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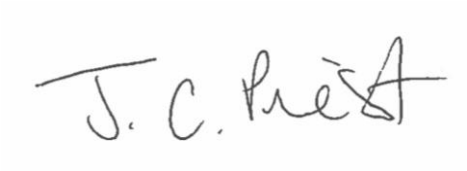
Commission on the Future of Surgery: Call for Contributions

Dear Sir/Madam

The BMA is a trade union representing and negotiating on behalf of all doctors and medical students in the UK. A leading voice advocating for outstanding health care and a healthy population. An association providing members with excellent individual services and support throughout their lives.

The Association welcomes the opportunity to contribute to the Royal College of Surgeons independent commission on the Future of Surgery.



Yours sincerely

Jenny Priest
Head of Public Health and Healthcare

Enclosure: BMA full submission

We have amended the order of our submission to reflect the areas we feel we can add the most value to this call for this evidence.

The BMA is supportive of innovation that is proven to reduce clinician workload, improve patient safety and drive efficiencies that reduce demand on the chronically overstretched health service. The NHS sets aside less than 0.1 per cent of available resources for the adoption[1] and spread of innovation, a small fraction of the funds available for innovation itself. As long as this continues, the NHS's operating units will struggle to adopt large numbers of innovations.

Please consider the direct or indirect impact of such innovations on areas such as:

- **Patients and their choice of treatment in a rapidly changing health and social care system**
  Given the increasing range, sophistication and speed of introduction of new forms of treatment it will be essential to ensure that surgeons are highly effective in explaining the available procedure options, risks, benefits and outcomes to patients, in terms they can clearly understand. This will be crucial in ensuring that patients can give meaningful informed consent.

  In the context of shared decision-making, careful attention will need to be given to the patient's personal beliefs etc when discussing treatments that involve the use of stem cells for example.

- **The training and role of future surgeons**
  We have serious concerns that medical education and training does not prepare medical students, junior doctors or current doctors for emerging and future technologies. During their education and training, the doctors of the future must be exposed to these emerging technologies so they are familiar with them before they start providing patient care. This is particularly important in an age where patients have greater access to information about their treatment, and treatments that are available or in development. Medical schools are well positioned to provide this exposure, which in the long term will significantly benefit doctors and patients.

  The role of surgeons has already changed with the introduction of some of the innovations listed above. For example, during robotic assisted surgery, surgeons are no longer necessarily at the patient's side and are using a computer console to operate a robot who performs the surgery on the patient. This is a significant shift in the role of the surgeon. AI, VR, AR will have a similar impact. Also as new disciplines such as genomics, stem cell implants and 'personalised healthcare' develop, doctors will need to be trained in these areas.

  Ultimately surgical innovation should not impact on the human interaction between a clinician and the patient. It is important to note that machines are not infallible and can

[1] https://www.kingsfund.org.uk/publications/innovation-nhs

suffer 'bugs' of their own[2]. Therefore, it is vital that surgeons remain in control of the surgery at all times and innovation is only used to enhance the surgeon.

- **Patient safety**
  There are numerous examples of the innovations listed above that have improved patient safety. For example, MIS and robotic assisted surgery allows patients to undergo surgery that would have been too risky traditionally[3]. However, some innovations in surgery have not improved patient safety[4]. Future innovations in surgery must, through properly funded research, have a clear evidence base that demonstrates that they are safe for patients before they are adopted.

What will be the challenges of such innovations?

The lack of a co-ordinated adoption strategy is a key challenge to the success of innovation in the NHS. Most innovation is driven by local doctors or companies creating pockets of innovation within the health service[5]. A long-term strategic vision for innovation, supported by a clear evidence base, is required for it to benefit patients and healthcare professionals.

As innovations are experimental in nature this can lead to its own challenges. It will raise challenges in terms of ethics and patient consent. It will also be a challenge to understand how to regulate these new innovations to ensure they are safe and consistent[6].

Furthermore, most of the innovation discussed has been driven by scientists and engineers who often lack biological insight. One of the challenges for innovation in surgery to be successful will be to ensure there is a close exchange of ideas between clinicians and innovators.

Cost also presents a challenge with the adoption of innovations. Most of the innovations listed will be more expensive than traditional surgery. For example, Robotic-assisted surgery is more expensive than other minimally invasive surgeries. Extensive marketing and competition among hospitals has led to widespread use of robotic surgery for a broad range of procedures. However, despite the increased costs there is a lack of evidence of improved outcomes compared with non-robotic minimally invasive approaches[7].

[2] http://www.independent.co.uk/news/health/nhs-computer-problems-blame-hundreds-deaths-harold-thimbleby-martyn-thomas-gresham-college-a8197986.html
[3] https://www.digitalhealth.net/2018/01/robot-surgeons-barts-health-nhs/
[4] http://www.bbc.co.uk/news/health-42110076
[5] https://www.rcseng.ac.uk/news-and-events/media-centre/press-releases/patients-must-see-the-benefits-of-the-latest-surgical-innovations/
[6] https://www.digitalhealth.net/2018/01/reform-report-ai-nhs/
[7] https://uk.reuters.com/article/us-health-surgery-robots/robotic-assisted-surgery-more-expensive-but-not-always-more-effective-idUKKBN1CT2U1

What will be the opportunities brought about by such innovations?

Opportunities that have not been discussed already include:

- Sharing of resources - AI, VR, AR and robotic assisted surgery allow for resources to be shared. This could result in financial savings for the NHS. It could also make up for skill shortages in particular specialists.
- Reducing health inequalities - Allowing all patients to access the innovations discussed could close the health gap. Innovators have found ways to deliver care effectively at significantly lower cost whilst increasing access and quality. Unfortunately, at the moment innovative techniques often widen the health inequalities as they are only available at certain hospitals and are not available to all patients[8].
- Patient empowerment / personalised healthcare – a number of the innovations listed will either give patients more knowledge about their own health or give them knowledge about different options that are available to them.

What steps do you think would be desirable or necessary, if any, to prepare for such innovations and their impact?

It will be important to prepare both clinicians and patients for such innovations and their impacts. One of the most effective ways of doing this will be to ensure that clinicians and patients are very much involved in the adoption and developments of surgical innovations. This may include communication as well clinical skills as surgeons will have to clearly communicate surgical interventions that patients may not be familiar with. This will be especially important if the innovation being used is experimental in its nature.

As listed above it will be vitally important to ensure that medical training and education adapts to reflect the changes that have already happened and the changes that are very likely to happen over the next decade. It will be vital to ensure that there are enough teachers and appropriate facilities if doctors and patients are to reap the benefits of tech/innovation. That will require adequate funding and a Government commitment to create the environment for this sort of learning.

The NHS risks falling behind other health services if this isn't prioritised which could damage our global reputation. To ensure the NHS can attract the top people in this field we need a clear commitment to training and development of innovation across the NHS. We need a plan that identifies how the future workforce will be trained in this area. We also need to foster the academic sector in the UK to keep innovating healthcare for the NHS.

It would be helpful if the public were made more aware of the developments that are being made in treatment options within the field of surgery. This would help contribute to more effective shared decision-making when patients are faced with the need for treatment.

[8] https://www.mckinsey.com/industries/healthcare-systems-and-services/our-insights/the-emerging-market-in-health-care-innovation

Would you be happy for your work / contribution to be featured in future media coverage about the Commission?

Yes.

We are particularly interested to hear about innovations you think may have a significant impact on surgery in areas such as those listed below. It would be helpful if you can detail evidence suggesting the greater or lesser likelihood of the innovation occurring.

If properly resourced, the innovations listed below have the potential to significantly change the nature of surgery and healthcare in the NHS. The innovations have been grouped to reflect those that are likely to change surgery within the next five years, those that could change surgery in ten years and what might change surgery in the next 15 to 20 years.

Five years

- **Minimally invasive surgery**
  This has already made a significant impact on surgery[9]. It has proven to improve outcomes for patients including lowering of morbidity and vastly increasing recovery time[10]. Therefore, it is very likely that the use of MIS will continue to expand over the next five years as it improves patient and clinical outcomes.

- **Imaging**
  Imaging is already used extensively in the NHS and its impact on diagnostic and clinical outcomes is well-documented[11]. For example, the advent of MRI and CT are well-established within the NHS. However, imaging technology will only continue to advance and the possibility of developments in this field, such as Realtime images, could improve surgical techniques even further within the next five years[12].

- **Artificial Intelligence (AI)**
  The impact of AI will only grow over the next five years. AI is already being combined with imaging (listed above) and NHS England (NHSE) Chief Executive, Simon Stevens, has stated that this will be an area that NHSE will be investing in over the next 12 months[13].

  As this technology develops, it could help the NHS become more efficient and deliver better outcomes for patients[14]. Artificial intelligence is likely to be combined with a number of the other innovations listed, including robotic assisted surgery[15], imaging, 3D printing as well others over the next five to ten years.

[9] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5695957/
[10] http://www.laparoscopic.md/concerns/advantages
[11] https://www.ecpi.edu/blog/medical-imaging-advances-have-changed-world
[12] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4749141/
[13] https://www.bma.org.uk/news/2017/september/artificial-intelligence-will-be-adopted-says-nhs-england
[14] http://www.reform.uk/wp-content/uploads/2018/01/AI-in-Healthcare-report_.pdf
[15] https://www.techemergence.com/machine-learning-in-surgical-robotics-4-applications/

- **Robot-assisted surgery**
  This is already happening in pockets of the NHS. For example, teams at The Royal London Hospital aim to use their Da vinci robot on 500 patients each year by 2020 across six specialities[16]. Given its success at the Royal London, it is likely that this innovation in surgery will be adopted nationally over the next five years.

- **3D printing**
  3D printing or various simulation techniques have already helped to reform modelling and planning for complex surgical procedures[17]. Therefore, it is likely that this innovation will continue to change surgery over the next five years.

  Research has shown that it may one day be possible to use 3D printing to create replacement tissues and organs which will significantly impact on the success of future surgery[18]. However, this concept is still experimental and therefore is likely to impact on surgery in the next ten to twenty years.

Ten years

- **Nanotechnology**
  Nanotechnology has the potential to revolutionise surgery in the future.
  There is a lot of research in this area and evidence suggests that this technology will occur but it is not widely used in the NHS currently. Examples of studies that point to the potential adoption of this innovation include:

  1. Researchers at the University of Illinois have demonstrated that gelatin nanoparticles can be used to deliver drugs to damaged brain tissue more efficiently than standard methods. The researchers hope that this method will result in more effective drug delivery for brain injuries[19].
  2. Researchers have demonstrated a method to generate sound waves that are powerful, but also tightly focused, that may eventually be used for non-invasive surgery. The method uses a lens coated with carbon nanotubes to convert light from a laser to focused sound waves. The intent is to develop a method that could blast tumours or other diseased areas without damaging healthy tissue[20].

- **Virtual Reality / Augmented Reality**
  Virtual and Augmented Reality have the potentially to radically change how surgery is performed in the future. However, the implementation of this technology is still relatively new. For example, less than two years ago, in April 2016, a cancer surgeon at

[16] https://www.digitalhealth.net/2018/01/robot-surgeons-barts-health-nhs/
[17] http://www.innovationagencynwc.nhs.uk/media/documents/Case%20Studies/3D%20Life%20Prints%20April%202017.pdf
[18] http://orgamites.com/technology-changing-future-organ-transplants/
[19] http://www.understandingnano.com/medicine.html
[20] http://www.understandingnano.com/medicine.html

the Royal London Hospital became the first surgeon in the world to perform an operation using a virtual reality camera that allowed surgeons from around the world to jointly operate on a bowel cancer patient.[21] As this was the first surgery of its kind anywhere in the world, it is unlikely it will be used nationally within the NHS over the next five years. However, given that the operation was successful It is likely that VR and AR will change surgery in the next ten years. It is possible that VR and AR will change the training of medical students in surgery as well[22].

- **Genetics and genomics**
  Developments in this area are likely to impact on surgery within the NHS in the next decade[23]. New genome-engineering tools could allow researchers to perform microsurgery on genes, precisely and easily changing a DNA sequence at exact locations on a chromosome [24]. These developments are likely to be further away than other uses of genomics but given the drive for patient empowerment the interest in this area will only grow.

- **Stem cells**
  Technology is advancing rapidly in this area and it is difficult to predict the extent of how much Stem Cell treatment will change the future of surgery in the future[25]. It has massive potential, especially when combined with other techniques such as 3D printing etc, to make new organs. Leading experts think it could be as little as 10 years before advancements in this area begin to become reality[26].

- **Pharmacology**
  'Personalisation' in medicine and healthcare has become very popular over the past decade[27]. With the changes in technology and decrease in the cost of molecular profiling it is likely that this field could impact on surgery within the next ten years[28]. If patient interest in genomics increases it could potentially increase the introduction of personalised medication to replace / compliment surgery[29].

Twenty years

- **Regenerative medicine**
  This emerging field spans stem cell transplantation, cell reprogramming, synthetic organ creation, tissue engineering and nanotechnology. However, despite the progress of the past 10 years, it is still uncertain how regenerative medicine will develop in the

[21] http://medicalfuturist.com/the-technological-future-of-surgery/
[22] https://www.digitalhealth.net/2017/10/surgeons-from-across-the-globe-work-together-virtual-reality/
[23] https://inews.co.uk/news/health/nhs-offer-personal-cancer-care-based-patients-genetics/
[24] https://www.technologyreview.com/s/524451/genome-surgery/
[25] https://www.nhs.uk/news/genetics-and-stem-cells/stem-cells-used-to-repair-childrens-eyes-after-cataracts/
[26] https://humanlimbregeneration.com/3d-printing-of-human-organs-with-the-use-of-stem-cells
[27] https://inews.co.uk/news/health/nhs-offer-personal-cancer-care-based-patients-genetics/
[28] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4285684/
[29] http://bmjopen.bmj.com/content/6/7/e010243

future. Currently, effective and safe regenerative therapies beyond bone marrow transplants remain elusive and expensive[30]. Therefore, it is unlikely that regenerative medicine will significantly impact surgery in the NHS within the next ten to twenty years.

- **Transplantation**
  The future of transplant surgery lies in other areas mentioned such as stem cell, regenerative medicine and 3D printing. At the moment none of these innovations (apart from perhaps 3D printing) are widely used and it is unlikely that they will be within the next decade. For example, in April 2016, a girl became just the sixth person in the world to receive a windpipe transplant made from her own stem cells. However, as over 6,000 people in the UK alone have died over the past 10 years waiting for transplants, it is likely that interest in this type of innovation will increase[31].

- **Implants and prosthetics**
  Prosthetics and implants are currently well embedded in surgery. However, at present the most advanced prostheses available only have some degree of mental control and have no sensory feedback[32]. The future of organically controlled prosthetic limbs is quite far away and is not likely to impact on surgery immediately in the NHS. Reasons for this include the cost of this type of innovation given that each prosthetic is very specific and ongoing care is needed to ensure the prosthetic remains effective. Also, even for the most basic prosthetics to be directly integrated into the body requires metal systems that can be inserted into or attached to the bone. However, other innovations noted here such as 3D printing could help develop the technology given that they allow for custom manufacturing of textures and shapes[33]. However, it is still unlikely to significantly alter surgery in this area within the NHS in the next decade.

- **Developments that may alter surgery as the preferred therapeutic intervention for certain conditions, or even make surgery redundant.**
  Many of the concepts in this list have this potential. Specifically, though, it is clear that if genetics and epigenetics increase patient personal health knowledge then this may impact in the future on whether a patient chooses to have surgery. As our understanding of fundamental mechanisms at the molecular level advance, new ways to approach a disease or condition will emerge. This could include therapeutic interventions for certain conditions instead of surgery. For example, a new technique to treat prostate cancer could mean men won't need surgery in the future. A drug activated by laser light has the potential to treat early prostate cancer without surgery, therefore avoiding the risky side effects associated with this surgery[34].

[30] https://www.kingsfund.org.uk/projects/time-think-differently/trends-medical-advances-surgical-innovation
[31] http://orgamites.com/technology-changing-future-organ-transplants/
[32] https://www.theengineer.co.uk/future-prosthetic/
[33] https://www.theengineer.co.uk/future-prosthetic/
[34] https://www.nhs.uk/news/cancer/new-laser-therapy-for-low-risk-prostate-cancer-shows-promise/