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Review Article

Advanced Screening Technologies and Their Applications in Gynaecological Cytology: Can It Be a Pyrrhic Victory?

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ABSTRACT

The impact of artificial intelligence (AI) is already affecting cytopathology on diagnostic medicine, which offers a great perspective and many attractive approches for it. But, even though it may indeed improve accuracy and enhance many processes, the study aims to highlight some additional challenges and ethical issues that are relevant as well. Also, it points out the role AI can play as a strategy to improve cytology practice and teaching worldwide, aiming to obtain best possible performance in population-based cervical cancer screening according to the different scenarios we can find, and to have the best strategy that may vary accordingly to were it is to be implemented.

There is a vast amount of scientific data on the field of artificial intelligence (AI), founded in the late 1950s, and since then, it has produced a wide variety of technologies, so it is necessary to reflect on the real impact that the implementation of these technologies may have on diagnostic medicine, which permeates cytopathology, including the Pap test and presenting as a real promise to change the course of cytopathology as we know [1].

AI is the branch of computer science concerned with the development of machines with the ability "to perform those activities that are normally thought to require intelligence." It is a broad field that encompasses several sub-categories such as machine learning, deep learning, robotics, and knowledge representation, among others [2]. Whole slide imaging (WSI) represents a paradigm shift in pathology, serving as an initial step for a wide array of digital tools to enter the field, such as automated screening, mass cytometry, tomographic images and many similar ones are attractive and desirable promises or even a reality [3].

This whole new data is exciting to some and frightening to others. Nevertheless, it is not acceptable to choose the second-best for the sake of convenience when there is a better and affordable way of doing things. It is expected that a cytologist shall adopt the best suitable and affordable method and to become engaged in order to optimize diagnostic accuracy and enhance operational processes as well. This is something anticipated when AI systems are implemented and developed, including the application of machine and deep learning to cervical cytology specimens, that was the initial target for the application of machine learning given the sometimes tedious nature of the job and the relevant volume that it represents within the sample of most laboratories. That said, there are some gray areas to be addressed regarding less common topics related to these new methods: and the issue that clearly must be addressed is how to approach all these novelties within the global scenario.

Essentially, the vast majority of publications related to this topic focus almost exclusively on its many applications, the competing techniques, regulatory process, financial impact and scientific evidence concerning the validity and safety of each tool or algorithm. Considering the unquestionable relevance of all the variables exemplified, it is expected that these will be the dominant approach and the main focus of most studies. However, there are aspects that are frequently neglected, although it is known that those are also conditioning factors in any comprehensive decision-making process that involves the adoption of any of these methods. There is no way to properly evaluate the relevance

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or suitability of any of these tools without assessing the unique aspects of each region of the world in a cautious and responsible way, since these aspects are also essential to understand the impact that an eventual technique may have and if it makes sense to do that in a specific scenario. Respecting demographic and regional peculiarities is not a mere option, but a fundamental condition for us not to run over processes that are still too precarious for something so disruptive and may be damaging to some populations, already so underserved and when it comes to public health, that will cost our lives. Since cervical cancer is still a burden, particularly for those women living in developing countries, we cannot rush into any movement that might lead us to even greater inequity in terms of access to public health in those places, such as in Latin America and Africa.

In many populated regions around the world, there are women that remain devoid of any health assistance, that spend their whole lives without a single Pap smear. There are many limiting factors that may prevent them from having an early diagnosis and, as a consequence, a more effective treatment: education and screening programs that are properly designed and conducted are certainly among the most frequent ones. Certainly, those innovative tools may be of help, perhaps playing a different role that adapts to the scenario and challenge in question. It can help us to improve accuracy, optimize the workflow but there are other potential roles that might be useful, such as educational programs and teleconsultation. Although there is still some resistance from the scientific community and also from the population in terms of the decision-making process without human intervention, there is an undeniable progress that can no longer be ignored.

Among the features of deep learning, it is the pattern recognition and predictive model building from big data that makes it so appropriate to health-related applications and there are evidence that support its effectiveness, which is why several innovative software solutions and medical devices have demonstrated diagnostic accuracy that matches the performance of clinical experts, and some optimize their performance to improve as they progress, even without any human intervention [4, 5]. Also, the optimization of image analysis algorithms can be iterative processes; the user adjusts some preferences and runs the algorithm on images, assesses, and reoptimizes it he sees fit [6]. Seeing this phenomenon increasing the diagnostic assertiveness of more and more diseases, often with no need for human interaction, is not optional, but factual. And this should not be seen as something negative in itself, since there is a gain in the final diagnosis report, which is certainly something to be pursued unceasingly by scientists. One potential benefit of some regulatory approvals may be cultivating the development of machine-learning algorithms, making the use of deep learning more likely to permeate laboratories that will optimize those tools by providing larger datasets and, as a consequence, enhancing the power of deep learning devices with an integrated digital pathology infrastructure in place. Of course, there are some challenges: cost, other data storage, and pathologists' mindsets and acceptance.

Although it may take time to overcome some barriers, the large amount of literature can also be expected to get even more common, improving guidelines and validating artificial intelligence systems specific to pathology. In addition to their main purposes, those novel techniques very often promote greater access to data shared in a remote way, an easier interaction between colleagues, effective training of residents and fellows and not to mention the great ease in terms of filing. With that, they carry as a seed the potential to spread knowledge hitherto inaccessible even to the most remote corners, if they are used in a propitious way for that to happen. This has not yet been the case, at least in terms of the locations where they are accessible so far: both devices and specialists are not distributed equally throughout the world and there are very few training centers for doctors and technicians and those tend to be concentrated in developed countries, since many of these surveys are conducted there and these are the countries that can more realistically bear the implementation costs and maintaining them. And to change this scenario, undoubtedly, is something to be pursued by those who can help to improve the way it has been shared, a more comprehensively setting, involving researchers from different countries in the validation programs and disseminating knowledge in a broadway seems an excellent advantage way to proceed.

However, all those great points are not free from some ethical questions: and the ethics invite us to assess whether in countries where not even a Pap smear is offered to a relevant number of women, those state of the art hardware are really the answer for those realities. Which should be the next step forward in terms of public health when it comes to these so deprived places? From the most ordinary screening program to the most sophisticated methodologies, there are many possibilities. But the step to be taken must vary according to the social scenario in which it is to be implemented. There is not a simple and clear-cut way to address it. So, the question is how to take a step forward while maintaining the focus that one must never forget that it will depend on the starting point of this race against cervical cancer.

Clearly, the ideal program for a scenario is generally not the wisest decision when assessing a different reality in terms of population impact. The demographic profile is necessarily a preponderant factor to be considered between and even within some countries, which may present a huge spectrum of patient profiles between different regions so that the prioritization of public health resources is more assertive and accesses the largest number of women possible after a detailed demographic study.

It seems quite unfair to neglect the good and possible program for many in order not to momentarily give up what really seems ideal for situations in which we already have the starting point ahead and therefore cannot be used as a rule and there are authors that highlight the deficit of evidence that these algorithms will actually work in clinical settings found in developing countries [7]. The wise thing to do is to consider the patients best interest, and, it goes without saying: search for knowledge and access to all possible improvements are prerogatives for those who are committed to diagnostic medicine; Still, while it is our duty to know the state of the art techniques and constantly improve our technical capacity, we must focus honestly and with righteousness on what is best for the population we are attending, in order to avoid a Pyrrhic victory, due to an eventual impulsive decision-making process, driven more by vanity than by legitimate reasons, deeply rooted on public health strategies. There is not a single answer to this question, on how to take the necessary step forward when it comes to cervical cancer screening. There is just an invitation to the most realistic perspective possible regarding what, in each case scenario, will actually add as much value

as it is possible for the women to whom the exams are aimed, are about whom we are talking about, after all.

Finally, we can say that it will take effort and engagement in order to rely on large data sets, which is a key point for better results achieved by deep learning. Additional challenges are the relevant value and resistance it faces among us. But there is no doubt that AI can be the strategy to augment cytology practice and improving decision-making [8].

Considering that the cultural, economic and demographic aspects of populations around the world as a determining variable for the success of the method of choice for a screening program of greater scope and efficiency in terms of effective impact on local mortality and ensuring that the starting points from which each one of us will travel the journey ahead are duly analysed and taken into consideration, a cytologist will certainly be more capable of adopting the strategy that best suits a service when provided with this data. Certainly, we are not dealing with something that can be easily standardized worldwide and the option of which path is the most effective in terms of mitigating the devastating effects of this disease in our population, aiming to obtain the best possible performance locally in the long run is not easy to be made, since it is indeed hard to access the "new" (even when it is suitable and intended) while facing previous cervical cancer screening programs that were inefficient, confusing or not even accessible and relying on scarce government financial resources.

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