# Technology & Innovation in Pediatric ICUs: An Advanced Look at Europe

Speakers:

Dianna Ferro, Peter White, Erik Koomen, Joppe Nijman

Diana Ferro: Hello and welcome to the WFPICCS World PICU Awareness Week 2025 podcast series. I'm Dr. Diana Ferro, researcher and data scientist at Bambino Gesù Hospital. It is a great privilege today to have with me three amazing speakers. I'm going to ask them to introduce themself. Peter, you're first.

Peter White: thank you very much.

So, my name's Peter White. I am the chief nursing information officer at Alder Hay Children's Hospital in Liverpool, England.

Erik Koomen: I'm Erik Koomen. I'm an anesthesiologist working on the pediatric ICU in Utrecht with the Wilhelmina Children's Hospital in the Netherlands.

Diana Ferro: and Joppe.

Joppe Nijman: Hi, nice to meet you. I'm, Joppe, I'm a pediatric intensivist in Utrecht, also in the Netherlands, working on the pediatric ICU as well as doing research on AI.

Diana Ferro: All right, so, this is an amazing time of the year to recognize the incredible work done in pediatric intensive care units around the world. This year we are focusing on crucial team technology and innovation at PICU. Our goal is to allow and help PICU everywhere in the world, from cutting edge hospital in major city, to other resource limited settings are driving change.

Innovation in critical care isn't just about the latest equipment, it’s is about creative problem solving adaptability, and making difference, in children's life and their family. I would say, let's jump in and go with the first questions.

All right. I will ask you, what is the one key innovation in pediatric clinical care that you see having the most significant impact in your future? Maybe if you have an example, what about you Peter?

Peter White: So, I think, there's a lot of talk obviously at the moment around AI and the possibilities of AI and I think there is going to be some really seismic changes in the way we operate, particularly with kind of ambient listing technologies in the near future, but also  Some emerging technologies, which are, I know that, Erik is, is certainly looking into, I think particularly for critical care, for me personally, there's a big opportunity with the kind of telemedicine and sharing information across distances and being able to use the, digital twin, which is a sort of concept of having all of the data and information relating to a patient and then being able to replicate that elsewhere and look at performing, either. Treatments or, procedures, and the outcomes that are likely to come from that, that would then make our practice much safer.

But also , we're able to use more treatments, more effectively and hopefully reduce some of the more invasive procedures that we might have to do in lifesaving treatment and critical care and then be able to justify that through. Safety of performing it digitally, without risks to the patient.

I think the other element, particularly, for me, for technology, is about how we can share information between different units and be able to see information. It's not just about having the best doctors in a hospital or the best doctors in a country, we can now share that information internationally and be able to do that live.

And we have seen that over the last sort of few years where we've been utilizing video conferencing services, but also how do we share the patient data more effectively and as the internet gets better and we're able to share greater amounts of data, we should

be able to work on in sharing those sort of difficult patients and equally improving our basic practice.

I think for me personally as a nurse, it's really a great opportunity to be able to link in with professionals from around the world and be able to do that more effectively. Obviously we have things like WFPICCS where we can get together annually, but we should be utilizing the networking that provides that.

And I think that's where there's some really great opportunity to share learning far and wide and be able to make care more effective and safe.

Diana Ferro: I love that. You know, caring, caring, issuing. I love that line. I will take that away from you. Caring is reassuring and is outstanding that especially with technology now, we are able to connect as never before.

And I think that if we can take something nice from covid that was. You know, we are now able to do better healthcare because we're able to connect better because, in the lockdown we learn how to work over zoom, how to communicate across countries, how to share data efficiently and fast.

So, I think that is an amazing opportunity for innovation here and that's especially true for children so, if we can keep them out of the hospital is a way better. Right. So, Joppe. What is your take?

Joppe Nijman: Yeah. Well, I think I would totally agree with what Peter just said. I think connecting would be, well, the most important key innovation in the upcoming years.

What you mentioned, Peter, that you use, digital twins, to improve care. We are actually doing the same, but then to improve the smart alarms, and to well test the alarms while not testing it directly on the patients. And, we can do these things because we are getting our data infrastructure right, so we can really use all the data we acquire in our patients.

So, I think that that, well having access to our data, having access to all data, and being able to use those data to make digital twins,

to use it for developing ai, and also to improve our workflows. That would be the key innovation in the upcoming years in pediatric critical care.

In my opinion.

Erik Koomen: And if I may add on that, is that if we, what we see on this moment is looking to the alarms that a lot of our devices on this moment are totally disconnected in their own world with the future will be, especially with sec servers oriented, the device communication on this moment developed and.

Hence to a lot of major companies, medical device companies, that will be the route to get that communication better and organize that. We have all that data structured in a good way to combine that data and alarms, and I think it's essential that the standards of communication of data will be there.

Otherwise, it will not get where we want to be with AI.

Diana Ferro: Yeah, actually it's interesting that you mention alarms because, I have been recently in the ICU, you know, I'm a data scientist, but I do AI at point of care. So I go every time to talk to patients and providers and I'm trying to understand how to make their everyday life better and I was noticing, nurses that were telling me alarm fatigue was real.

They were like. There are external alarms, which ones are good alarms, which are not good alarms, stress and burnout coming from alarms. And I do believe that why we are developing technology, especially for Pediatric ICU and NICU, we have to really be committed to do not only provide good quality care, but also release some burden from the care providers. Right? Regarding this, you know, there's a lot of innovative ideas and technology, however, only few can reach the patient. So, what do you see as the biggest barrier to implementing those innovations? Peter, will you, would you like to start with that?

Peter White: Yeah, So, I think that, well, you raise a really good point about alarm fatigue and a real barrier for that.

But, I think what Erik mentioned about standards for communication, So, for me in my world, it's an interoperability challenge and we see that in in all aspects in critical care. We, there was a very big push a few years ago to make sure that the settings were the same across. So, if you were looking at BiPAP, it meant the same thing across all the different devices. And that was a very hard won battle with, with, device manufacturers. But we now sort of, at a point where a lot of the devices that we attach to patients, can give messages in a standard format, which is called hl seven, which is brilliant. But then having the systems, the electronic patient records, the different ways of charting, the different information streams that we've got all have their own.

different ways of doing things. And so, that interoperability is a huge challenge. And even within a local hospital, you can find that systems don't talk to each other very effectively at all and when you're looking at trying to do things at scale, it can mean that, you know, trying to get that information in a standard format that is interpretable by each different system is extremely difficult.

So, we are sort of limited by what those manufacturers will provide and I think it's on us as clinicians to push back to those systems. And as we did with ventilators many years ago, it's really important that we say we must have this interoperability and be able to talk between systems so that we are getting that full picture.

And there aren't any sort of elements in the record, which look like there isn't anything recorded, actually. It's just available elsewhere. And I think the other really important part is that there's kind of system constraints. You know, obviously it's quite expensive to develop these technologies, but if we are collectively saying we must have this to make the best.

Care for our patients, then, the onus is put back on those manufacturers. And I think the other big key aspect of that is that obviously there's a large number of electronic patient record systems, but they tend to be provided by large American vendors. And do they actually match the standards of the healthcare system for me and say the NIHs in England, but al. So, the kind of European standards and things, and are they actually matching what our health system is, our processes are.

And how can we sort of encourage those solutions to be more effective? And I think that's where it can be quite difficult because if you are a nurse or a doctor who's working between units, you'll have a completely different system to get around, each and every time. And, particularly for, medics, when they move between organizations, they will get used to certain processes, but it's really difficult to be able to sort of have that standard process and, yeah. The kind of digital literacy is a whole other, other element, and then I'm talking very much from a kind of first world element, but certainly in in lower income environments, this is a real challenge because they can't make those kind of decisions and be able to invest in the latest and greatest technology, and we should be making it so that it's easy as possible to be able to deploy the technologies and then sustain them.

Diana Ferro: what you say it means to me that we need staff training. I mean, we need to be able to not only be able to share data, share knowledge, but also , you know, train the next generation of providers that are dealing, not Hollywood patients and pen and paper, but also with technology. What is your take on this?

Joppe? You have anything to add to that?

Joppe Nijman: It's quite interesting because, what we see also in development of AI models, how do you make your AI model so that it connects to the workflow of the one using the AI model. So, whether that be a nurse or a doctor. It should work in the setting where you are working.

And there are two problems. So, how do you interact with the model, but also how is the model trained? And especially in pediatric critical care, we have a use heterogeneity of our population. So, training an adequate model for your specific population, it's quite a challenge actually. And if you have a trained model, then how do you integrate it within the workflow?

For example, we are working on a model. Which is classifying the clinical stability of the patient at a current time point. When, does the nurse need to look at that model and when does a doctor

interacts with the model that are very important. Questions we do not have answered yet.

So, I think there are still a lot of challenges with integrating this kind of innovations within our workflows actually.

Diana Ferro: yeah, integration seems to be a real challenge right now because, you know, models develop faster and faster and faster. And so many times it takes a lot of time to even have a committee, proving your research regarding a model because that model is already old.

Right? So, I almost that research is actually running behind the advancement in technology and policymaking. Back stuff. A point more, sorry. Erik, what about you? What do you think about family care? Because we're talking about providers and we're talking about the hospital, but I believe that there is some kind of integration that also regards family.

Right. What is your take on that?

Erik Koomen: I would say if we are looking through the whole scheme of what we are doing in care, then we see an overload on alarms and data going to the nurses. But what the other problem is, what we see is that our nurses are getting less and less, and the demand from patients and parents are getting bigger and bigger, and I think there is a major discrepancy going on.

What can we deliver? From a care point of view and the question mark there, I would say, and also the future challenge would be how to use and utilize family as well. Within that whole care process is also not about how we inform our models. The nurses and doctors, but also how do we get the good integration with the family?

Because I think in the future there will be a part of what the nurses are doing now on the floor. It will be done by the family itself because there are not enough nurses. I think the nurses profession will go more in managing situations than. Applying a lot of the things. I think changing a diaper, doing the physical stuff

around the patient is also possible that the family can help with that.

And I think that we further need to think how do we get the ecosystem where we not only work together as medical advisors, but also, as a team, not only the nurses and doctors, but also the family. How do you get the family integrated care organized because. We are fairly, we will get limited and more limited in how we can deal with care to our patients.

So, I think that's one of the challenge to make. And I think in that same challenge, we need to change not only how literature our nurses and doctors are about the it data, but also about how to deal in a better combined work environment with relatives. If we are looking to the pediatric ICU.

Diana Ferro: and you know, sometime the little go, long way. I remember, you know, just walking to the floor and seeing that some keyboards were not working well and just changing the keyboard, upgrading a little bit. The monitors, making technology more accessible because, you know, if you are an emergency and you know, you're taking care of your patient and you're trying to prescribe your pharmacy and you know, you're all that.

And on top of that, you have to log in info in your chart and your keyboard is not working. It gets frustrating and you know, everything, can become a huge burden while if you really just go around it your everyday stations and say, oh, how technology can improve here and say, oh, we need a monitor to show all the bad vitals.

We need a better station for the nurses to be able to log in the data efficiently. We need perhaps to tweak a little the way how the interface even is being set up. So, it is more easy to use. I noticed that, there's a lot of manufacturers that provide system intense intended as software that is being designed and without keeping the provider in mind, we tunnel to field to complete and a lot of time consuming action they need to be taken to properly log in facts regarding the patients.

And I think that that's where, you know, co-design is so important.

Erik Koomen: I think the same, I think, but I think also that. What is happening now? We have a user interface of all the medical devices where we work with as medical professions, but I think if you would show a part of that data in a simplified way, you could show.

Parents are also better and family. What's going on at this moment? They're looking at the same screen. They try to understand everything, what we are doing, and I think that's creating also over complicated situation for them. They're not trained for that. They are. They may be aware what's going on with their.

Loved one, but quite often if you have a better sophisticated way of giving them information instead of overspending them with a lot of data points, I think that would be helpful and giving more rest around the bed space of that patient. And I think a lot of the healing environment, what's going on and how to optimize care is about getting it.

Right the first time around that bed space. And that is not overdoing a lot of things. What we are doing now, we are notified sending information to a pa, to a parent. If you look to the monitor. It's made for healthcare providers, but even a lot of the data points or are not for the nurses on this moment, it's the question mark is what kind of UI user interface do we need in which kind of situation and how could we optimize there the structure to improve care?

Because I think on this moment, especially the nurses are getting an overburdening of tasks into their pockets, and that's more than they can handle. And as we said already about the alarms, our ICU, there is every one to two minutes an alarm. And I can tell you if we would record this with a timer and every minute there will be going an alarm, nobody would listen to this recording because it's, you can't concentrate if you are every minute or disturbed by noise.

Diana Ferro: thank you for that. That is an incredible point of view. Peter, do you have any concrete case from re about integrating

technology that has improved that or improved patient care in general?

Peter White: yeah, I, I think there's, there's a couple of things. I mean, just feeding into what we're talking about there, about noise, I think, a really innovative piece that we've had recently at adopted, Aaron Gates, who is one of the intensivists and also an innovation consultant, is, deployed sensors in every bed space that monitor not just noise because, you know, it's well establish from the research that noise can impact patients.

Also, lights, air pollution and other sort of environmental elements that will, you know, may impact on the patient. It's not actually part of the patient record yet, but it's certainly something that we're trying to explore to see. You know, external influences of stress beyond just being in an intensive care environment.

And I think that's a really novel approach and something we probably need to explore further because we, well understand, you know, a noisy bin is just as bad as, alarms going off and we, or even. Nurses chatting, you know, it can be quite stressful. But what about the light? What about, you know, the air quality, even though it's going through, say, a ventilator that's filtered, et cetera.

We need to make sure that we are looking after the patients, you know, in a holistic manner, but also , you know, when we can see that, say parents are by the bedside and how that impacts their care. So, I think that's a novel and innovative solution. I think the other, other key development that's been within alder hay over the last few years, Adam McNeil, who's a lead for the electronic patient record system here, has done a huge piece of work to integrate all of the medical devices into the electronic record so that it reduces the administrative burden of recording all the information, but also that really clear data and, and data quality for the patient record. And I think that is really vital for making clinical decisions and having more information is always better, but having all of the, the systems interacting and, and feeding into one place has been really effective at managing the patients, much more effectively. You get much better data to make decisions and then you're very clinically led and I agree with the conversations about how we involve parents and how we bring them along. You know,

obviously you try and prepare parents as much as they can, but for the majority, they're not prepared for coming into intensive care environment and alarms and things like that.

So, again, we have done quite a lot to try and improve some of the documentation and some of the support that we have for parents. And I think, again, that's, that's just somewhere that we need to be investing more and co-designing the, those solutions is, is absolutely vital.

And it's then how do we prepare families for when they step down from intensive care environment? I think that's something that we often se. And how can we make that better? Because they go from a very high intense, you know per So, n by the bedside at all times down to a ward level or even into the community, and how do we make sure that they still feel safe and they still feel assured that we're monitoring patients.

And they, some of those developments that we've had within our patient records have, have been really well received. But I know there's still a lot of work to be done in this space.

Diana Ferro: what about you? What about your institution? Do you ask for some practical example too?

Joppe Nijman: yeah. Well, we're actually building a new PICU and in the new PICU, we are going from a ward architecture to single boxes for the patient and the family. And that has also , some challenges in it. And one of the challenges is how do the nurses and the doctors know that they, that the patient is safe while we are not seeing them, anymore and, that was actually one of the rea So, ns to develop our clinical instability, AI model, which I just mentioned.

So, it does not detect acute deterioration, because for that we have the monitor, but it does classify slow deterioration or improving of the patient actually, and I think, well we are currently able to use the model at bedside, so, we have like the flow of data coming from the monitor, going to like a data warehouse, going to a place where we can apply the model and seeing the results at bedside.

Well, we have that loop in order so, we can now validate the model. And I think we are not using it yet, but. Learning from, getting it to the bedside and being able to validate this kind of models. I think that can be a success and can also help us to getting this kind of models to the bedside and learning what we need not only in developing this model, but also how AI can help us with challenges going to a new, new PICU or, well, doing different workflows.

Erik Koomen: if I may add, we were working on a new pediatric ICU. We have done that on more an it way on agile, where we have developed a room in 40 iterations with parents, with nurses, and that we used. Family integrated care already by the building of the space. And what we said, now, we are working on two sides of the bed, but what we want is one side of the bed needs to be the family domain and the other side is the cockpit of the nurse and the doctors.

And we reshape the whole room with parents, with nurses, and step by step, we ideally create that in a mock up room and build the whole room. On a one-on-one scale, because that's, I think, a way of dealing, how could you do co-design evaluation with parents and nurses in this kind of design way. The other thing, if I need to give an example of how family integrated care as well is working, we can look especially to our neonatal.

People as well, and the population where they do a lot of kangaroo. Having the child on the chest, on skin, on skin, you see that they have. Far less need of sedation and other stuff to do, and the family bonding is better. So, we see already if you change the way of dealing, with a patient and using family can also have benefits on a medical domain, but also in a family domain.

A lot of those parents are feeling more responsible what's going on in a, in when they're preterm and they take. Can have also a beneficial part of the care being there and being with their child and helping the system. And I think that's beneficial for the future. So, I think we need to openly see how we use it.

Technique I, medical devices, but also, are using what are we doing with family and how to see in that ecosystem with each

other, how to optimize patient's care, especially on this moment where we see that there are limited limitations within. The technical part, but also in nursing and doctor part where we don't have all the staff anymore.

There's not, not a lot of units anymore in the rest of Europe, where in the pediatric ICU, there's one-on-one ratio. Nursing one to two is already getting far more normal than the system for one-to-one. And in this perspective, we need to see how we help the system organizing the care in a better and efficient way.

Diana Ferro: amazing work guys. Congratulations. Really, that's amazing work. Before closing, I would like you, to give some kind of advice or recommendation, what would you say to hospital or clinicians that want to adopt an integrate innovative technology? Anything that you come to mind after our discussion that you would like to, give us advice.

Peter White: yeah, so, I think that the most important thing for me is networking, both in the digital sense and in the kind of physical sense from a digital point of view. Make sure that your systems are talking to each other. Make sure that your devices and everything is, is working together and. That information is being shared, but also from a personal point of view, share knowledge.

Make sure that you are working together, collaborating with others, reaching out to other units, reaching out to other professionals, and also publish. Make sure that you are getting that research through and getting that into the, the, the space. The really important thing for, for me is, you know, investing in the.

Digital, specialty and making sure that we do have those clinicians, those nurses who are dedicated digital experts, who are working with units, working in areas to make sure that the latest innovations and technologies are being developed, but also . Collaborating and co-designing solutions with, as a team, but also with families, and with the children, young people in mind to make sure that they're effective, but also easy to use and easy to interpret.

But I think the, the, the main thing is to keep developing and, and working and collaborating together.

Erik Koomen: I think, Peter, you gave a totally summary for us, but I think adding some small stars, I would say let's standardize all the. It communication between medical devices, it gets standardization organized better, especially between them looking to our companies, supporting our care, but think with all each other.

And also, the data science that our work is in a hetogic population, and there's no standardization of that heat. Energy within our population. It's about the communication layer where the standardization needs to be, and of course, I think working together and having this kind of message, sending out also what we are doing in this podcast, I think that's the right thing to do.

We need to work together and show that these kind of things are possible. And the only thing is by sharing and sharing of data is needed also to create better i.e. models, but also sharing data with families who are within our care. And of course if that, if that family is coming in on the first moment, that there's a trauma for them, that there are on our pediatric icu, but within a few days they want to be more in control with trying not to have a fixed model, how to deal with parents and families, but be flexible and let them do as much as possible what they wish and that creates a less standardized way of looking to nursing and how we work as doctors. I think that will be my take home message.

Joppe Nijman: yeah. And I can still add something because I also totally agree what Erik and Peter, just said but, well I think we also should take into account that, we really need to work together, but we also really need to work together interdisciplinary. So, we do not only need. To take the patients, the family, the, the nurses and the doctors, but also the data scientists working on AI. Also defenders of the medical devices, et cetera, et cetera.

They all need to work towards the same direction. And that is improving care by our innovations.

Diana Ferro: thank you, Erik, for the last sentence, because I am a multidisciplinary scientist and I believe that hospitals need to work toward creating space for us too. I mean, we are the people that connect the dots, and right now there is not much.

Space for us. Or, or, or they wanted to work on data in it, or they wanted to work on the floor smd, or they wanted to work on management, but only for the research side. You know what I mean? Like I do believe the multi is the key of excellence as. Especially in the implementation, especially the point of care, do not harm patients and family should be the first directive, you know, and to do that working together mean also having players in the team that can do the, shift in mindset so they can put together and have everybody talking together, communicating together.

And that's actually what we talk about it in the. First minutes of this call. You know, digital twins need multidisciplinarity. Sharing information internationally mean multidisciplinarity, overcome system constraints. Building AI champions also require multidisciplinarity interdisciplinarity,

So, moving forward, we need really to break down the silos in my point of view. We need really to find a way to communicate and work together. And we do that just, you know, investing in training, training providers, training families, training even children's. I mean, I always, amazed our children's in the hospital when they talk to me and say, hey, I'm wearing the sen So, rs because I know that my data come to you and you're gonna help me.

And this mean that patient. Even p occupation are very aware about how technology can improve their lives. We, we just need to be able to communicate to them. And get them in the loop. This is how we do true patient-centered approach to healthcare in my point of view, especially in pediatrics. So, we're gonna wrap it up for today.

I want to thank our speakers. I am really impressed regarding all that you're doing in your different ecosystems, and i, again, invite you to the next epi So, de of this podcast. Thank you very much and have a great day. Wherever you are.