

# Teaching clinical toxinology in medical schools: The need, challenges and opportunities

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## ABSTRACT

**Clinical toxinology is an essential subject that should be included in undergraduate medical curricula. By equipping students with the knowledge and skills to identify and treat venomous animals and use antivenom appropriately reduces the risk of medical negligence and delays in treating and transporting these patients. Unfortunately, given the packed curriculum of undergraduate medical programs, it is important to focus on providing students with essential knowledge and skills to function as competent house officers. Student-centered learning approaches, such as gamification and community service projects, can be effective in enhancing learning and promoting awareness of appropriate toxin-related public measures.**

## KEYWORDS:

*Clinical toxinology, snake envenomation, bites and stings, medical education, student-centered learning, gamification, community services*

## INTRODUCTION

Defined as 'the medical discipline that encompasses the diagnosis, treatment, and prevention of toxin diseases caused by exposure to venomous and poisonous animals, plants, and mushrooms'<sup>1</sup>, clinical toxinology should be an important subject to be included in undergraduate medical curriculum. At least three reasons can be advocated for this inclusion.

## THE NEED

First, Malaysia's high operating expenditure of healthcare budget means that one needs to be prudent in stocking up the right amount of the right types of anti-venom depending on the geolocation.<sup>2,3</sup> Overstocking without proper species identification is not only expensive but also wasteful.<sup>2,3</sup> Clinical toxinology provides medical students with the knowledge and skills necessary to identify different types of venomous animals and the appropriate anti-venom needed to treat their bites or stings.

Second, with an ongoing crisis in emergency departments with lengthy wait times increases the risk of medical negligence and delays in transporting patients who need anti-venom in a tertiary facility. Due to a surge of non-COVID patients coupled with staff shortages, some Malaysian general hospitals' emergency departments are experiencing excruciatingly long waiting times of up to 6–7 days for ward admission. The delay in admission and

treatment can lead to medical negligence and worse outcomes for patients with bites or stings. Clinical toxinology equips medical students with the necessary knowledge and skills to recognise and manage such cases in the prehospital stage and reduce the risk of medical negligence and delayed transportation.

Third, the increasing integration of artificial intelligence (AI) in healthcare means that there is a need to be more aware of the inherent biases in these AI algorithms. Artificial intelligence bias is a phenomenon that arises when an algorithm systematically delivers biased results due to erroneous assumptions in its machine learning processes.<sup>4</sup> For example, during a reverse Google image search performed by the author on some of the local snake photos that had bitten our patients, most of these snakes were not accurately identified by the search engine. Whilst this may be due to the crushed anatomical structures of the dead snakes rendering identification difficult, this could also be due to the insufficient image data of local snakes from this region in the Google algorithm's training set compared to data from other regions of the world.

## THE CHALLENGES

Due to the packed curriculum of most undergraduate medical programs in Malaysia, the extent and depth of clinical toxinology that should be taught to medical students should be carefully considered. In this regard, it is crucial to remember that the overarching goal of any undergraduate medical curriculum is to ensure that students have obtained sufficient clinical competency to function effectively as future house officers. In this regard, the focus should be on providing students with the essential knowledge and skills that a house officer is expected to know and perform when managing patients with bites or stings. These include basic interventions such as administering copious irrigation on bite wound, immobilisation of the bite wound, rapid transportation to a facility with anti-venom availability, positively identifying the snakes, taking a proper history of the patient, examining the patient for signs of envenomation and knowing where and how to seek help (such as expert consultation from clinical toxinologists using the remote envenomation consultation services, or RECS).<sup>2,5</sup>

## THE OPPORTUNITIES

When considering how to teach clinical toxinology, it is important to note the recent pedagogic shift from teacher-centered to student-centered learning.<sup>6</sup> In the traditional

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approach, the instructor delivers information through lectures and textbooks ('sage of the stage'), whereas in student-centered learning, the instructor encourages students to take ownership of their own learning processes through active engagement ('guide on the side').<sup>7</sup>

One fun approach to promote student-centered learning is through gamification.<sup>8</sup> In the context of clinical toxicology, the classical snake-and-ladder game can be creatively modified to make it an engaging way for students to learn about snake envenomation and other toxin-related illnesses. To turn the game into a learning tool, for example, players who are 'bitten by a snake' would be relegated to a lower position, and the player must then pick a card with a picture of a snake and be tasked to correctly identify it and administer appropriate first aid measures. Correct answers will allow the player to move forward. A 'ladder' can transport them more quickly to an anti-venom facility. In fact, the snake-and-ladder game can also be customised for public health education with an appropriate level of difficulty of the card questions tailored to suit different age groups, such as school children.

Another student-centered learning activity related to clinical toxicology that students can participate in is community service projects. For example, students can embark on projects aimed at dispelling myths and harmful practices such as cut and suck, electric shocks and herbal remedies that can cause more harm than good<sup>2</sup> and research on understanding the socio-cultural reasons behind these harmful practices. Inspired by the chain of survival for cardiac arrest victims, perhaps a novel concept known as the 'chain of snake envenomation management' can be developed to identify and strengthen the weaknesses within the chain. This is because the strength of the chain is only as good as its weakest link. This chain would consist of (1) early identification of the snake species and call for help, (2) early first aid, (3) early resuscitation, (4) early anti-venom administration and (5) early post-resuscitation care and monitoring.

## CONCLUSION

In conclusion, clinical toxicology is an important subject that can equip medical students with the knowledge and skills to manage bites and stings, reducing the risk of negligence and transporting patients to the right facilities. Student-centered learning approach, such as gamification and community service projects, should be incorporated to enhance the learning processes and promote the awareness of appropriate toxin-related public measures.

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