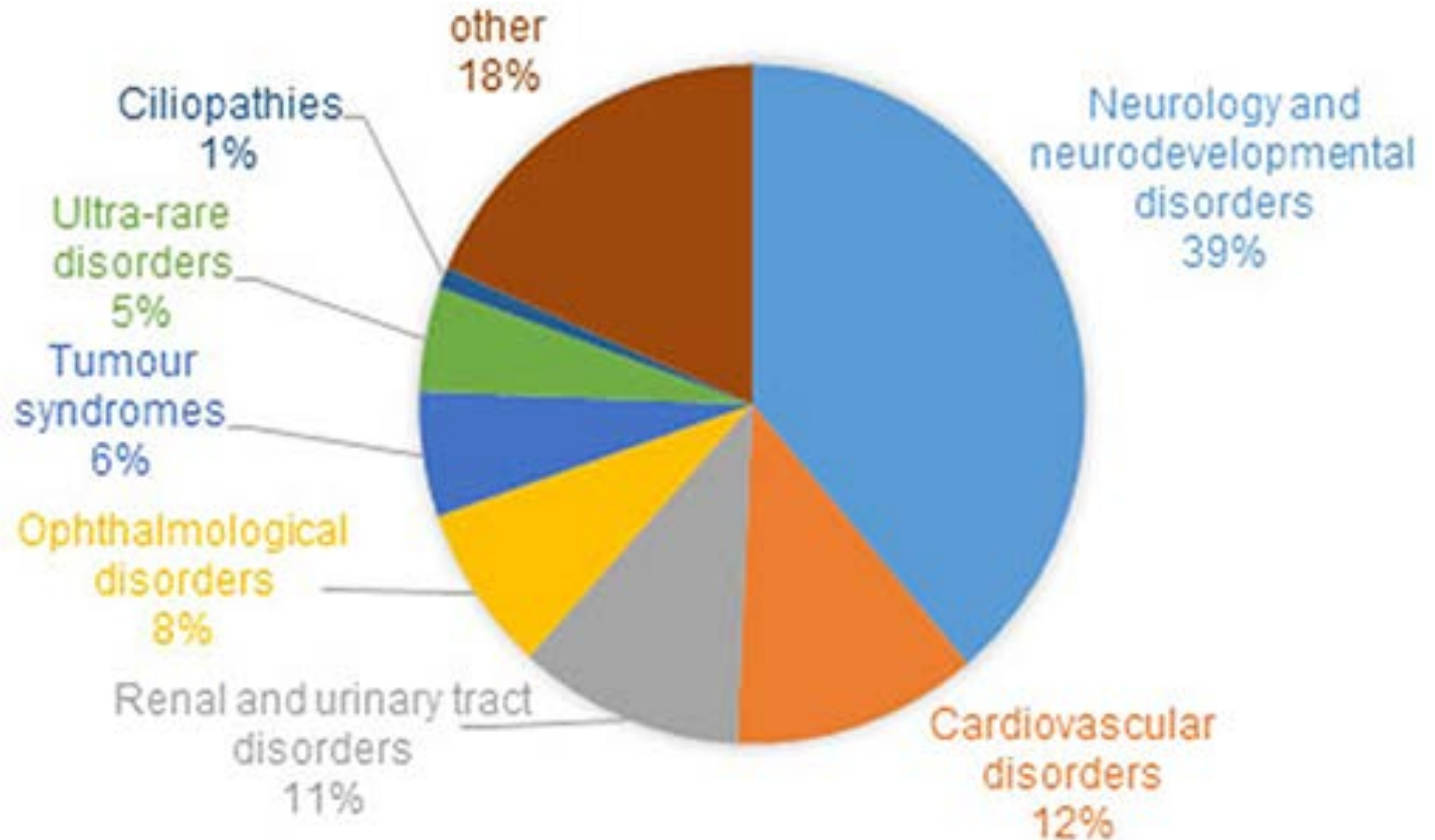
conserving operations

- oncoplastic techniques and neoadjuvant treatments
- Risk stratified breast screening
- Genetic profiling of tumour for personalised treatment
- Increased use of ultrasound scan by surgeons to facilitate clinical diagnosis and intra-operative techniques
- Widespread introduction of novel methods of localising impalpable screen-detected cancers (eg radioactive seeds, magnetic seeds, radio-isotope injections)
- AI aiding diagnosis in both radiology and pathology
- More preventive surgery following genetic profiling
- 3D printing aiding reconstruction
- Advances in chemotherapy
- Liquid DNA analysis for early diagnosis and screening
- Non-surgical treatments (eg laser)

100.000 Genome Project(1)

- £300 million national project aimed to sequence 100,000 complete genomes from 70,000 individuals with cancer or rare disease, and their unaffected family members .
- The 100,000 Genomes Project was launched in 2012 in the UK to improve diagnosis and future care for individuals affected by rare diseases like ciliopathies, through whole genome sequencing (WGS).
- Cilia are highly specialized cellular organelles that serve multiple functions in human development and health
- On 31st September 2018, recruitment to the rare disease pathway of the 100,000 Genomes Project closed.
- DNA samples from 61,282 rare disease patients and family members have been deposited in the UK Biobank and 87,231 whole genome sequences have been produced, from rare disease and cancer patients.
- 1st October 2018 the new National Genomic Medicine Service was established, with an aim to provide consistent and equitable access to genomic testing services across the NHS.

100.000 Genom Project (2)



100.000 Genome Project (2)

- Has catalysed the process of bringing genomics to routine healthcare.
- **NEW NHS TARGET :**
- **To sequence *one million* genomes**
- **over the next 5 years**

NHS Genomic Medicine Service (13 centres)

- Five million genomes in the next five years were announced by Matt Hancock(Health Secretary) .
- Seriously ill children' will be offered whole genome sequencing as part of their care, as will adults with certain rare diseases and hard-to-treat cancers.
- The goal of the new NHS Genomic Medicine Service is to harness this knowledge in order to provide personalised treatments and interventions for patients.
- **The BRCA2 gene and its links to cancer were discovered 20 years ago by scientists at The Institute of Cancer Research**
- Gene sequencing has come a long way since 2003, when the first human genome was fully sequenced
- **it took more than 10 years and cost more than £2 billion.**
- Next-generation sequencing: can sequence a whole genome in a day at a cost much closer **to £700**, and this is getting cheaper and faster all the time.
-

Commission anticipation

In the next five years

- Remote surgical teams will increasingly be able to access expertise and conduct multidisciplinary team meetings through digital technology.
- Outpatient appointments will more frequently occur through a digital platform.
- Imaging of organs will move from static anatomical displays to showing how an organ is functioning.
- 3D planning and printing will advance further and be used more frequently for teaching, training and surgical preparation for complex surgical interventions. The use of 3D models will increasingly become the norm for major hospitals.
- 3D models will also be used by patients to help improve their understanding of a procedure, illness or injury.
- Operating theatres will continue to incorporate imaging facilities such as x-ray, CT and MRI scans, with more hybrid theatres.
- Enhanced imaging technologies incorporating fluorescence will allow surgeons to identify more readily blood vessels, lymphatic channels, tumour bearing tissues or specific organs.
- Advances in imaging and simulation will continue to be used on a wider scale to complement surgical training and planning. More trainees will use mobile apps to supplement their training curriculum.

1. **In the next 10 years**

- **AR will make a bigger impact, with surgeons able to overlay data and visuals over a patient's body during surgery.**
- **VR will become a standardized aspect of surgical training, with training centers and teaching hospitals needing to invest in VR suites.**
- **Digital applications providing training will be more commonly used and provide surgeons and medical students access to global knowledge and standards.**

1. In The Next Twenty Years (20 years)

- **Ultra-high definition stereo endoscopes and microscopes will be in use, making further improvements to the accuracy of diagnosis and surgery.**
- **Imaging data will increasingly be combined with other patient data, providing powerful information to the surgeon undertaking an operation.**
- **Surgeons will more frequently be able to conduct surgery from a remote console, enabling more patients around the world to gain access to expert surgeons.**

Changes to training

- The content of the surgical training curriculum will need to change and be flexible to reflect the likely future career of a surgeon and innovations as they evolve. With flexibility will come options to be a clinical surgeon, scientist, entrepreneur, educator, innovator or manager, with the ability to move across different roles throughout a career.
- Training must incorporate knowledge of computing, engineering, molecular biology, data literacy, leadership, team building and communication. In an increasingly digitilised health service, we must strive to ensure and enhance the humanity in surgery.
- New technologies such as data analytics, AR and VR will enhance training, with high-fidelity patient-specific simulation, and **remote mentoring and proctoring**.
- Entry requirements for medical school will need to reflect the diverse range of skills required and encourage students from other backgrounds, such as engineering or computing, to enter medicine.

1.The patient journey

- Further emphasis on peri-operative care across patient pathways, and new technologies improving rehabilitation and recovery, will help support patients before, during and after surgery.
- The use of data analytics, wider access to genomic testing and better imaging **will enhance predictive and personalised medicine**, enabling more preventive and earlier interventions.
- Better diagnostics and less invasive interventions could shorten the patient's journey with more one-stop appointments.
- **An expansion in multimodality clinics can be anticipated.**

Which technologies will deliver the greatest impact?

- Minimally invasive surgery
- Imaging, virtual reality, and augmented reality
- Big data, genomics and artificial intelligence
- Specialized interventions

Minimally-invasive surgery

- Surgical robots will be more versatile, lighter and probably cheaper
- The next generation of surgical robots due in early 2019 – could be moved between hospitals and theatres, helping to make robot-assisted surgery more widely available.
- It seems unlikely that there will be fully autonomous robots in the next two decades. Nano-robotics for diagnosis and drug delivery may become a reality.
- The wider use of robotics is likely to reduce variation in surgical performance and the invasiveness of interventions. This may raise the possibility that skilled surgical technicians could undertake some procedures under the supervision of a surgeon .

Robotic Breast Surgery

- ❑ The FDA recently issued a **warning** about the use of robotic surgery for *mastectomies and other cancer-related surgeries*.
- ❑ The warning focused on **preliminary evidence** that the robotic-assisted procedures may be linked to **lower long-term survival, but more research is needed**.

Imaging, Virtual Reality and Augmented Reality

- **The shift in imaging from static anatomical displays to showing dynamic organ function is likely to be extended across many areas of surgery.**
- **AR and VR technology platforms will enable multidisciplinary teams to connect and specialist surgeons to support complex procedures remotely.**
- **3D planning and printing will advance and be used more frequently for teaching, training and surgical preparation for complex surgical interventions.**

Automated Ultrasound (ABUS)

- At least nine peer-reviewed publications have shown that adding ultrasound to mammography results in approximately ***3.5 additional cancers detected per 1,000 patients in those with dense breast***
- Inciardi M.D. "[Breast Ultrasound: What's New in 2013](#)." Imaging Technology News. 2012; 10:39-41.
- ABUS increased sensitivity — about 97 percent — when used in conjunction with mammography .
- Traditional U/S operated dependent (usually ½ hour),
- ABUS 3-7 minutes , 3D(robotic arm used)
- .

Imaging Combining Cellular and Molecular Level Delivery of Drugs (1)

- Integrated Imaging Technology: **Aims To Provide Real-Time Look at Cancer Treatment.**
- Albany Medical College, have developed novel optical imaging methods that allow researchers to observe : *down to the cellular and molecular level — delivery of drugs to the cell, and any interaction that might happen.*
- Real time images
- Combining the two technologies will help researchers single out the cancer cells and monitor their responses to therapeutic agents.
- If researchers could observe drug delivery and its effect on cancer cells in **REAL TIME** , they would be able to tailor treatment options with unprecedented specificity.
- My personal opinion :It will be real breakthrough in cancer treatment

Imaging Combining Cellular and Molecular Level Delivery of Drugs (2)

- X-ray and optical are highly synergistic modalities working together.
- This new integrated imaging approach will allow the biologist team to explore :
 - *why that resistance is happening*
 - *by enabling to understand specific cancer mechanisms more deeply,*
 - *assess in real time if a drug is accurately and thoroughly being delivered to the tumor cells,*
 - *if the drug is effective and persistent.*

Genomically-adjusted radiation dose (GARD) can predict risk of local tumor recurrence and optimize radiation dose

- GARD is the first opportunity for a genomically-driven personalized approach in radiation oncology, and is a research priority for the field.
- Recent research has found that:
 - **GARD values are lower for those tumors that are resistant to radiation**
 - **and higher for those tumors that are sensitive to radiation treatment.”**
- In a [new study](#) published recently in *EBioMedicine*, Moffitt researchers validated the use of the GARD model in two separate groups of triple-negative breast cancer patients treated with radiation therapy from Europe (N=58) and the Total Cancer Care program at Moffitt (N=55).¹ They demonstrated that GARD values were associated with the risk of breast cancer recurring locally. The researchers also used GARD to calculate an individualized radiation dose for each breast cancer patient in the group of patients from Moffitt. They found that the range for biological optimal radiation dose in triple negative breast cancer ranged from 30 to 76 Gy, and that the current standard to deliver 60 Gy to all patients could be overdosing a significant number of patients.

3D printing breast implants for cancer survivor

○How does the technology work ?

- First, a hollow implant is 3D-printed using the same material found in dissolvable sutures. Then, a small sample of healthy tissue is taken from the patient and placed inside the implant. Once the implant is inserted into the patient, the tissue within grows and fills out the breast (the team suggest this should take four-eight months).
- **Pre-clinical trials on rats and pigs and plans to start its first human trials in 2021.**

Specialized Interventions

- A number of novel interventions may reach clinical application:
 - some stem-cell therapies,
 - 3D bioprinting of tissues and organs, artificial organs,
 - animal-human transplants and
 - neural prosthetics with adaptive control mechanisms.
- More advanced imaging could enable;
- ‘nano-surgery’, where surgeons could use miniaturised devices to operate on individual cell clusters, potentially with revolutionary effects for cancer patients .
- Novel treatments are likely to become increasingly dependent on collaborative, highly specialised interdisciplinary teams

Lasers in Cancer Treatment (Light Amplification by Stimulated Emission of Radiation)

- Carbon dioxide (CO₂):
- Argon:
- Neodymium: yttrium aluminum garnet (Nd:YAG):
- **Treating cancer with lasers**
 - Lasers can be used in 2 main ways to treat cancer:
 - 1- To shrink or destroy a tumor with heat
 - 2- to activate a chemical – known as a **photosensitizing agent** –
 - that kills only the cancer cells. (This is called photodynamic therapy or PDT.)
 -

Liquid Biopsy For Cancer

- Circulating Tumor Cells (CTCs)
- Cell-free DNA (cfDNA)
- Extracellular Vesicles (EVs)
- Other Circulating Biomarkers

Blood tests for cancer

Evidence received from geneticists, clinical scientists and surgeons specialised in genomics suggests that

in 20 years the population may

be able to undergo annual testing for cancer through a blood sample, while similar tests are already being evaluated to monitor recurrence.

Although there is work yet to be done to extract the genomic signature from a blood test, the Commission anticipates that a

‘liquid biopsy’ might provide an even better view of a tumour, compared to a solid biopsy of the tumour itself, thus avoiding an invasive procedure for the patient.

Several well-publicised studies have shown encouraging results for blood tests potentially able to detect signs of cancer years before the first symptoms appear.

THE PATIENT JOURNEY



What does the future mean for patients? 1

- **How surgery and healthcare will change**
 - Surgery is currently used to treat advanced disease and takes place after the display of symptoms. In the future, surgery will potentially prevent – and not just treat – illness.
 - Healthcare will continue to shift towards establishing and maintaining good health, prevention and prediction of disease, early intervention and co-ordinated management of chronic conditions.
 - Patients can confidently expect surgery to become gradually less invasive, more accurate, have more predictable outcomes, faster recovery times and lower risk of harm.
 - The current unique relationship between the patient and the surgical team will become even more important, as technology allows greater access to information.
 - Surgery is likely to increasingly focus on improving quality of life and operating on well people and older patients with the aim of prevention.

What does the future mean for patients?(2)

- Who will undergo surgery?
- New drugs and the development of other non-invasive treatments may make surgery obsolete for some conditions.
- Advances in radiotherapy and immunotherapy may drastically reduce the need for cancer surgery.
- Vaccination programmes are likely to affect the incidence of virally-driven diseases, such as the vaccination against human papillomavirus to prevent cervical, anal and oral cancer.
- Less invasive technologies and advances in imaging will enable more patients, particularly frail and older people, and more diseases to be treated with surgery. For example, functional imaging of the brain is already enabling more radical but safer micro-surgery for some cerebral tumours

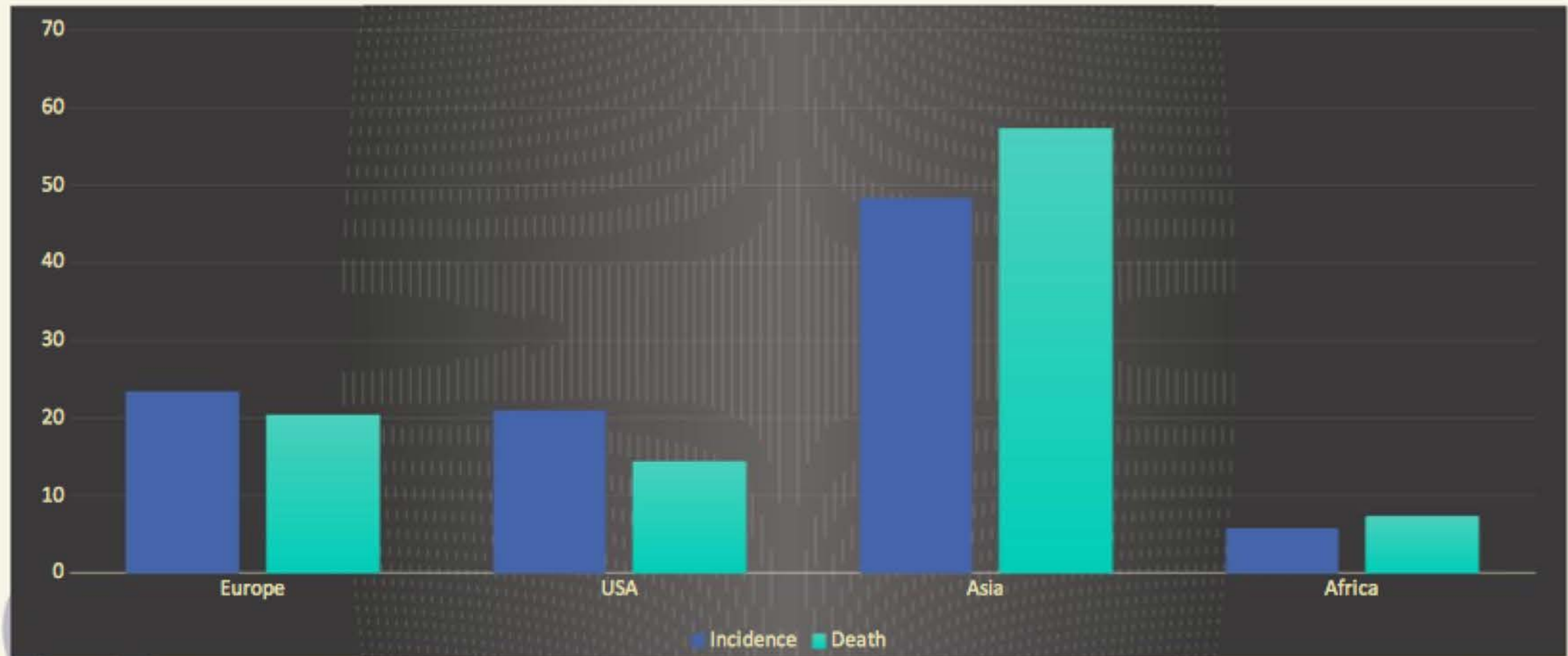
How health will change

- The Commission **does not anticipate any radical increases to life expectancy** unless a significant breakthrough revolutionises prevention of the main causes of mortality. Societal attitudes to conditions like obesity might influence future longevity.
- Patients will continue to experience an increasing burden of non-communicable chronic diseases and multiple morbidities, such as diabetes or dementia.
- **Possible risks**
- The ubiquity of healthcare information and personal data may help patients to become **more informed about their own health, but may also lead to greater anxiety.**
- **For example, genomic information may inflate demand for risk-reducing surgery.**
- **The speed and variety of innovations and information available will be such that** patients may need specialist advice and support to make decisions about their care. For example, greater access to data and medical knowledge may generate inequalities due to different levels of health literacy.
- **New inequalities may be driven by the potential cost and availability of specialised treatments. Patients may turn to the independent sector if there is slow adoption or limited availability due to financial constraints within the NHS.**
- **Changes may have a different impact on individuals and groups within the population, and it will be important to promote access** to worthwhile innovations equitably on the basis of need.
- **On the other hand, greater access to and sharing of data, widespread availability of new technologies and remote support of experts may reduce inequalities and variation in treatment outcomes between different hospitals.**

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Continental Disparity In Percentage Of Incidence of cancer and mortality



7 Modifiable Factors Behind Poor Cancer Care

- Lack of Intelligence In the Health(care) information
- Chronic shortage of healthcare professionals
- Medical malpractice
- Medical Errors
- Poor Patient compliance
- Lack of evidence-based practice
- Medical over-investigation & over-treatment





World's Largest
Data Science
Project
In
Cancer-Care
**Artificial
Intelligence**



youdiagnose

**World Class Cancer
Care
No Matter Where You
Are
In The World!**



Humane Healthcare
Through
Clinical Artificial Intelligence

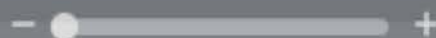
World's First AI Application On Cancer Care

Vision



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To reduce the disparity in cancer care due to geographic location, access to healthcare, socioeconomic status and genetic/biological factors by using data science and cutting-edge modern technologies



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Our Vision

Reducing global
disparities in
Cancer Care
& Healthcare!



CONCLUSION

- The surgeon's role will become increasingly multifaceted.
- *will need to become 'multi-linguists',*
- *understanding the language of:*
 - Medicine
 - Genetics
 - Surgery
 - Radiotherapy and bioengineering.

THANK YOU



Thorin Kadoglou





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THANK YOU

**ANY
QUESTION ???//**