


# A mixed-methods study on evaluating an updated, francophone version of ETAT+ training in Madagascar

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**Background.** Madagascar needs major efforts to achieve the UN Sustainable Development Goals, despite the considerable reduction of child mortality during past years. In this context, implementation of emergency triage assessment and treatment (ETAT) plays an important role. In recent years, ETAT training activities rarely took place in Madagascar. To strengthen ETAT in Madagascar, a pilot training course was conducted in December 2019 at the University Hospital Mahajanga.

**Objective.** This study aims to evaluate if the ETAT+ pilot training content matches clinical needs in Madagascar and whether participants achieved their learning objectives.

**Methods.** In this cross-sectional mixed-methods study, a 41-item questionnaire was used at the end of the ETAT+ training to evaluate their learning experience from the 12 participants (paediatricians, physicians, nurses and midwives). Six weeks after the training, guided interviews were conducted among five participants to describe how training content could be transferred into clinical practice in five health facilities.

**Results.** Results suggest that this pilot project designed to contribute to the re-establishment of ETAT in Madagascar meets participants' needs and is adapted to clinical realities in terms of transmitted knowledge, skills and competencies. However, results also show that considerable multi-disciplinary efforts are needed to advance ETAT+ implementation in Madagascar.

**Conclusions.** Implementation processes of ETAT training programmes need re-evaluation to assure their validity to contribute to quality of care improvements efficiently. Further operational research is required to evaluate sustainable, innovative implementation strategies adapted to contexts in Madagascar.

**Keywords.** Emergency triage assessment and treatment (ETAT) training; essential emergency and critical care (EECC).

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## Contribution of the study

This study aims to evaluate an updated Malagasy version of the Emergency Triage Assessment and Treatment Plus (ETAT+). The training met the participants' needs and was adapted to the clinical realities in Madagascar relating to transmitted knowledge, skills and competencies.

The under-five mortality rate (U5MR) in Madagascar is still high despite a considerable reduction within the last three decades from 157 to 51 per 1 000 live births.<sup>[1]</sup> Additionally, morbidity and mortality in the age group of 5 - 14 years and among adolescents need to be tackled in efforts to improve child health.<sup>[1]</sup> Most deaths among children and adolescents are either preventable and/or treatable.<sup>[1,2]</sup> Socio-economic and political determinants, as well as public health interventions, have significant impact on child health.<sup>[1-5]</sup>

Many deaths among children, especially in resource-limited settings, are due to severe infections; e.g. respiratory infections, severe malaria, and diarrhoeal diseases.<sup>[6,7]</sup> Malnutrition increases the risk of developing critical illness, and ~45% of deaths in U5 children are associated with

undernutrition.<sup>[7,8]</sup> Additionally, human immunodeficiency virus (HIV), infections and tuberculosis (TB) substantially contribute to morbidity and mortality among children and adolescents.<sup>[9,10]</sup>

Without early efficient management, serious infections can progress to severe multi-organ dysfunction. This process can be defined as sepsis and is not necessarily documented as a distinct entity in Global Burden of Disease estimates.<sup>[6,11]</sup> A considerable number of children who survive critical illness (e.g. cerebral malaria) suffer subsequently from life-long disabilities.<sup>[12]</sup> Access to essential paediatric emergency and critical care (EPECC) can contribute to a reduction of mortality and also of preventable disability.<sup>[12,13]</sup> To improve access to EPECC, referral pathways from communities and peripheral health facilities to district or regional hospitals

need to be strengthened.<sup>[14-16]</sup> However, access to adequate hospital-based emergency and critical care is challenging for many populations in sub-Saharan Africa (SSA).<sup>[15]</sup>

At health facility level, it has been shown that implementing efficient patient circuits and essential paediatric emergency care services can have a considerable impact on paediatric hospital mortality.<sup>[17]</sup> In this context, the World Health Organization (WHO) produced guidelines and training modules for emergency triage assessment and treatment (ETAT) targeting care of children managed at hospital level.<sup>[18,19]</sup> ETAT guidelines follow international emergency care algorithms (e.g. advanced paediatric life support (APLS)),<sup>[20]</sup> but are not designed to cover the whole spectrum of competencies needed to treat critically ill children at hospital level. Based on WHO guidelines, levels of paediatric emergency and critical care can be adapted to available resources, workload and skill levels of clinical teams.

In previous years, ETAT training activities rarely took place in Madagascar. To revive ETAT in Madagascar, a multidisciplinary team from the University Hospital Mahajanga (Chu PZaGa), the WHO, the Management Sciences for Health (MSH)/USAID Accessible Continuum of Care and Essential Services Sustained (ACCESS) project, Madagascar and Witten/Herdecke University conducted an ETAT+ pilot training course in December 2019 at Chu PZaGa. The present article describes the preparation process and delivery of this training activity. The study uses a mixed-methods design to examine whether the ETAT+ pilot training met the clinical needs of participants and whether participants met their learning objectives.

## Methods

### ETAT+ training (adapted Malagasy version)

The training content is based on the ETAT+ training curriculum outlined by the Royal College of Paediatrics and Child Health (RCPCH)<sup>[21]</sup> and management algorithms defined by the WHO in their *Pocket Book of Hospital Care for Children*.<sup>[18,19]</sup> These materials have been evaluated and successfully used in several low-resource contexts.<sup>[17]</sup> The process to develop an ETAT+ training version adapted to clinical realities in Madagascar (Fig. 1) was endorsed by the *Société Malgache de Pédiatrie* (SOMAPED), the CHU PZaGa Mahajanga and the Ministry of Health. In a multi-step process led by Malagasy partners, training contents, teaching methods and course organisation were adapted to the anticipated

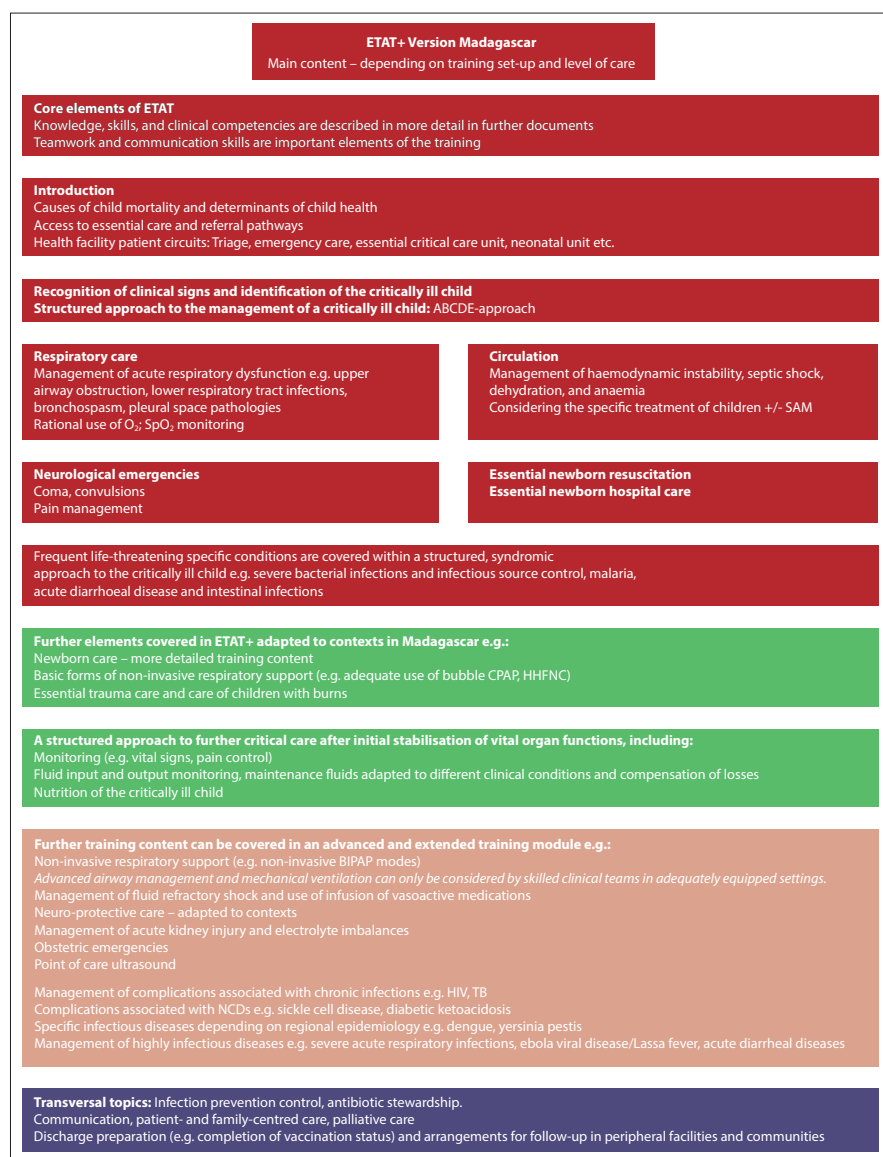


Fig. 1. Key topics and learning objectives of the ETAT+ training conducted in Mahajanga, December 2019. This training content is based on internationally recognised ETAT-guidelines. Further training content was adapted with a focus on particular needs identified by health professionals with extensive experience in child health programmes in Madagascar. (CPAP = continuous positive airway pressure; HHFNC = humidified high-flow nasal cannula air-O<sub>2</sub>; BIPAP = bi-level positive airway pressure; NCD = non-communicable diseases.)

training needs of inter-professional course participants. This process was finalised in a 5-day preparation workshop in Mahajanga.

### Design of the evaluation process

A mixed-method design was applied for this evaluation.<sup>[22]</sup> The mix of methods refers to the combination and integration of quantitative and qualitative methods. This approach is well adapted for complex evaluations in comparison with purely qualitative or quantitative approaches.<sup>[23]</sup> The evaluation of the present study uses a sequentially explanatory mixed-methods design. The initial quantitative results and interpretations are strengthened

by subsequent interviews conducted six weeks after the initial pilot training.<sup>[23]</sup>

### Sample

Twelve Malagasy health professionals (paediatricians, physicians, nurses and midwives) from six health facilities situated in four different regions of Madagascar attended a five-day ETAT+ training course in December 2019 in Mahajanga. Participating health workers practised in paediatric and emergency departments on different health system levels.

### Data collection

In the quantitative part, data were collected at the end of the training using a paper-

and-pencil self-administered questionnaire. All 12 participants gave informed consent. Additionally, participants were asked whether they would be available for a telephone interview six weeks after the 5-day training to evaluate their experience in the practical application of the ETAT training content in their respective health facilities. All 12 participants consented to the interviews. Subsequently, five participants were selected randomly for interviews.

## Questionnaire

In the questionnaire, eight dimensions (reading materials, engagement, critical thinking, collaborative working, overall experience, training delivery, role as trainer and training content) were used to evaluate the training's learning success. The questionnaire was based on structures frequently used and assessed in different training contexts.<sup>[24]</sup> For use in this ETAT+ training evaluation, questions were adapted and some training-specific questions were added (Annex 2). The questionnaire consisted of 37 closed questions and four free-text options (completion time about 15 - 20 minutes) in the French language. For the quantitative data, descriptive responses to each item were shown.

## Interviews

Five guided interviews were conducted six weeks after the training (January 2020). The objective of these interviews was to evaluate the potential role of ETAT+ principles in the respective health facilities and to identify opportunities and challenges to implement or improve processes of essential paediatric emergency and critical care using ETAT+ management algorithms. Owing to the significant geographical distance of the participants, interviews were carried out by telephone and were recorded via a digital recording device. Interviews were conducted by a Malagasy project member in French. Subsequently, interview results were anonymised and transcribed. Content analysis followed the procedures described by Mayring.<sup>[25]</sup>

## Translation

All materials used in the study were reviewed in a standard forward-and-backward translation process with monolingual and bilingual tests.<sup>[26]</sup> This approach allows study information, informed consent, questionnaire and guided questions translated from English to French. The evaluation free-text answers and interview transcripts were translated from French to English using the same method.

## Results

### Descriptive profile participants

The demographic and professional characteristics of participants ( $N=12$ ) are shown in Table 1. More than half of the participants were female (58%) and were physicians (66%). The participants came from four different regions of Madagascar and six different health facilities. Three participants from each region attended the training. Most of the participants worked in university hospitals (50%); others came from regional hospitals (25%) and district hospitals (25%).

### Quantitative evaluation

Questionnaire results are shown in Table 2. Participants described training content, training methods and course organisation as highly relevant to Madagascar's clinical realities and felt motivated and encouraged to engage in the training process.

### Pre-course reading material

Five of the 12 participants stated that they studied pre-course reading

**Table 1. Demographic and professional profile of participants**

Training Respondents, N=12	Interview	
	Respondents, N=5	N (%)
Gender		
Male	5 (42)	2 (40)
Profession		
Physician	8 (66)	5 (100)
Nurse	2 (17)	–
Midwife	2 (17)	–
Region		
Atsinanana	3 (25)	1 (20)
Boeny	3 (25)	2 (40)
Atsimo Andrefana	3 (25)	1 (20)
Vatovavy-Fitovinany	3 (25)	1 (20)
Institution		
University hospital	6 (50)	3 (60)
Regional hospital	3 (25)	1 (20)
District hospital	3 (25)	1 (20)

materials which were provided online. Participants' feedback on content, relevance and structure of pre-course reading materials was positive (75% positive answers). However, 42% of participants stated that pre-course study time was limited owing to late provision of reading materials.

### Engagement

Nevertheless, half of the participants (50%) felt well-prepared for the training. The interactive design of the training and opportunities to contribute during training sessions actively were rated positively. Eighty-four percent of participants stated that they asked questions during the training. However, only 58% said they discussed their actual personal training performance with facilitators during the training.

### Critical thinking

Participants engaged with a positive attitude in the learning process and indicated that the training helped them to develop new ideas or new understanding (100%). Additionally, 83% of participants stated that the training experience exposed them to previously unknown or poorly understood management approaches of severely ill children.

### Collaborative working

During the training, participants experienced numerous opportunities to interact and discuss with other participants. Eighty-three percent of participants reported that they worked together during the teaching course sessions and discussed each other's training experiences as well as specific clinical topics. Outside the training sessions during the 5-day course, training experiences were less frequently discussed with other participants (42%).

### Overall experience

The general feedback on the training was consistently positive. All participants (100%) rated the training as interesting, stating that it challenged them to recall their best performance and achieve their learning objectives.

### Training delivery

All participants (100%) rated the course content as up-to-date and

**Table 2. Response distribution of closed items of the written evaluation assessment, N=12**

	n (%)				
	Yes	No			Missing
<b>Dimension 1: reading material</b>					
Did you read the training materials provided before the ToT training started?	5 (42)	7 (58)			0 (0)
	<b>Definitely agree</b>	<b>Mostly agree</b>	<b>Mostly disagree</b>	<b>Definitely disagree</b>	<b>Missing</b>
The reading materials are perfectly adapted for preparation to the ToT training.	3 (25)	6 (50)	0 (0)	0 (0)	3 (25)
The amount of reading materials for the training is adequate.	1 (8)	8 (67)	0 (0)	0 (0)	3 (25)
The reading material was well structured.	1 (8)	8 (67)	0 (0)	0 (0)	3 (25)
I received the reading material in time to prepare myself adequately for the training.	2 (17)	3 (25)	3 (25)	2 (17)	2 (17)
<b>Dimension 2: engagement</b>					
I came to training sessions fully prepared.	4 (33)	2 (17)	3 (25)	2 (17)	1 (8)
I often asked questions during the training.	5 (42)	5 (42)	0 (0)	0 (0)	2 (17)
I discussed my training performance and/or feedback with staff or tutors.	3 (25)	4 (33)	2 (17)	2 (17)	1 (8)
<b>Dimension 3: critical thinking</b>					
I analysed ideas or theories in depth.	2 (17)	9 (75)	0 (0)	0 (0)	1 (8)
I evaluated a point of view, decision or information source.	3 (25)	7 (58)	2 (17)	0 (0)	0 (0)
I formed a new idea or understanding from various pieces of information.	4 (33)	8 (67)	0 (0)	0 (0)	0 (0)
I applied knowledge to new situations.	5 (42)	5 (42)	0 (0)	1 (8)	1 (8)
<b>Dimension 4: collaborative working</b>					
I worked with other participants during tasks or assignments.	10 (83)	0 (0)	1 (8)	1 (8)	0 (0)
I explained training materials to other participants.	3 (25)	7 (58)	0 (0)	1 (8)	1 (8)
I discussed ideas from my training with others outside of the training (e.g. family, friends or colleagues by phone, social media, etc.).	1 (8)	4 (33)	2 (17)	5 (42)	0 (0)
<b>Dimension 5: overall experience</b>					
This training has challenged me to produce my best work.	10	2 (17)	0 (0)	0 (0)	0 (0)
I engaged with my trainers regularly.	6 (50)	3 (25)	2 (1)	0 (0)	1 (8)
I found this training interesting.	12 (100)	0 (0)	0 (0)	0 (0)	0 (0)
I met my learning objectives.	6 (50)	6 (50)	0 (0)	0 (0)	0 (0)
<b>Dimension 6: training delivery</b>					
The training content was adequately illustrated (e.g. by examples, visualisations, etc.).	6 (50)	6 (50)	0 (0)	0 (0)	0 (0)
The training was well structured.	5 (42)	5 (42)	1 (8)	1 (8)	0 (0)
The learning objectives of the training were clearly defined.	7 (58)	5 (42)	0 (0)	0 (0)	0 (0)
Additionally, helpful resources were provided (e.g. articles, videos etc.).	3 (25)	8 (67)	1 (8)	0 (0)	0 (0)
The trainers were open to criticism.	2 (17)	9 (75)	1 (8)	0 (0)	0 (0)
The content of the training content is very relevant to my work.	7 (58)	4 (33)	0 (0)	0 (0)	1 (8)
The training was conducted at an appropriate pace.	2 (17)	5 (42)	3 (25)	1 (8)	1 (8)
The amount of material to learn in this training was too extensive.	1 (8)	6 (50)	2 (17)	1 (8)	1 (8)
The content of this training was up to date.	6 (50)	5 (42)	0 (0)	0 (0)	1 (8)
I highly value my learning success through this course.	6 (50)	5 (42)	0 (0)	0 (0)	1 (8)
<b>Dimension 7: role as a trainer</b>					
I feel now prepared to train others on in a triage, emergency and treatment training.	8 (67)	4 (33)	0 (0)	0 (0)	0 (0)
I feel able to identify challenges in my daily clinical life due to the training.	6 (50)	5 (42)	0 (0)	0 (0)	1 (8)
I would like to have a refresher course after some time so that I can further develop my skills.	9 (75)	3 (25)	0 (0)	0 (0)	0 (0)
I think that what was proposed in the training is straightforward to implement in my institution.	1 (8)	4 (33)	5 (42)	2 (17)	0 (0)
<b>Dimension 8: training content</b>					
	<b>Yes</b>	<b>No</b>			<b>Missing</b>
Are there any topics missing in ToT training?	0 (0)	12 (100)			0 (0)
Are there topics in ToT training that you consider unnecessary and could be omitted?	0 (0)	12 (100)			0 (0)
At the end of the training, did you feel sufficiently well prepared for the examination?	9 (75)	3 (25)			0 (0)

ToT = Training of Trainer.

relevant for their work. Equally positive (100%) was the rating for clarity of the presentation of learning objectives as well as the illustration of course content. Additionally, the set-up of the course and the use of multiple training methods was evaluated positively. Using different training methods benefited the learning process. Some participants (33%) stated that the 5-day training course was too short to transmit the training content comprehensively.

**Role as trainer**

After the training, all participants felt capable of providing teaching of certain elements of the ETAT+ course in their facilities. Participants also felt able to identify essential training needs in the care of critically ill children in their respective hospitals. Furthermore, all participants (100%) stated that a refresher course would have the potential to benefit their clinical skills as well as their capacity to function as

a trainer. Some participants perceived the implementation process of ETAT+ in their institutions as a considerable challenge. Only 42% could imagine a rapid and comprehensive introduction of ETAT+ management principles in their institution at this stage.

### Training content

According to participants, the training did not include irrelevant content (100%), nor were there any essential topics missing (100%). The participants indicated the following training topics as most relevant for their routine clinical practice (Fig. 2). The structured 'ABCDE-approach' to a critically ill child was described as the most relevant content ( $n=11$ ), followed by 'management of shock and fluid-resuscitation' ( $n=5$ ), 'the triage process and identification of the critically ill child' as well as 'the practice to gain intra-osseous access' (both  $n=4$ ).

### Interview findings

In the qualitative content analysis, the content of the interviews was conceptualised into six categories: 'ETAT+ training content', 'qualification of course participants to apply learned knowledge, skills and competencies', 'qualification of participants to act as trainers and transfer ETAT+ training content', 'motivation of course participants to practise learned skills and competencies and to act as trainer', 'conditions and requirements needed for ETAT+ implementation' and 'general challenges in daily clinical reality and the implementation of ETAT+ principles'.

#### ETAT training content

Participants emphasised different elements of the training content, which were particularly challenging to practise as an individual clinician, and which were also difficult to introduce in routine clinical practice. One participant described the difficulties as follows:

"The intraosseous access ... the subject on the intraosseous access is a theme that I do not sufficiently master and that I still hesitate to put into practice... it is true that we practised on chicken bone in Mahajanga during the training, but we had no direct practice on a human being." (Interview no. 1 en: 16 - 16)

In this context, both lack of appropriate practical experience and lack of equipment, as well as adequate set-up of the clinical environment, were elements seen as challenges in implementing training content. This example highlights the importance of clinical mentoring by experienced paediatric critical care clinicians in the trainee's clinical environment. Additionally, participants stated

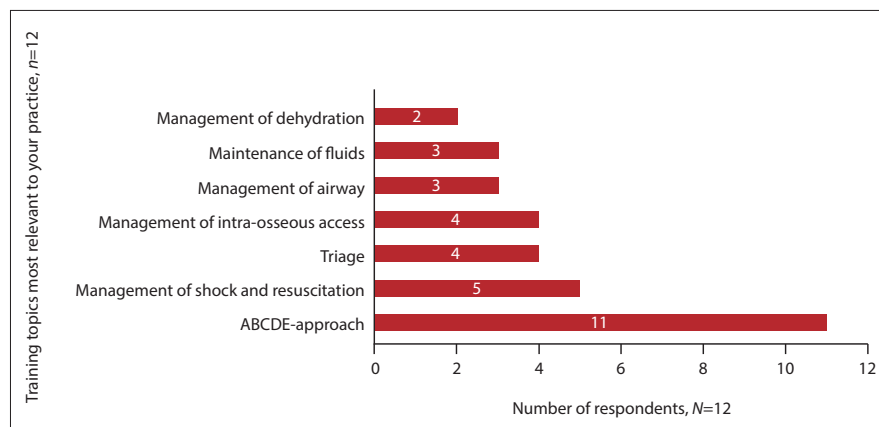


Fig. 2. Free text answer set: Please let us know which three training topics were most relevant to your practice.

that equipment, supply processes and the set-up of clinical environments needed to be adapted.

In the implementation of specific clinical interventions lack of adequate equipment and logistic set-up of health facilities were highlighted as particular challenges:

"...the resuscitation phase requires the use of oxygen... but in the case of our institution, we have no source of oxygen... only the CHU of Tuléar around here has a working oxygen extractor... The training is undoubtedly feasible and relatively simple even... but it is the practical implementation, which is problematic..." (Interview no. 2 en: 22 - 22)

However, all participants agreed that the content of the training was beneficial for their daily clinical practice. Rapid identification of the critically ill child and focusing on essential priorities in the structured approach to stabilising vital organ function in their opinion is crucial to the ETAT+ training. This approach was considered as a beneficial concept, which can be directly translated into clinical practice.

#### Qualifications

When asked to rate their qualifications as trainers in general and their clinical competencies, participants indicated that they felt qualified and confident in aspects of essential paediatric emergency and critical care. However, we need to emphasise that clinical performance and training skills were not directly evaluated in the participants' clinical setting. The interest and need for ETAT+ training of clinical staff in the respective health facilities are described as high by the interview participants.

#### Motivation

The motivation of interview participants and clinical staff at the health facilities was repeatedly emphasised during interviews

and described as exceptionally high, both for training activities and for daily clinical work.

#### Content transfer

In general, interview participants did not see their skills as trainers as a problem but rather the practical implementation of continuous training programmes in their respective health facilities.

A further challenge for the mostly young participants was to convey content to experienced or hierarchically higher-ranking colleagues:

"The second challenge, which I also face, is the fact that I have to train personnel... let's say, more competent or even qualified than me... It is a great challenge for me to play the trainer's role towards my superiors." (Interview no. 2: 30 - 30)

#### ETAT implementation conditions

Participants gained further skills and knowledge and developed additional competencies. However, the results of the interviews emphasise considerable challenges, which need to be addressed in the process of implementing ETAT in health facilities. These challenges were related to structural and organisational priorities and clinical equipment. Here, the interview participants considered support from health facility administrators in particular, but also external groups such as NGOs, as very important.

Furthermore, the importance of personal effort and motivation was also pointed out. Thus, the interview participants saw sufficient payment of health workers and on-the-job training, as well as training outside the institution, as important factors for successful implementation of a 'Madagascar's ETAT+ version'.

### Discussion

The Malagasy ETAT+ pilot training can contribute to a process leading to the

establishment of an ETAT+ programme adapted to regional clinical realities. Course evaluation results indicate that the design and delivery of ETAT+ training by a multidisciplinary team meets the needs of participants. Directly after the 5-day course, participants were highly motivated and able to describe plans to implement ETAT+ contents in their respective health facilities. Results of interviews conducted among five-course participants six weeks after the initial training suggest that this level of motivation could be maintained. In several resource-limited settings, ETAT+ training has been adapted to match specific contexts while maintaining essential elements of paediatric emergency and critical care as outlined in WHO guidelines.<sup>[27-30]</sup> Implementing ETAT principles can contribute to a substantial reduction of paediatric hospital mortality in resource-limited settings.<sup>[17,28-31]</sup>

Results of this evaluation suggest that perceptions of learning experiences and training methods were similar among health professionals with different clinical backgrounds such as general practitioners, nurses and midwives. However, results also indicate that certain elements in the preparation and delivery of ETAT+ training need to be adapted (e.g. earlier and better access to pre-course learning materials). In the future, efforts can be undertaken to develop an online learning platform providing learning materials in French. Furthermore, the pace of delivery of the training content needs to be tailored to different levels of knowledge, skills and competencies of participants. This aspect highlights a major limitation of ETAT+ 'short courses' running over a few days: that this training format can only introduce essential elements of ETAT+ but is certainly not sufficient to develop comprehensive clinical competencies.

Interview results demonstrate important challenges of participants to implement ETAT+ principles in their health facilities. While participants largely retained essential knowledge of training course content, evaluation results revealed challenges in practice of particular procedures (e.g. insertion of intraosseous access) or managing complex critical scenarios independently without senior support. These results suggest that the initial introduction of training content needs to be followed by mentoring periods assisted by experienced training teams in clinical settings.<sup>[32]</sup> The use of log-books (paper or app) can guide an individual comprehensive learning process. On-the-job training periods can be coupled with online mentoring activities supporting self-directed and peer group learning activities.<sup>[33]</sup> Additionally, the training format of short courses is not sufficient to develop competencies necessary for performing as an ETAT+ instructor. Short courses can help to identify participants with instructor potential. Following existing models of instructor training processes,<sup>[34]</sup> an instructor training and support strategy needs to be developed in order to implement ETAT+ in low-resource settings. This strategy should include efforts to clarify the role of ETAT+ trainers within the human resource systems of health facilities to effectively contribute to quality improvement in essential paediatric emergency and critical care.<sup>[35,36]</sup>

Participants identified further challenges in implementing ETAT+. Firstly, patient circuits need to be optimised in health facilities to improve triage and access to immediate emergency care.<sup>[17,31]</sup> Additionally, essential equipment, consumables and medication need to be provided to efficiently treat critically ill patients (e.g. O<sub>2</sub>-concentrators, intraosseous needles, paediatric infusion sets). To safely run biomedical equipment, reliable electricity systems are essential.<sup>[37,38]</sup> Context-adapted biomedical equipment needs to be available, and efficient repair and maintenance systems must be developed.<sup>[39]</sup>

This discussion underlines the importance of a multidisciplinary approach to ETAT+ implementation. The process includes clinical

expertise, training programmes, human resource management, logistical and biomedical engineering support, and functioning supply chains.<sup>[36,40,41]</sup>

Before the training, different stakeholders conducted a preparation workshop to define content and training methods of the ETAT+ pilot training. WHO management guidelines for hospital care of children provided the core elements of the ETAT+ training.<sup>[18,19]</sup> Additional topics important to practitioners in Madagascar were highlighted (Fig. 1), e.g. the particular importance of essential newborn hospital care was expressed as well as the introduction of basic non-invasive respiratory support (e.g., bubble continuous positive airway pressure (CPAP), further context-adapted critical care after initial stabilisation of vital organ functions and an introduction to essential trauma care and burns management. Additional important topics were identified which could not be included in the initial ETAT+ pilot training, e.g., management of obstetric emergencies as part of adolescent care, and treatment of complications associated with certain non-communicable diseases (e.g. sickle cell disease, diabetic ketoacidosis). In the future, also, dengue virus infections and other outbreak diseases need to be considered.

In addition, training methods were defined during the preparation workshop for the ETAT+ pilot training, while realising that further continuous medical education programmes need to be introduced in the different regions of Madagascar (Supplementary files 1 and 2).

A process ensuring regular review of training content, emerging evidence, and efficiency of training methods, needs to be established.<sup>[42,43]</sup> This process needs to be led by SOMAPED as well as national training institutions. In this context, further research is required to find sustainable solutions for the implementation of training programmes in essential paediatric emergency and critical care in Madagascar.<sup>[36,44,45]</sup> This process must take into account the different levels of care available at various levels of referral pathways.<sup>[35]</sup> In addition to ETAT+ training programmes, it may be beneficial to develop a further training module covering more advanced levels of paediatric critical care (Fig. 1).

## Study limitations

To our knowledge, this is the first study to evaluate ETAT+ training activities in Madagascar in the last decade. In addition, the study describes factors influencing implementation and scaling-up of ETAT+ guidelines in Madagascar.

Several limitations associated with this study need to be considered. The sample size of the study was small. Furthermore, associated with the paper-based survey with self-reporting, the nature of the data collection may have influenced the responses of participants. In addition, biases may have occurred in the transmission or translation of data. During the ETAT+ pilot training, practical skills, knowledge and clinical competencies, as well as communication skills, were reviewed continuously by instructors. However, this evaluation process can be strengthened by sequential evaluation of clinical simulations exercises.<sup>[34,46,47]</sup>

Challenges and opportunities associated with the implementation of ETAT management principles were assessed by telephone interviews. Multidisciplinary on-site evaluations may be of greater value to contribute to implementation processes aiming to improve essential paediatric emergency and critical care in health facilities.<sup>[36]</sup>

## Conclusion

Implementation of ETAT+ could have the potential to substantially improve paediatric hospital care in resource-limited settings. This study highlights that training programmes in essential paediatric emergency and critical care need re-evaluation to ensure efficient contribution to quality-of-care improvements. Further operational research is needed

to evaluate sustainable, innovative implementation strategies adapted to clinical realities in Madagascar.

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