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# Developing a blended learning orientation programme for junior doctors in Neonatology

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## I. INTRODUCTION

Neonatology is considered a 'niche' paediatric subspecialty. Most junior doctors posted to the department have limited prior exposure to the neonatal population, and require quick and effective training to help them function safely on the clinical floor. In recent years, postgraduate medical teaching has found the use of blended learning to be effective (Liu et al., 2016). Blended learning is defined as a combination of classroom face-time with online teaching approaches, and there is currently paucity of literature on its efficacy in 'up-skilling' relatively inexperienced healthcare professionals in a subspecialty setting. Hence, the aim of this study was to design and evaluate the efficacy of a blended-learning orientation programme in improving neonatal clinical knowledge and procedural skills amongst junior doctors.

## II. METHODS

### A. Study Setting and Participants

This study was set in the largest academic tertiary paediatric hospital in Singapore.

### B. Curriculum Development

We adopted the Kern's six-step approach for curriculum development (Thomas et al., 2022), as it systematically identifies and addresses learner needs, and its cyclical nature also allows for constant modifications and improvements.

### 1) Step 1: Problem identification and general needs assessment

We conducted a quantitative survey to identify the general issues with our current programme, which consisted of daily face-to-face, largely didactic lectures over the first month of the posting. We noticed that many junior doctors missed teaching sessions due to work obligations, resulting in 'piecemeal' and ineffective learning. The one-month programme was also considered excessively lengthy.

### 2) Step 2: Targeted needs assessment

Most junior doctors considered themselves to be 'novice' learners in neonatology. This emphasised the importance of starting with foundational teaching concepts to avoid overwhelming them. Junior doctors also preferred interactive learning methods.

### 3) Step 3: Goals and objectives

Our main objective was for the junior doctors to be competent and safe members of the clinical team, with basic neonatal clinical knowledge and the ability to perform and assist in neonatal procedures.

### 4) Step 4: Educational strategies: Course content development

We identified a list of core topics and procedural skills which formed the programme curriculum (Figure 1).

The teaching format was changed from mainly didactic lectures to case-based scenarios in both online and face-

to-face sessions, as this has been shown to better motivate students towards self-directed learning and develop problem-solving skills. Case-based scenarios would also facilitate greater peer discussion and interactivity amongst learners in the face-to-face sessions.

We worked with IT specialists to convert specific topics to six online learning modules, and included interactive

components such as clickable elements and narration to better engage learners (Choules, 2007). Each module was designed to be completed within 30 minutes.

For neonatal procedural skills, learners were expected to watch online demonstration videos created by the department prior to attending hands-on practical sessions.

Format of blended-learning orientation programme	
1. Online component (initiated 2 weeks prior to clinical rotation)	
<b>Clinical knowledge</b>	
<input type="checkbox"/>	<b>Newborn examination and screening</b>
<input type="checkbox"/>	<b>Neonatal jaundice</b>
<input type="checkbox"/>	<b>Respiratory conditions in the newborn</b>
<input type="checkbox"/>	<b>Attending newborn deliveries</b>
<input type="checkbox"/>	<b>Common post-natal neonatal conditions</b>
<input type="checkbox"/>	<b>Neonatal nutrition – an introduction to total parenteral nutrition, making online TPN orders</b>
<input type="checkbox"/>	<b>Procedural skills videos</b>
<input type="checkbox"/>	<b>Infection control</b>
<input type="checkbox"/>	<b>Articles on common neonatal conditions for self-reading</b>
<b>Administrative component</b>	
<input type="checkbox"/>	<b>Introduction to neonatal department and administrative issues</b>
2. Face-to-face sessions	
<b>Clinical knowledge</b>	
<input type="checkbox"/>	<b>Ventilation strategies with hands-on ventilator sessions</b>
<input type="checkbox"/>	<b>Didactic lectures by ‘content experts’ with short case-based discussions</b>
	o <b>Neonatal nutrition</b>
	o <b>Therapeutic hypothermia</b>
	o <b>Hypoglycaemia in the newborn</b>
<b>Procedural skills</b>	
<input type="checkbox"/>	<b>Procedural skills sessions- including basic procedural skills such as blood taking, capillary blood gas sampling, advanced procedural skills such as umbilical line insertion and chest drain insertion</b>
<b>Administrative component</b>	
<input type="checkbox"/>	<b>IT systems orientation (clinical documentation, medication orders etc.)</b>
<input type="checkbox"/>	<b>Patient safety briefing</b>

Figure 1. Outline of blended-learning orientation programme

### 5) Step 5: Implementation

The blended learning programme was implemented with junior doctors across two batches from July 2022 to January 2023. Majority were from post-graduate year three to five, with approximately half having no prior working experience in neonatology. All participated in the face-to-face sessions and completed the online modules.

We used our institution’s online learning management system to deliver the e-learning modules, and department faculty members conducted the face-to-face sessions. Designated ‘protected teaching time’ was implemented to facilitate attendance during office hours.

### 6) Step 6: Evaluation and feedback

We designed a pre-and-post-programme assessment consisting of 24 multiple-choice questions covering the following aspects – (1) clinical scenarios with interpretation of laboratory and radiological results, (2) factual knowledge and (3) questions on procedural skills.

The junior doctors also completed an online survey which assessed the learners’ perceptions on blended learning. Consent for the survey data to be used for research was implied in their participation.

### III. RESULTS

The junior doctors had a positive experience with blended learning. All participants agreed that the learning content was relevant and appropriate for their level of experience. Almost all participants felt that there was ease of access to the online learning modules, with minimal technical issues. Learners also found specific online modules such as respiratory conditions ‘useful’, but enjoyed the face-to-face nature of sessions such as ventilatory strategies, as it gave them the opportunity to clarify doubts with their facilitator. Overall, the duration of the face-to-face orientation sessions was halved, and there was a significant improvement in the mean MCQ score.

### IV. DISCUSSION

A blended learning programme designed for novice learners in Neonatology is effective in preparing junior doctors for clinical work.

Learning theories suggest that adult learners are motivated to invest time in learning if they understand its relevance (Taylor & Hamdy, 2013). The shift towards case-based learning bridges theory and practice, and motivates participation in clinical decision-making. This is an effective form of learning as demonstrated by an improvement in the mean post-test MCQ score of the participants. The experience was also deemed a positive one in qualitative feedback. In addition, the accessibility of online modules provided learners with autonomy to control their pace of learning. However, it is important to strike the right balance between online and classroom teaching, as learners still value the interactivity offered by face-to-face teaching.

We should work to create a supportive infrastructure to support blended learning methods by training more clinician-educators in online learning approaches and designing ‘reusable’ learning resources, which can be modified and integrated into other medical courses in future (Singh et al., 2021).

The limitations of our study include reliance on multiple choice tests to assess knowledge, and a lack of formal evaluation of procedural skills. Competency-based evaluations, as well as practical skills evaluations can be implemented in future runs to evaluate the efficacy of the courses.

### V. CONCLUSION

Technology enhanced learning is fast becoming an integral part of medical education. Through this study, we demonstrate that blended learning programmes can be successfully integrated into the training of junior doctors in a subspecialty setting.

#### Notes on Contributors

WT led the design and conceptualisation of this work, implemented the education programme, and drafted the manuscript. BQ provided feedback and guidance on creating the content of the education programme. CC provided guidance on the evaluation of teaching programme. CC, AT and BQ provided feedback on the manuscript. All authors approve the publishing of this manuscript.

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#### Declaration of Interest

All authors declare that there are no conflicts of interest.

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