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Comment on: Do medical students feel prepared to prescribe antibiotics responsibly? Results from a cross-sectional survey in 29 European countries

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Sir,
It is with great interest that we read the recent results of the well-performed cross-sectional survey by Dyar *et al.*¹ in the *Journal of Antimicrobial Chemotherapy*. As we navigate and attempt to stymie the ever-evolving peril that is antimicrobial resistance, it is imperative that we strategically focus educational efforts across all levels of practitioners. Dyar *et al.*'s analysis attempts to look at how well that is accomplished and what impact that has on European medical students' perceptions of preparedness to responsibly prescribe antimicrobials.¹ As demonstrated in their analysis, students perceive themselves to be quite prepared in their approach to the recognition of the infected patient.¹ Somewhat surprisingly, medical students also felt sufficiently prepared to recognize when antimicrobial therapy is not warranted, as well as to discuss that lack of need with patients. These concepts and others associated with high preparedness scores (recognition of infection, interpretation of microbiology, assessment of severity) lend themselves better to traditional education delivery methods in the current medical curriculum. Unfortunately, where the sufficient degree of preparedness began to wane was in regard to the more difficult-to-teach skills of antimicrobial stewardship and associated strategies. Indeed, communication with senior providers, antimicrobial therapy re-assessment, truncation of duration of therapy and formulation changes proved to be an uncertain area for the surveyed students. Because of the complexity

involved with these concepts, traditional methods of curriculum delivery may leave students lacking in these 'softer' skills. Ultimately, this manifested in Dyar *et al.*'s analysis as a request for more education.¹ This is not unique to European students. Surveys by Abbo *et al.*² and Justo *et al.*³ have similarly demonstrated that medical and pharmacy students alike recognize the importance of prudent use and are highly variable in their knowledge, and indicate that more education is warranted. Herein lies the difficulty facing health-professional programmes. The regression model by Justo *et al.*³ showed a strong correlation between the completion of an infectious diseases clerkship and knowledge scores. Similarly, Dyar *et al.*'s survey indicated that students felt infectious diseases clinical placement was a useful strategy for providing education.¹ Bland *et al.*⁴ demonstrated greater knowledge as well as confidence of pharmacy students with regard to antimicrobial stewardship principles upon completion of an infectious diseases advanced practice clerkship, including concepts like de-escalation of therapy upon culture results. In addition, these students exhibited greater confidence in discussing antimicrobial stewardship issues with other healthcare providers. Lastly, Stover *et al.*⁵ demonstrated improvements in student knowledge following completion of an infectious diseases advanced practice clerkship, irrespective of timing during the final professional year. While infectious diseases student clerkships as an effective strategy for teaching these skills are likely to garner consensus from all infectious diseases practitioners, the current academic and clinical workforce is unlikely to have enough resources, including time, to support this strategy in a sustainable manner. Instead, these data should be used to demonstrate the impact of active learning strategies on student education. The Dyar *et al.*¹ survey provides insight into the perceived usefulness and actual employment of various strategies used to convey infectious diseases knowledge. Indeed, more than one-third of European medical students surveyed indicated complete absence of various active learning exercises, including peer to near-peer teaching (38.3% not used), active learning assignments (33.8% not used) and role play or communication skills sessions (57.5% not used).¹ The absence of these strategies, in our opinion, strongly correlates with the lack of perceived preparedness to speak to senior clinicians regarding antimicrobial strategies and to re-evaluate antimicrobial therapies after initiation (auditing, 48–72 h evaluation, intravenous–oral formulation changes etc.). Further reflecting the current confines of traditional medical school curricula, only half of the students felt prepared 'to work within the multi-disciplinary team in managing antibiotic use in hospitals', correlating with one of the highest rates of 'no teaching'. Antimicrobial optimization within the structure of an integrative team is primed for active learning encounters, critical to success, and is mandated by regulatory bodies.⁶ Additionally, medical student career interest in the field of

infectious diseases is waning and pedagogical innovation engaging learners in these active strategies has already been recognized as a potential mechanism to reverse this trend.⁷ The excellent data by Dyar *et al.*,¹ together with the other data discussed above, should be taken as a sign to strategically re-visit the way that antibiotic and antimicrobial stewardship principles and delivery are conveyed to students globally across all health-professional schools.

In thinking through the best way to fill these gaps, each institution must consider two major, interrelated areas: curricular content and content delivery. As elegantly discussed in a recent editorial, alternative methods of delivery of age-old content is unlikely to meet the needs of a rapidly evolving healthcare environment.⁸ Similarly, use of traditional methods to deliver novel content is unlikely to meet the needs of rapidly evolving learners. In order to meet needs of both learners and the environment, both content and delivery should be evaluated routinely, with appropriate updates incorporated to best fit needs. Because of the shift towards multidisciplinary healthcare, one potential method of updating both content and delivery within health-professional schools is the incorporation of inter-professional educational (IPE) strategies earlier and consistently across curricula. Foral *et al.*⁹ found that an IPE-focused antimicrobial stewardship initiative involving multiple disciplines and levels of learners and clinicians resulted in high rates of intervention acceptance. Of note, the most common interventions provided in this report paralleled areas where students felt insufficiently prepared in the analysis by Dyar *et al.*¹ (i.e. route/formulation change, antimicrobial duration reductions, therapy re-assessment/streamlining). Furthermore, MacDougall *et al.*¹⁰ demonstrated that an inter-professional curriculum delivered as a workshop and online learning module hybrid to medical and pharmacy students effectively improved students' comfort in communicating with other professions. Importantly, students viewed both the online and workshop sessions favourably. In conclusion, we urge health-professional schools to re-envision the antimicrobial stewardship/infectious diseases curricular content, as well as explore novel ways of moving away from didactic lecture-based content delivery.

Transparency declarations

None to declare.

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Comment on: The 'morning dip' in antimicrobial appropriateness: circumstances determining appropriateness of antimicrobial prescribing

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Sir,

We were inspired by the work of Sikkens *et al.*¹ published in the June issue of *JAC* and showing that antimicrobial prescribing for 276 patients admitted to a tertiary care hospital in 2011–12 was