Royal College of Surgeons' Commission on the Future of Surgery

The evolution of Surgery requires the inclusion of elements that enable the constant renewal, not only of the elements of Surgery, but also of its very definition. Thus, the Surgery of the future, hand in hand with innovation, must become the part of Medicine that makes possible the treatment of patients by means of any kind of structural alteration in organs and tissues, but also in cells, genes, and metabolites.

Like any other discipline, Surgery has a learning process. However, the Surgery of the future cannot be taught using traditional techniques. The main premise of Pedagogy is that the goal of any kind of teaching is to help students to become self-creators – in this case, to become future surgeons by acquiring knowledge, skills, and attitudes that will enable them to practise their profession on the basis of basic skills. Future surgeons could be regarded as veritable molecular biologists who work with their hands.

Dr William Halsted's classic description of the teaching of Surgery: "*See one, do one, teach one",* based on face-to-face, work-based learning, is not currently sustainable due to the regulation of the labour framework for Surgery residents in terms of working hours, as well as due to the need to take knowledge to every corner of the planet. Teaching is currently based more on observation, initial experience, interaction, reflection, and finally action. Much more ambitiously, the goal is the direct transfer of skills through suitable training systems.

The proposal from the Royal College of Surgeons (RCS) is broad and encompasses practically all the fields in which Surgery is advancing and redefining itself. However, the Surgery of the future arising from the advances that the development of all these fields will generate requires a new teaching method.

This new framework for the teaching of Surgery will be obviously influenced by the contents to be conveyed, as well as by the means available; but also by the new students and by the conditions pertaining to access to medical education. Thus, innovation should not be defined by the advances which certain developers and technology providers can offer, but should also extend to educators and communicators. However much Surgery advances, if the way in which it is taught does not adapt to the demands of a society in constant change and does not enable the dissemination of the associated knowledge, it will not have a true impact to improve treatment.

The teaching of Surgery takes place in three very different scenarios in which the main agents – students – are very different, requiring adapted strategies, methods, and technical resources, as they encompass both initial surgical education and ongoing medical training. To begin with, students who are learning the principles of Surgery for the first time will have a profile in which the use of cutting-edge technology will be the main option during digital training, and there will be no adaptation period. In fact, this kind of student will create his or her own learning system, and, through experience, will change the methodology according to his or her needs. That is, the next generations of surgeons will have to acquire pre-established competencies, but it will be the students themselves who will design how to attain them.

Secondly, surgeons with solidly acquired competencies which are constantly updated, who need to learn about the latest developments, require dynamic, reliable training channels. But these channels should also provide unlimited access, adapted to the time available to them, as well as the possibility of participating or at least contributing their views regarding the knowledge being offered.

Finally, there is a significant number of surgeons who have difficulties updating their competencies. Sometimes, due to difficulties in access to ongoing training; sometimes because there is a technological-generational breach that makes it hard for them to learn in a digital environment; and sometimes because that breach generates cognitive-behavioural resistances to the acquisition of new concepts which may challenge traditional tenets that they have found effective when treating patients during their career.

Moreover, the current context, characterised by the increasing difficulties in gaining access to education due to financial problems, as well as to regulation, makes it absolutely necessary to redefine a framework for the development of medical education, not only continuous medical training, but at every level. In developed countries, there is the influence of a framework of changes in industry support to access education, changes in event and/or sponsorship regulations, as well as the possibility of overcoming distances and time schedules without losing immediacy and quality. But the developing countries should also be taken into account, as education should reach all kinds of surgeons everywhere in the world. The principle of equality should be upheld. Finally, the face-to-face model for training activities in Surgery should start to be reassessed from the point of view of its real environmental impact – from its carbon footprint to its direct, indirect, and intangible costs.

The main channel for the dissemination, storage, and interaction of a huge number of educational materials is currently the Internet. The proliferation of online sources of knowledge makes it possible to implement training in new techniques, procedures, the creation of protocols, and data acquisition / processing.

In this regard, our proposal involves regarding online platforms as the basic pillar of the teaching of Surgery. By firmly and permanently introducing the new paradigm for the offering of high-quality education in Surgery, the rules of surgical teaching will be redefined.

What are the basic characteristics and basic elements of the tools for training in future Surgery?

Firstly, surgical education should be ubiquitous, provided at any time, and at no cost whatsoever. The teaching materials offered should be free to access, revisable and updatable, as well as constantly, dynamically, and interactively validated (students go beyond their role as mere recipients of knowledge and actively rate contents). In our own experience, contents can be simultaneously shown live in more than 120 countries in all 5 continents, encouraging the participation of more than 26,000 surgeons asit happened during our last winter event (https://aischannel.com/congress/winter-event-2017/).

Teaching ceases to be static and becomes something much closer and changing, depending on students' needs, as the concept of "academia" is redefined. The new "surgical academia" dispenses with the traditional figure of the teacher, and becomes much more demanding by requiring, in addition to teaching ability and provable knowledge, the capacity to adapt to students' needs. Thus, the new paradigm of "surgical academia" is actually more inclusive, as it is open to opinion leaders and surgeons with the ability to innovate who are usually not part of the classic academic environment but who are willing to share their knowledge and skills in a transparent, bidirectional, and global manner.

What structural components should it have?

1- Courses: on the basis of three basic models (*state of the art lectures, step-by-step performance of surgical procedures, and mentoring experience on cadavers and in simulators*), and using validated

contents taught by opinion leaders in each field who have a special teaching talent, assessable contents can be generated. The provision of contents through a website, applying Artificial Intelligence algorithms, can in turn enable the automatic generation of personalised courses. On the basis of the profile generated by the user and his or her areas of interest, the system can provide, in an orderly manner, pre-classified contents in order to meet users' needs to achieve a certain skill / ability.

2 - Creation of live events / congresses: teaching is, to a large extent, the transfer of knowledge, but preferably based on needs, with maximum availability and using the best sources. A programme for training in Surgery should be able to quickly and regularly run educational events that not only review basic aspects of a field of surgical knowledge, but can also quickly react to controversial cases or the need for the dissemination of dramatic changes in the principles of Surgery or clinical practice.

3 - Live surgeries, although the impact which live surgeries can have both for patient safety and for the surgeon and his or her team is currently under debate. Broadcasting pre-recorded but unedited surgeries makes it possible to observe every detail as well as the real difficulties of a procedure. The surgeon can also answer all the questions from the audience in real time through an online chat. In our experience, this type of activity is very warmly received by all types of surgeons, from experts commenting on specific details to surgeons in impoverished areas who are grateful to have access to basic data, such as the materials used or the patient's position.

4- Congresses: as was previously discussed, the funding of attendance of medical congresses is not universal, and moreover will become increasingly restricted due to the growing restrictions on industry support. It is also our duty to minimise the impact which frequent, avoidable travel can have on the environment. Furthermore, the physical availability of working surgeons is very limited. For all these reasons, offering the contents of the main scientific meetings through a website makes it possible to access them at any time and from any location. If access is also free, surgical training becomes genuinely democratised.

5 - A forum for discussion as a way to make and develop proposals: on the basis that surgical research always arises from a question derived from observation, the interaction enabled by educational websites is useful to answer questions, reinforce concepts, identify obsolete knowledge, as well as to generate and propose new ideas much more quickly. These proposals are instantaneously shared, so working groups to develop them can be generated in seconds. In turn, educational platforms can provide expert support/collaboration, as well as the possibility of testing and spreading proposals.

6 - Data acquisition and analysis: the interactive activity detected on the websites that currently offer online surgical training is very intense. This activity generates many data, which can be easily stored and analysed. The more specific this activity is and the higher the level of interaction involved, the more specific the data generated will be, which can help to detect learning problems or difficulties, as well as spontaneous ways to solve them, habits and behaviours, and of fields of greater or lesser interest, among others.

In this way, it is obvious that the new teaching model proposed will have a clear impact on at least five of the areas of interest identified by the RCS:

The training and role of future surgeons: it can be assumed that the model will be much more efficient and effective by adapting much better to the needs of future surgeons and the technology with which they will have to co-exist. In addition, it will redefine their role by enabling the easy acquisition of transversal competencies and a multidisciplinary profile that should not be incompatible with in-depth knowledge of a topic or entire field.

Staffing and career pathways of the surgical team: the new model will probably make possible a much more accurate and fair assessment of competencies, in the initial stages and during the acquisition of advanced skills, as well as the discovery of new tools. This possibility of objective monitoring can be useful to verify surgeons' competence throughout their training, thus making it possible to design their itineraries towards a specific sub-speciality as well as to recommend professional promotion or not.

Ethical and regulatory challenges: the new model is optimal as regards the consideration of patient rights in a context of autonomy ethics. The risk of exposure to techniques that are not fully validated is minimised, and transparency is encouraged. The possibility of having access to free medical education not only strengthens the principles of equality and justice, but also reduces to a large extent the conflicts of interest with the industry as the industry does not fund access.

Patient safety: learning in the digital era will be more effective, as, before they have their first experience with real patients, training surgeons will have gone through an adaptable educational itinerary that can be monitored and which will reduce to a large extent the possibility of their failing to acquire a specific competence.

Clinical outcomes: teaching using the model proposed will improve clinical results quantitatively and qualitatively. The possibility of observing how procedures are performed, remotely and at any time, with the possibility of providing mentoring and monitoring, will lead to techniques becoming standardised and easier to learn – but will also lead to the sharing and auditing of negative experiences, identifying and discarding more quickly those procedures that do not improve on the outcomes previously obtained or place the patient or even the surgeon at risk.

Therefore, for all of us in AIS Channel it would be a pleasure and a sure honour to participate in such an exciting project as Commission on the Future of Surgery and be featured in any kind of media coverage.

Sincerely,

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