Assessing the impact of the Advanced Resuscitation of the Newborn Infant course

The Advanced Resuscitation of the Newborn Infant (ARNI) course focuses on extending skills for specialist intervention at birth in more complicated neonatal clinical resuscitation situations. This mixed methods study, using pre- and post-course questionnaires followed by semi-structured interviews, investigates how attending the ARNI course affects the later clinical performance of participants.

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Keywords

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Key points

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1. The ARNI course increased confidence levels in a variety of areas across the whole spectrum of professionals (especially the doctors) that took part.
2. Nurses' confidence did not show a significant improvement in areas not traditionally associated with their role.
3. It is important for facilitators to tailor feedback appropriately in a supportive and sensitive manner.

Resuscitation courses are run in many countries to train healthcare professionals in adult, paediatric and neonatal resuscitation to attempt to optimise standards of clinical practice in resuscitation management, minimise error and decrease patient morbidity and mortality. These usually involve a standardised curriculum that includes cardiopulmonary and other adjunctive resuscitation techniques, delivered to a group of learners over a finite period of time in a pre-defined, structured manner. A central feature of these courses is the use of a multidisciplinary approach to teaching and learning to replicate the multi-disciplinary team involvement that occurs in real resuscitations.[1] The courses utilise simulation, which supports experiential and reflective learning[2,3] and prepares the practitioner to deal with real patients.[4]

Kirkpatrick[5] described a model of learning outcomes with four levels:

- Level 1 – evidence of learners' views on the overall learning experience
- Level 2 – modification of attitudes and perceptions and acquisition of knowledge and skills
- Level 3 – behavioural change and evidence of transfer of learning to clinical practice
- Level 4 – change in organisational practice and benefits to patients/clients, families and communities.

ARNI

Intended learning outcomes for participants on the ARNI course are the acquisition of new knowledge and skills in a safe environment that will prepare the participant for real-life situations in clinical practice and thus improve their clinical performance in resuscitation situations, which in turn may improve clinical outcomes (Kirkpatrick outcomes levels 3 and 4).[5]

In order for an optimum standard of resuscitation management to be delivered and maintained and for patient outcome to be potentially improved, retention of knowledge and skills is important following these courses and this retention needs to be sustained for the long term. In practice, the degree of knowledge and skill acquisition following resuscitation courses may vary.[6] This has been confirmed in a recent systematic review that also found that knowledge and particularly skills might deteriorate as early as three months after a resuscitation course.[7] More specifically, it has been shown that the airway management and non-invasive ventilator skills taught on the Neonatal Life Support (NLS) course, when tested in a simulated scenario, deteriorate within a few months of attendance.[8] It is not known, however, whether deteriorating skills as assessed by simulation correlate with deterioration of skills in clinical practice.

In contrast to the deterioration in skills in individuals that occurs after a course, the systematic review found that the instigation of resuscitation training in healthcare institutions where it previously did not exist does significantly improve the clinical management by staff of resuscitations and also patient outcome (including survival – Kirkpatrick outcome

level 4) after resuscitation attempts.[7]

ARNI was developed as a result of a joint venture between the Resuscitation Council (UK) and Bliss.[9] The two-day course focuses on developing the extended skills required for the care of babies who have a need for specialist intervention at birth in more complicated neonatal clinical resuscitation situations, as well as crisis resource management and communication. The course is taught as real time simulation with manikin manipulation to create reality. Simulation is informed by Bandura's theory of four areas of social learning: knowledgeable facilitators and peers provide course participants with *personal and vicarious experiences* in a supportive environment, using *positive persuasion* to encourage participants to complete tasks. In this way, participants' self-efficacy is increased, along with *physical and psychological arousal*, which transfers into *motivation for practice*.[10-13] Key learning outcomes addressed by the course are working with the multidisciplinary team and communication with the family, in addition to innovative skill stations with real time objective feedback on performance. Debriefing is facilitated as a learning conversation with wide focus throughout the course on human factors and non-technical skills. These aspects are very different to the NLS course and may influence the later clinical performance of the participants differently to that after the NLS course.

A proof of concept course, two pilot courses and two inaugural courses took place in 2014. An evaluation of a similar course run in the north west of England (The North West and Mersey Deanery pre-ST4 simulation course, which included skill workshops and real time simulations and debriefings with an emphasis on human factors) revealed that participants felt more confident after the course in aspects of neonatal emergency care that were covered on the course. However, a follow-up study was not performed to assess the effect upon the participants' clinical practice.[14]

Aims

The aim of this study was to investigate how attending the ARNI course affects the clinical performance of participants later. As it is not clear whether the 'skills decay' demonstrated by simulation correlates with clinical performance in a real resuscitation, rather than re-assessing participants and their non-technical skills in a simulated situation, the study focussed on participants' perceptions of these in their clinical practice subsequent to the course. In doing this, some insight might be gained into the extent that Kirkpatrick 3 and 4 outcomes are achieved as a result of the course.

Neonatal face mask ventilation
Neonatal intubation
Difficult neonatal airway management
Insertion of neonatal chest drain
Initial management of congenital diaphragmatic hernia
Initial management of a preterm baby
Initial management of a baby with suspected cyanotic heart disease
Managing a sick postnatal ward baby
Initial management of baby with suspected necrotising enterocolitis
Managing a pneumothorax
Managing airway obstruction
Managing post-resuscitation care
The ability to manage an unsuccessful neonatal resuscitation
Communicating with parents regarding resuscitation
Overall confidence in ability to take a role in a neonatal resuscitation
Confidence in ability to lead a neonatal resuscitation
Confidence in ability to communicate well with the team during neonatal resuscitations

TABLE 1 The pre- and post-course questionnaire themes. Standardised questions measure the participants' perceived self-efficacy and effectiveness in issues covered in the ARNI course.

Methods

At the beginning of the course a short presentation about the study was given to the participants and they had the opportunity to ask questions. Each participant was then given an evaluation pack consisting of pre- and post-course questionnaires containing standardised questions, each with a linear analogue scale to measure the participants' perceived self-efficacy and effectiveness in issues covered in the course. In addition, the pre-course questionnaire asked for demographic information about the participant's profession, stage of training (if relevant) and current post. The pack also contained a participant information sheet and an expression of interest form for the candidate to record their name and contact details in order to take part in an interview some months after the course. The documents in each pack were marked with a unique number and letter combination to enable the questionnaires to be completed anonymously but be matched for each participant (eg 1a and 1b = Participant 1). The expression of interest forms and questionnaires were completed at the beginning and end of the course.

For each of the 17 questions (**TABLE 1**) on the pre- and post-course questionnaires, the position that the point marked by the participant was on the analogue scale was measured in millimetres from zero. The median measurement was then calculated for each question and these medians were compared for each of the questions between the pre- and post-course questionnaires using the Mann-Whitney U test.

The interview

The interview phase of the study used an interpretative approach in order to elicit understanding of a complex experience over a six-month period.[15] Participants were contacted between six and 12 months after the course and invited to take part in a telephone interview, which took place only if the participant had read the information sheet and returned a signed consent form. All interviews were recorded

with a digital audio recorder and took less than an hour. They were carried out by TKM and AJK (academic research assistants) and were conversational in style, semi-structured, tailored to ensure all partici-pants were supported to talk about their views of the training and any impact on their practice, while allowing the interviewer to follow relevant avenues of enquiry opened by the participants. The interviews focussed upon the participants' experiences of neonatal resuscitation subsequent to the ARNI training and use of learning from the course in this or other areas of work.

The interview transcripts were subject to thematic analysis.[16] The protocol was approved by Edge Hill University Faculty of Health and Social Care's Research Ethics Committee and Health Education England (North West) Research and Development Committee.

Results

Quantitative results

Thirty-two candidates attended the first two ARNI courses and agreed to participate. There were 30 returned completed questionnaires: 13 nurses (including six advanced neonatal nurse practitioners, ANNPs) and 15 doctors. In general, mean confidence scores pre- and post-course were lower among nurses compared to doctors. In the group as a whole, the mean confidence scores were significantly higher in the post-course compared to the pre-course questionnaire for all items (**TABLE 1**). This was also the case when the doctors' data were analysed separately. However, with respect to the nurses, mean confidence scores did not significantly differ in the post-course compared to the pre-course questionnaire for ability to:

- intubate
- manage an unsuccesful resuscitation
- communicate with parents regarding a resuscitation
- take a role in resuscitation
- lead a resuscitation
- communicate well during a resuscitation.

Qualitative results

All interviewees were working in a full-time capacity. Fourteen interviews were undertaken. These included:

- seven consultants
- two specialist registrars
- two nurse practitioners
- three classed as 'other'.

Challenge	Interviewee quote
Clear communication across the team	*I guess even now we're still learning communication. One of my stressful things is asking people to do things and you're watching to see if they've done it but they, perhaps, don't do it the way you would have done or as quickly as you would have done.* **Interviewee 6**
Task orientation (knowing everyone's role)	*The initial challenge when we arrive on scene is organising people. The scene goes very quickly from having no one there to do the job, to having far too many people there. It's mostly in the beginning; to make sure that everyone knows what he or she is supposed to do.* **Interviewee 12** *Some time to communicate just beforehand; who's going to do what role, where everyone is going to stand, what everyone is going to do.* **Interviewee 3**
Difficulties leading a resuscitation and simultaneously focusing on specific tasks	*As the consultant... you are expected to lead. But obviously you are expected to do tasks as well and I think that's the thing I learnt in ARNI... that when you are task-oriented you lose a 'helicopter view' of the overall picture.* **Interviewee 3** *Trying to keep pace of what's going on around you while you're trying to run it. It's not as though we have a vast team that gets called to do resuscitation; sometimes there's just a midwife, a junior and myself. It's trying to run it and do things at the same time, which isn't ideal. Ideally you'd want to be on the outside looking in and giving instructions to people.* **Interviewee 6**

TABLE 2 The challenges of resuscitations.

Those who attended the ARNI course spent varying proportions of their time on resuscitation activities. For some, these made up the bulk of their role; others experienced them on a near-daily basis, with one on-call paediatrician describing how such activity accounted for between a third and half of their working hours. With regards to the frequency with which interviewees encountered, in their view, serious resuscitations, working experiences were again varied. One individual, for example, estimated that such occurrences accounted for around 10% of workload; another stated that they dealt with such cases every two months and another again dealt with 'serious' resuscitations about once a year.

Two themes were identified in the analysis:

1. Challenges of resuscitations

Interviewees discussed various challenges that were faced when undertaking resuscitations (**TABLE 2**).

2. Impact

Although some participants reported that they could not totally attribute any change in their daily work or clinical skills to attendance on the course, when assessing the impact that the course had on their own practice many participants stated that discussions on team building and team roles had been positive and informative, increasing knowledge around team functioning, establishing roles, and leadership, implying that they had developed more situational awareness (**TABLE 3**).

Feedback and recommendations

The course was variously described as well organised, well structured, comprehensive, well designed, credible and helpful. Crucially, the majority of interviewees, without being prompted, said that they would recommend the course to anybody considering attending. Coverage of inserting interosseous needles for resuscitation as well as greater focus upon surgical resuscitations, were both suggested as areas that could be added or extended in future iterations of the course. Moreover, to further improve the experience of those attending it was noted that written feedback would enable course participants to refer back to and reflect on comments made in the months following the course; written feedback may also be useful for nurse revalidation. It was also suggested that the impact of the course might be amplified by increasing access to more junior grades of staff, increasing the range of those attending and increasing the frequency of ARNI courses, as they are 'oversubscribed' (interviewee 7) and 'seem to be very few and far between, which is a bit of a shame' (interviewee 3).

Additionally, another participant recommended that the scenarios be changed regularly as the course develops, to ensure new learning opportunities for re-attendees (interviewee 13).

Lastly, four participants highlighted the need for facilitators to be mindful of the impact of tone and terminology used when providing individualised feedback to attendees. Two participants made the recommendation of preparing ARNI attendees prior to attending the ARNI course for the amount of very detailed feedback that will be given, as it "became a touch too personal" (interviewee 13) and "it can hit you when you do get comments" (interviewee 14). Participants felt that feedback given was most useful when it was delivered in a constructive and positive manner.

Discussion

The effect of the ARNI course on the confidence and later clinical performance of its participants has been investigated. It is clear that the course increased confidence levels in a variety of areas across the whole group of professionals that took part, especially the doctors who reported the most significant increases.

Nurses' confidence did not show a significant improvement in areas not traditionally associated with their role (intubation, managing an unsuccessful resuscitation, communication with parents regarding a resuscitation, taking a role in resuscitation, leading a resuscitation, and communicating during a resuscitation). The numbers are small and so the results must be treated with caution as the general trend was towards improvement in these areas but the differences in scores were not statistically significant. It is, however, likely that nurses feel more vulnerable and out of

Impact	Interviewee quote
'Hands-off leading' resuscitation to maintain situational awareness	*Since the ARNI course the movement now is definitely towards having someone to run the resuscitation that doesn't necessarily touch the baby at all.* **Interviewee 10** *What is quite useful, rather than taking over an airway that someone else is managing appropriately, stand back and stay. Be the person leading the resuscitation but don't be the hands doing the task.* **Interviewee 3**
Communication with team and parents	*I feel stronger in leading a team... with the right phrases and being able to pick up on cues. Procedures are slicker or done without as many problems. The team feels better. It's a lot calmer; therefore there must be some positives for the patient also. You get to where you need to be quicker.* **Interviewee 2** *What I got most out of the ARNI course was counselling skills... approaching parents regarding resuscitation. How to approach them during a resuscitation was very valuable... whether they should witness a resuscitation, were they being supported, what sort of language, what sort of body language, counselling these parents afterwards. Something I don't often get a chance to witness or do because if I'm doing resuscitation it's usually my colleagues who do stuff like that. It was very interesting to see that side of it.* **Interviewee 5** *Teamwork and addressing parents in difficult situations; that was very good. ARNI has probably taught me there are ways that you can prepare parents in small stages for what's happening. You can take time away because somebody can 'bag' the baby while you go away and speak. The course taught me that, whereas at that time I just focused on the baby until later. I think it's taught me to probably go over to the parents more often where possible and explain what's going on.* **Interviewee 9**
Verbalising thoughts and being prepared to challenge	*ARNI just highlighted some of those really vital things that you don't even think about; how your team functions and what could have been done differently. Establishing roles and establishing the leadership, that was really good from ARNI. I had a resuscitation just the day after ARNI and... we said "Let's do this ARNI style" and we did it just like that! Although a very serious resuscitation, because we were all like-minded and thinking very similarly, everybody had a role to perform and we all kept checking with each other, communicating with one another.* **Interviewee 1** *I think we all learned the importance of speaking up if there's an issue, effective teamwork and if you think something's being missed, it's okay to say that. I was a fairly experienced nurse in resuscitations before I did the course, but I didn't always feel it was my place to speak up if there was something I didn't think we were doing effectively, or asking the question 'Why haven't we tried this?' I would just do what I was told to do. I still do what I'm asked to do but I seek more rationale, something I wouldn't have done in the past.* **Interviewee 10**
Improved techniques	*One of the tasks that we did on the course was looking at the seal that we had on our masks and that definitely made me think more about how I position the mask, how I hold the mask, the amount of pressure that you use... technique has improved.* **Interviewee 11** *About the pneumothorax; that was an interesting point. I would normally often leave my butterfly in to keep aspirating but [a facilitator was] saying that there have been a number of cases where needles have been left in and at post mortem they found multiple punctures of the lungs. So I do quite a bit of teaching on that and now I tell people it's probably better to take the butterfly out and if you do need to reinsert it, do it at that point in time.* **Interviewee 4** *Increasing the likelihood of switching to a two-person technique more quickly and escalating and treating airway deterioration in neonates with other conditions such as necrotising enterocolitis 'much more rapidly and aggressively' than prior to the ARNI course.* **Interviewee 8**

TABLE 3 Impact that ARNI had on practice: examples of learning as described by interviewees who attended the course.

their comfort zone when practising these activities as they rarely perform them in the clinical area. It is therefore important for course faculty to be aware of this and to tailor feedback appropriately in a supportive and sensitive manner regarding areas that participants don't perceive as their primary responsibility.

The qualitative data reveals what a varied exposure to resuscitation events the candidates had, again emphasising that faculty should be aware of their background and should aim to give feedback contextualised to their role.

The interviews provided some powerful accounts of how health professionals had used learning from the ARNI course to inform their practice afterwards. This included increased situational awareness and improved communication when trying to work effectively as a multidisciplinary team in very intense and potentially stressful situations, corroborating the findings of Armentrout and Cates[17] that simulation is an effective teaching method for applying communication principles to practice. Participants recognised this had a positive effect on delivering quicker and better outcomes for the patient and their families.

Currie et al[18] discussed how important it is for parents to be informed as partners in decision-making and to maintain their role as a parent, despite their child's critical state; furthermore, to be present with their child during lifesaving procedures, as this can support the bereavement process if the child dies.[18,19] Our study suggests that, following the ARNI course, candidates would find it easier for parents to be more involved throughout resuscitations. On a practical note, candidates also reported that course attendance had resulted in improvement in their practical procedure skills and the availability of, and their competence in the use of, some items of equipment in the workplace. Indeed, participants felt that most challenges identified prior to the course were addressed and they highlighted that leading a resuscitation using a hands-off approach was a skill that was particularly useful to practice. There will be inevitable sensitivities that surround the observation of resuscitation skills. On the ARNI course, candidates might feel particularly vulnerable; therefore the faculty should consider how feedback is provided after the scenarios. Some participants felt the nature of the feedback was, at times, very personal and direct. These individuals reported this was an aspect of the course that could be improved. It might be possible to prepare participants beforehand on how feedback will be given and its intense nature. The results of this study have been fed back to the ARNI steering committee, which hopefully will aid in development of the course.

Conclusion

ARNI is a well-received course that appears to increase the confidence of participants and has resulted in improvement in their communication and in leading and managing resuscitations in the clinical area.

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