

Clinician engineers – Re-injecting the thinking into medicine

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I. INTRODUCTION

Medicine historically relied on astute history and examination skills. As technology was lacking, ward rounds focused on debate and discussion of diagnoses and possible differential diagnoses based on the history and physical examination. The technology movement into healthcare was never truly predicted. With its occurrence, came the ability to scan a patient from top to toe via computed tomography and magnetic resonance imaging. Technology now serves as our main diagnostic tool (Patel, 2013).

‘When did the patient have their scan? Shall we repeat it? Maybe we are missing a subtle cancer?’ These are now common questions.

For those that enter medicine, we do so on the basis of the intellectual challenge, the desire to piece together a patient's symptoms and examination findings and formulate a diagnosis. However, we have now become technicians. Patients are imaged and labelled depending on what the scan tells us. Has our critical thinking now gone (Hall, 2019)?

We urgently need to reinject the thinking into healthcare. Otherwise, retention and recruitment into the medical field will diminish. How can we achieve this? Technologies certainly will not die and patients want them. Hence, we envisage a change in the way doctors are trained. A system where future doctors not only gain clinical knowledge but engineering expertise. By

developing a training system whereby engineering colleagues can provide medics an understanding of device and diagnostic development, we will not only be able to accurately diagnose and manage patients but also be able to keep the thinking alive. As clinicians can recognise the limitations in how patients are managed, they can solve these limitations once armed with engineering know-how.

II. METHODS

As the authors of this piece, we have launched the first global clinician engineering platform for medical undergraduates, the clinician engineer hub (www.clinicianengineer.com). The hub is led by one founding clinician NS and two founding engineers MSB and AKY. All members have global experience in their respective fields including internal medicine, gastroenterology, biomedical imaging and biosensors. Next came the decision to recruit an international advisory board, comprising senior experts and mid-level career individuals. Recognising the fact that medical students undertake sabbaticals abroad, it was essential to ensure an international angle. The focus of the first programme was on biomedical optics for early cancer diagnosis and wearable sensors for real-time health monitoring. The focus of the engineering content was based on consensus among the founders and advisory board with the decision to review the theme of the programme on a biannual basis. The programme took place over a two-week period. The first week involved clinical observation to understand the clinical problem and what potential limitations exist in terms of diagnosis

and treatment. This involved exposure to patients in an outpatient setting and in the ward. The second week focused on theoretical aspects of engineering and device development. Additionally, it involved lectures and hands-on practical activities. Each learner gained appropriate credit for full participation in the programme with the opportunity to provide feedback on how to enhance the learning experience.

III. DISCUSSION

As the programme builds, our aim is to next integrate engineering training during medical school which can be done in a variety of ways. It could, for example, commence as an elective. Alternatively, of more value, during each attached clinical rotation, be it gastroenterology, cardiology, or respiratory medicine, there could be dedicated teaching time allied to limitations in current diagnostic practice and management strategies with time spent appreciating

current engineering strategies and solutions, seamlessly integrated into the curricula (Tables 1 and 2). This way, both disciplines can be learnt simultaneously without prolongation of training time.

The clinician engineer training scheme can also be integrated into allied health care curricula. Globally, we are seeing healthcare being delivered by nurse specialists, physician assistants, and specialist prescribers. Nurse specialists, for example, exist in the field of heart failure management, diabetes, and asthma. Physician assistants play a significant role in the history and examination of patients as well as diagnosis forming. As these individuals enter their respective university programmes, their exposure to patient problems can also be of benefit to developing new diagnostic and treatment methods, alongside fellow clinicians, through an integrated engineering syllabus.

Cardiology	Gastroenterology
AM: Ward round	AM: Ward round
PM: Clinic	PM: Endoscopy observation

Table 1. Current teaching model during medical school

Cardiology	Gastroenterology
AM: Ward round/ Clinic (alternating)	AM: Ward round/ Endoscopy (alternating)
PM: Teaching on diagnostic and treatment limitations in cardiology with exposure to novel engineering-based solutions (e.g., wearable sensor construction for arrhythmia detection)	PM: Teaching on diagnostic limitations in gastroenterology (e.g., limitations with current endoscopic equipment for cancer detection and possible solutions such as spectroscopy)

Table 2. The proposed timetable for clinician engineering teaching at medical school

IV. CONCLUSION

Innovation in medical education is urgently needed. For decades, we have spent time and resources appreciating the most appropriate teaching strategy or way to assess our learners. We have now reached saturation in this regard. There is no one optimum way to teach a learner and no single optimum assessment method. What we now need is a stronger focus on healthcare deficiencies at a time where healthcare provision remains heavily invested in technology. Critics may highlight concerns allied to faculty resources, training of faculty as well as accreditation. However, it is our duty as educators to ensure our patients benefit from future doctors who have been trained in accordance with how healthcare is evolving. With expert clinicians and engineers already highly trained and guiding such programmes, full accreditation can be gained. The future is now not just clinical care but clinician engineering.

Notes on Contributors

NS is the founder of the clinician engineer hub and a clinician academic in gastroenterology.

MSB is a co-founder of the clinician engineer hub and lecturer in biophotonics.

AKY is a co-founder of the clinician engineer hub and senior lecturer in chemical engineering.

RM is a PhD candidate in biomedical engineering and instructor for the clinician engineer hub.

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Declaration of Interest

The authors declare no conflict of interest.

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