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National Estimates of Pediatric Sepsis

In this World Shared Practice Forum Podcast, first authors Drs. Frances Balamuth and Chanu Rhee describe the objectives and methodology for their study "National Estimates of Pediatric Sepsis in US Hospitals Using Clinical Data" published in the March 2026 edition of JAMA. They discuss the process of modifying the Phoenix Sepsis Criteria to an electronic health record-based Pediatric Sepsis Event (PSE) definition and the methods for validating this definition. The authors share salient findings from their study, noting the limitations, and share their hopes for the future direction of sepsis surveillance research.

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Sarah Marcley *00:04*
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Traci Wolbrink *00:18*
Hello, and welcome to the OPENPediatrics World Shared Practice Forum podcast. My name is Traci Wolbrink, and I'm a pediatric intensivist at Boston Children's Hospital and co-director of OPENPediatrics. It is my pleasure today to be joined by Drs. Chanu Rhee and Fran Balamuth. Dr. Chanu Rhee is an associate professor of population medicine at Harvard Medical School and director of the Center for Sepsis Epidemiology and Prevention Studies at the Harvard Pilgrim Healthcare Institute. Dr. Fran Balamuth is professor of pediatrics at the Perelman School of Medicine at the University of Pennsylvania and is also the Division Chief in Pediatric Emergency Medicine at the Children's Hospital of Philadelphia. Doctors Rhee and Balamuth are the first authors of the study published in the Journal of the American Medical Association, in March 2026 entitled National Estimates of Pediatric Sepsis in US Hospitals Using Clinical Data. Welcome to both of you.

Chanu Rhee *01:09*
Great, thanks so much for having us.

Frances Balamuth *01:11*
Yes, appreciate the invitation.

Traci Wolbrink *01:13*
All right, well, Fran, if I could start with you, I was hoping that you might be able to let us know kind of what the objectives of the study was, what questions were you trying to answer, what methodology or approach did you utilize to answer this question.

Frances Balamuth *01:27*
Yeah, no thanks for that. I think you know epidemiologic estimates in sepsis have been challenging for a long time, largely because they have relied historically on ICD or diagnostic codes that we know are imperfect and can be subject to bias, you know, kind of coding level bias, and so there's been interest led at a charge led largely by Chanu on his team, honestly, and about 10 years ago in adults they did a study where they used electronic health record data to identify sepsis in kind of a more clinically meaningful way, so using the more the granularity of electronic health record data to identify infection with organ dysfunction in the hospital record, and so I think we are trying to adapt that approach to make it more appropriate for pediatrics in order to get a diagnostic code agnostic definite surveillance definition of sepsis in kids.

Chanu Rhee *02:21*
Yeah, just, just to add to that, since you know, Fran, you added some nice history there. I think, yeah, I think you know, we did kick this off, really focusing on adults. You mentioned that 2017 JAMA paper, where you know, we had basically adapted the Sepsis-3 adult definition into a clinical surveillance definition optimized for wide scale EHR based surveillance, and just for a little bit of history, I think that that's that study, of course, was funded by the CDC, and I think there was really immediate interest, you know, after that study in doing something similar in pediatrics. In fact, Fran, if you remember, you know, back around 2018 2019 you know, we had meetings at CDC, you know, we had a lot of stakeholders there. We even published a white paper in Pediatrics back in 2019 sort of outlining what we thought the path forward would look like in terms of doing something similar for pediatrics. Then, of course, the COVID pandemic hit, everyone, everything got derailed. Certainly, our colleagues at CDC got very distracted, to say the least, but we were thrilled, I think, sort of as the pandemic began to recede. Then back in 2023 when you know CDC was able to sort of resurrect this idea, and Fran and I and Scott Weiss and Mike Klompas, sort of as the leads for this study, you know, were able to sort of reconvene a coalition to take on this work. And I think the timing worked out really nicely, because I think one of the biggest challenges, you know, back in 2018 2019 when we were thinking about this for pediatrics, was, you know, what would be the goal, would be the reference standard, you know, we ideally you tie it back to sort of a consensus clinical definition, which at that time was really just based on the 2005 pediatric sepsis definition, but even at that time I think it was pretty clear that that was, you know, kind of out of date, especially with the advent of Sepsis-3. So, you know, back to our current study, I think the timing worked out perfectly. We knew that the Phoenix criteria were sort of, you know, being developed. We actually partnered, obviously, Fran and Scott Weiss were part of that task force. We partnered with other leaders on the Phoenix task force, so we sort of had a head start, and we were able to coordinate that timing to develop a surveillance definition that was really based on the Phoenix concept, but adapted for routine wide scale EHR surveillance.

Traci Wolbrink *04:36*
That's excellent, and I wonder if you wouldn't mind going into the definition, the pediatric sepsis event definition, and, and how you chose that. What sort of assumptions did you have to make as you, as you began to modify this from the Phoenix guidelines?

Frances Balamuth *04:53*
Yeah, great question. So, I can start, and then, Chanu, feel free to chime in, but I think we, we use the framework, the same framework that Chanu and his colleagues had used in adults, but kind of adapted it for Phoenix, as opposed to for SOFA, which is where the adult definition was based. We convened an expert panel, so many of the players that were present at that CDC meeting in 2018 2019 kind of came back into the fray, as well as some of the folks from the Phoenix task force, kind of sepsis experts from around the country and around the world to kind of come together and look through the categories of organ dysfunction in Phoenix and decide, you know, which components of that do we did we think were feasible to obtain from the electronic record and which ones could we do we do we think we needed to adapt, and so we did a couple of iterative rounds with that group, and then came up with kind of a candidate definition.

Chanu Rhee *05:42*
Yeah, exactly, and just, and just building on that, I think sort of one question, you know, folks might have off the bat, so why not just use the Phoenix definition? I mean, the Phoenix task force, you know,

operationalized the definition using large data sets, so, so why not use that, and you know, I think, I think what I would, what we would point out is that you know, obviously, the Phoenix sepsis criteria were a major conceptual advance, but they weren't really optimized for sort of population level surveillance or epidemiological estimates, and you know, their primary goal was to develop basically a, you know, sort of a new organ dysfunction score that was optimized for, you know, children with suspected infection, and so you know the way that they developed it was basically they use a very broad definition of suspected infection, like they use like any microbiology test plus any antibiotic within 24 hour window, and so you know makes total sense for what they were trying to do, but for our purposes when we were really looking at retrospective population surveillance, we want to not just capture those all the children who were initially treated for possible infection, but really want to try to hone in on patients who, in retrospect, probably did actually have infection through associated organ dysfunction. So that was sort of one important adaptation in thinking about sort of, how do you define infection, and then when it comes to the actual organ dysfunction, again, Phoenix, you know, they leveraged very rich data sets to develop their score, but several components within Phoenix are challenging, and for anyone who works with EHR data and these type of analyzes can sort of probably appreciate that it's never quite as simple as it seems to implement some of these rules and these parameters, so for example, ventilator parameters, so things like P to F ratios or S to F ratios, sounds great in theory, but when it actually comes down to operationalize these and do it at scale in a way that's consistent across hospitals, there's there's so many nuances that go into ranging from the completeness of the data, you know, how have you tied together the timing of a p, you know, of a p and an f values, so you know that was pretty clear that that was something that would have to be adapted and simplified, and similarly, one of the criteria in the Phoenix definition is fixed pupils, and you know, I think clinically a very important parameter, but, but you know, not routinely captured in electronic health record data, so those are some of the considerations we had when adapting the Phoenix definition, so you know, I don't know if we want to go into all the details with, but essentially, sort of the pediatric sepsis event definition really hones in more on blood cultures being drawn as the anchor rather than any microbiological tests, a little bit more specific for sepsis, and then it hones in on patients who got at least four consecutive days of antibiotics to hone in on those again, not just started initially empirically on antibiotics, which is nowadays like almost anybody, but sort of where the clinicians actually had sustained a concern for infection, and then the organ dysfunction again was adapted very closely from Phoenix. They said the biggest adaptations were around the respiratory failure criteria, where we basically streamlined it to invasive or non-invasive ventilation, and then we also had to simplify the GCS. I'm sorry, the neurological criteria where that fixed people really just wasn't a feasible component for this type of definition, and the GCS as well was also a challenge, because we also know that capture of GCS is very incomplete across hospitals, and so we also, in data sets where GCS was missing, we use actually use ICD codes for neurological dysfunction. So those are some of the practical adaptations we made to, again, to optimize it for wide scale application.

Traci Wolbrink *09:37*
That's great, and you know, I really appreciate all those considerations as you went into the definition. I also serve as program director for our critical care fellowship, and so I always like to think about, you know, as how do you even get started on these kinds of research studies? What are all the components into that that go into it? And so you've obviously spent a lot of time creating the definition and I'm curious, you know, the next step, obviously, is the validation of, you know, this definition. I'm curious, if you could walk us through a little bit of that, any lessons that you learned there, anything that didn't

work from the original definition that you had to modify before you started, you know, exploring this in the full study.

Frances Balamuth *10:15*
Yeah, great, so I can start with that too. And then, again, Chanu, feel free to chime in, but we chose to validate the study at three at three sites, all of whom had active quality sepsis quality improvement programs, and so we took advantage of the fact that they all participated in a collaborative called the IPSO, Improving Pediatric Sepsis Outcomes Collaborative, that submitted patients with infection, essentially who are who are admitted to the hospital, so it was kind of an enriched group of patients with infection, where the risk of sepsis was not, was, was higher than we took all comers in the hospital, and so we took, we sampled from that group of patients, and each hospital did around 200 chart reviews of patients, a mixture of patients that kind of met the IPSO sepsis criteria, and then patients who had infections and were admitted to the hospital, but didn't have sepsis, and we applied the candidate definition to that, and then did test characteristics, and looked at the patients where there were mismatches to try to figure out, you know, are they are they mismatched in a way that we could improve the definition moving forward. And so, so that's how we did the validation.

Chanu Rhee *11:21*
Yeah, yeah, and just, just add a little bit to that. I think you know, so chart reviews are always, you know, time consuming, and these, and anytime you're trying to adjudicate the presence of sepsis, I think you always run into some, some challenges, you know, the reviewers have to decide, you know, whether there was credible evidence of infection in retrospect, whether theres organ dysfunction at the at the specified thresholds, and then whether that organ dysfunction was, you know, potentially related to infection. So that's sort of how we operationalize, sort of the reference standard by which we calculated against which we calculated sensitivity and specificity, and you know, positive and negative predictive value. Basically, we took the concept of Phoenix and said, you know, we want, we want the physician reviewers at each of the sites to review these charts in great detail and decide exactly that was there a plausible infection, and you know was there organ dysfunction at the threshold specified by Phoenix that were potentially related to infection, so that was sort of our, our reference standard, and again, basically simply calculated performance characteristics. So, how long did that process take, Fran? I think I mean, we ended up doing almost 600 basically about 200 reviews at each of the sites, so it was, it was a multi-month process, and you know, we, we, a lot of, we spent a lot of time, as you can imagine, sort of, you know, creating obviously the standardized abstraction tool in Red Cap, doing some training at each of the sites, so just make sure everybody was on the same page about, you know, how we're going to approach these adjudications, how we're going to adjudicate, you know, possible, probable, definite infection and sepsis, and you know, so always a little bit of a squishy target, but you know we definitely had some experience, quite a bit experience doing similar type of validation exercise in the past that we were able to leverage that and build on that.

Traci Wolbrink *13:15*
Perfect, so you went in and defined pediatric sepsis events, you then validated, and now you're into your study. I was hoping maybe Chanu, if you could walk us through the results, what you found, what are the salient findings from your, your work?

Chanu Rhee *13:30*

Sure, yeah, so I think maybe the top line statistic, which is a national burden, the estimated national burden of sepsis and death. So when we projected the findings from the primary data sets nationally, we estimated over 18,000 pediatric sepsis cases annually, and over 1,800 associated deaths over that 2016 to 2022 time period. They were basically unchanged. After we developed and validated the pediatrics sepsis event definition, we applied it to multiple large data sets with a goal of estimating sepsis incidents, mortality characteristics, and trends over time, and I will say, you know, our primary data sets that we used for our national epidemiologic estimates were drawn from Epic Cosmos, which is an enormous data set from healthcare systems that use Epic, the Epic EHR, and sort of contribute to this centralized data warehouse, or sorry, database, and we also complemented that with data from the HCA Healthcare Network, which is a large, the largest private inpatient healthcare system in the country, and those were two non-overlapping data sets, and so basically that between the study years of 2016 and 2023 that gave us a cohort of about 3.9 million non-neonatal pediatric hospitalizations, and then we applied the PSC definition there. And to jump to the main findings, I would say the first was in terms of incidents, so basically about one in 75 non-neonatal pediatric hospitalizations involve sepsis, and you know, I think, although that incidence may not sound enormous at first glance, I think the associated mortality burden was quite striking, so about 1 in 10 of— 1 in 10 children with sepsis died during their hospitalization, and sort of when looking at that entire 3.9 million patient cohort or hospitalization cohort, nearly 1 in 5 of all in hospital deaths involved sepsis. So that was kind of some of the striking findings, just on the burden there. I think another thing I would highlight was that we, the advantage of this definition of electronic definition, is you can get a lot of granularity into the timing of sepsis onset, so where the criteria met sort of within the first two days, and then we classified that as community onset, or if they're met sort of on day three or later, then that's hospital onset, and what we found was that about a quarter, actually more than a quarter, of cases were hospital onset. I think that's something I'm also an infection control person, so you know, I really, you know, striking finding to me, because I think it suggests that there may be some meaningful opportunities for, you know, prevention and quality improvement within hospitals. And I think the third major thing I would highlight is the trends over time, and so we looked at trends sort of within the hospital cohort, and then we also projected it, we projected all these findings nationally, and we found that the sepsis incidence and associated mortality remain largely unchanged from 2016 through 2022 and to me that was, that was, a bit striking. We know there's been a lot of awareness and increasing emphasis on, you know, early sepsis recognition and treatment, and I think really emphasizes that, you know, we still have a long ways to go.

Frances Balamuth *17:05*
I think another, just a couple of things to highlight about it, about the use of the data sets that we used, is that I do think you know one difference I think between adults and pediatric care across the country is that you know pediatric critical care doesn't exist at every hospital, right, so you guys are exist largely in specialized centers, which is where most of sepsis will end up, but it's not always where sepsis starts, and then there are some sepsis cases that will get cared for in the community. So, an advantage, I think, of both the Cosmos and the HCA data sets is that they include kind of community hospital settings where often, you know, some pediatric research has struggled to find to find data from in the past. So, I think that's an advantage of this, and then I guess the other thing, just to call out again, which Chanu did say, but that just to underscore that neonates were not included in this study, so we know that there is a large burden of infection in young infants, and this, but that kind of both the biology and also the way that sepsis is conceptualized in kind of the NICU, or newly born population, is a little bit different from this, and so I think the consensus back in 2018 when we kind of convened that

discussion group at the CDC, was that neonatal sepsis would be kind of in a different bucket. So I think there hopefully will be future efforts in the neonatal space. And I guess just to add on top of that, I, you know, so that number 18,000 is is a smaller number than than have been presented in other pediatric sepsis epidemiologic estimates in the past, and I think kind of our interpretation of that is that, you know, Phoenix definitely identifies a quite ill population, right? The Phoenix organ dysfunction criteria were modeled based on mortality as the outcome, so these are children who are at the highest risk of death, and so I think it shows just kind of how far Phoenix has moved the needle on the illness spectrum, that we really are talking, the patients in this paper, like what we really are talking about, quite a sick population.

Traci Wolbrink *19:00*
That's great. And Fran, I was, I wanted to go back to one thing that you mentioned, you know, with the inclusion of community hospitals, and obviously sepsis is a global disease that affects lots of children around the world, and you know, we know less about incidence in low and middle income countries, and I'm curious, any lessons learned from trying to do this, national estimates that you think could potentially be applicable to those that might be wanting to do this type of research in low and middle income countries. I don't know if you got, if you talked about that at all as a group or any considerations with that.

Frances Balamuth *19:37*
Yeah, no, it's a great question. I mean, I think the, you know, the Phoenix data sets that were used to develop Phoenix did have data from low and middle income countries, at least some of it, and I think certainly this strategy, you know. Requires an electronic health record, so I think it would be tricky to do it in the absence of that, although certainly you know I think there are plenty of countries that have access to EHRs. I think the reason we did not, did not include other countries in this study was kind of practical, based on it was funded by CDC, was really kind of looking to develop a surveillance definition in the United States, but Chanu, I don't know if you want to add anything else.

Chanu Rhee *20:13*
No, no, exactly. I mean, I think I like to think that other countries could learn from this, but would certainly acknowledge that I think in low-middle-income countries, where if you don't have an EHR or robust EHR system, obviously it's not really going to be feasible, but, but as Fran said, that plenty of countries that that do, and again, I hope, I hope that you know some of these lessons could, could be adapted in other countries as well.

Traci Wolbrink *20:36*
I'm curious just to kind of move into some of the limitations of the study that you identified, and sort of describing a little bit of those in more detail.

Chanu Rhee *20:45*
Sure, sure, there are multiple limitations, as with any, any study, I guess. Fran, I think already mentioned sort of the fact that we, that we didn't focus on the neonates, so I think we can't, can't emphasize that enough. Very important population, but very, very different population that really needs their own surveillance criteria. I think, sort of from a measurement standpoint, I think you know we are big believers that EHR-based surveillance sort of takes us forward, it's a step up from, you know, code diagnostic code-based surveillance, but I think it's important to also be, you know, be realistic and

acknowledge that has limitations. It's not, it's not perfect. There's, there's no perfect way of identifying sepsis, and this method is no different. And, in particular, you know, misclassification or imperfect sensitivity, you know, is certainly possible. And so, so, where are some areas where the, you know, the pediatric sepsis event definition sort of can miss? I think the most, you know, we analyze this when looking at sort of the quote unquote "false positives" and the "false negatives" in the chart review validation cohort, and I think, you know, one common cause for missing sepsis cases were patients who you know actually did have infection and associated organ dysfunction, but didn't get, didn't meet that four day antibiotic threshold, and so I think I think we saw a number of those that were probably related to severe viral infections. Now we do include antivirals in the definition of qualifying antimicrobials, but obviously things like RSV, you know, they don't, where they don't have target antivirals, so that's one scenario where, where you know, we can miss true viral sepsis, and I think conversely, in terms of thinking about false positives, I think the two biggest areas are, well, a patient can have a blood culture drawn, they can get four or more days of antibiotics, they can have organ dysfunction, but actually, you know, when the dust is really settled, and you look closely at the case, the patient really didn't have to have infection, they were just being treated still empirically, because the team was very worried about the patient being very sick, so that certainly happens, you know, or, you know, the organ dysfunction that was flagged, you know, was was more clearly related to some other cause, they were intubated for, maybe they were intubated for a procedure, for example, or you know, all the other things that can, that can contribute to organ dysfunction in hospitalized patients. So, again, in overall, it performed well. It actually performed very consistent, consistently with how the adult sepsis event definition did, but important to acknowledge those, you know, the potential for misclassification in the definition.

Frances Balamuth *23:19*
I think you know one thing that was clear from the chart reviews, and I think maybe a partial explanation as to why we haven't moved the mortality rate in the country is just kind of how complex some of these patients are. So, you know, certainly another limitation, I guess, is that the validation was done at three academic centers, right? So we could have been enriched for more complex patients, but I do think that, you know, as we think about the kinds of patients that are coming to, you know, you know, academic centers over the last decade, certainly the complexity has gone up, right? CAR-T cells, there are many things that kind of cause multi-system organ dysfunction that can be difficult to interpret is that you know, is that kind of chronic organ dysfunction, is that associated with infection, and so I think that does kind of add to the complexity, also probably adds to the mortality risk, and so that may be another reason why the mortality has not moved.

Chanu Rhee *24:07*
Yeah, sort of building on that, I mean, this is this was primarily obviously a large surveillance and epidemiological study, and so I think the trends that we found were really, really fascinating, but you know, I think we're ultimately left to sort of, you know, speculate a little bit on why incidents and outcomes have remained in a relatively stagnant, and certainly we didn't dive into things around, you know, adhere, you know, adherence to protocols or bundles and sort of outcomes, so you know we weren't able to dive to that level.

Traci Wolbrink *24:36*

That's great, and I think that sort of, you know, puts me into the next question, which are, you know, what are the next steps for you and your co-investigators? What do you hope to do following up on this study?

Frances Balamuth *24:48*
So I think, you know, on a practical level, I think one of the big goals of this study were as to was to develop kind of surveillance tools that other hospitals could use at their, could use locally, so part of what we developed with this was a tool kit that hospitals could use to develop their own surveillance system, kind of most easily adapted with Epic, if you have Epic, because that's the kind of coding was written largely with Epic as the most common EHR, but I do think this will allow hospitals potentially to track outcomes of patients better, even with sepsis quality improvement initiatives. So, some of what Chanu said in the beginning, around, you know, most hospitals will track kind of antibiotic timeliness, fluid timeliness, bundle compliance in this kind of suspected sepsis population, but then, if we want to look for outcomes, you know, we really care about what happens to the ones who truly had it, and so this is a way where hospitals could say, okay, we're going to track our kind of, you know, timeliness metrics in a broader population, but when we're looking at outcomes, we could implement this kind of more, more stringent surveillance definition that might help us to see, you know, if our, if our strategies are working in a more effective way.

Chanu Rhee *25:52*
Yeah, so I think, I think I would certainly hope, and that hospitals will, you know, begin to incorporate pediatrics, sepsis event surveillance. I think, sort of from a research standpoint, I know Fran has lots of ideas as well, but you know, for me, I think potential next steps will be using this framework to better understand variation in pediatric sepsis epidemiology and outcomes across different populations and hospital settings. I think that would be very interesting. I mentioned before the hospital onset sepsis angle, and again, how sort of striking that over a quarter of cases appeared to be hospital onset sepsis, as you'd expect, they're associated with higher crude mortality, and so I think you know, and because it's happening obviously once they're under the care of a hospital, I think we have a particular responsibility to try to prevent as many of those as we can, so I think that's a really important and under-explored area for future investigation. And lastly, I would just highlight one other thing, which I think you know I'm very excited that you know certainly in adults we are moving more towards sort of a outcome, sort of a focus on outcomes in sepsis. So, what I mean by that is, you know, in adults we've had the national focus around sepsis quality and policy has really been around process, particularly through the SEP-1 bundle that's been around since 2015 and you know, I've certainly sort of been a critic of SEP-1. I'll acknowledge it up front, but I think what I would say is that, you know, certainly done a lot of good. It's raised a lot of attention. I think a lot of stuff, similar stuff has happened in the pediatrics world, a lot of, lot of focus on early recognition and treatment, but what I'd love to see is the field go more towards outcome-based measurement, so that yes, of course, the early bundles are important, but I think sort of having a robust, risk-adjusted outcome measure can really shed light into, you know, which hospitals are actually, you know, doing well overall, maybe beyond just the bundles, but sort of through comprehensive care throughout a patient's hospitalization, which ones might be dealing with the worst, and sort of, you know, are can we, can we target for, you know, more attention to sort of improve on their practices, and you know, in adults, we are, you know, we've been collaborating with the CDC and CMS. There's interest in developing a risk-adjusted mortality measure. Obviously, we're a bit behind on children now. We just, you know, came up with this pediatric sepsis

event definition, but long story short, I would love to see more work in that space begin to move towards a pediatric sepsis mortality measure.

Traci Wolbrink *28:35*
That's excellent. I'm curious, if there's anything from the study that really surprised you, any findings, or anything that was, you know, unexpected or different than you had planned.

Chanu Rhee *28:46*
I'm trying to remember, Fran, our group's reaction when we saw the trends over time. I mean, I think maybe I would say probably many of us were hoping to see a bit more of a decline in mortality rates, and so I'm not necessarily.. I wouldn't say I'm surprised because we saw something similar when we did our adult burden study, where we saw that incidence and mortality were largely flat, so, but that I think that's one thing where, again, maybe we were hoping to see sign more encouraging signs, and we didn't.

Frances Balamuth *29:22*
Yeah, and I think maybe this is not surprise, but just kind of underscoring again the mortality rate in Phoenix sepsis is really kind of a little bit different, I think, than what's been conceptualized in prior definitions of sepsis, and so thinking about that, and what the impact of that will be, you know, moving forward, right? Like, are—there certainly are sick children who have degrees of organ dysfunction that don't meet Phoenix criteria, and you know, does that mean, do those patients, I mean, yeah. Kind of, do we need to think about those patients in a different way? I think will be interesting moving forward.

Traci Wolbrink *29:55*
Any other lessons that you have, lessons learned for our community to take away from our findings that you haven't already mentioned, or anything that we haven't talked about that you want to make sure gets discussed here?

Frances Balamuth *30:07*
I mean, I think I feel like I say this in every sepsis study I work on, but I feel like, you know, sepsis is such a team sport that I think having such a varied team, you know, like I think you know Scott Weiss, I think from Peds Critical Care, and then having Chanu and Mike from the adult world who'd had the kind of the original lens, and then all the people who contributed to both kind of the candidate definition, the chart reviews, and then all of the, you know, EHR kind of coding work on the back end really does, you know, sepsis is a complex phenomenon that I think takes a lot, a big team clinically in the hospital at the bedside to take care of the patient, and I think studying it because of that complexity is also takes a big team, and it's, it was cool to see all of that come together.

Chanu Rhee *30:49*
That's a, that's a great comment, Fran, and I'll just add, maybe just take this chance to emphasize again, you know, why you know that measurement, measurement really, really matters, and you know, I think just emphasizing, if we, if we really want to improve, you know, sepsis outcomes at a population level, you know, we really need, you know, reliable and standardized ways to track the problem, so we can understand if our interventions, you know, are really moving the needle. What's working and what's not working, and you know, again, our study, our method is not perfect, but, but we think, you know, this hopefully takes us to a better spot than we were before.

Traci Wolbrink *31:25*
That's great. I think both of those are really important items, so I appreciate you sharing those, and I'm curious, if you have any tips again, going back to trainees, junior faculty, for those that might be interested in this kind of research, any advice that you might have for people to kind of get started, or tips or strategies for success.

Frances Balamuth *31:48*
Yeah, I mean, I think, do it, you know, doing research on electronic, like on data that exists already is often a nice place to start for someone who's kind of tipping their toe into research, and that you don't have to, you know, prospectively collect data over a period of time. It certainly has, you know, its own levels of complexity. It's never as easy as it seems like it's going to be from the start, but I do think that, you know, finding good mentorship is always key, and I do think that there are these kind of increasingly rich data sets and tools to handle, you know, big data that, where we can learn a lot. So, I think there is a ton of possibility kind of in this EHR data space as we move forward.

Chanu Rhee *32:24*
Yeah, admit that I totally agree, and maybe I would add, just, you know, I encourage my mentees. So, first of all, choosing a good mentor, absolutely. And then I think choosing a good question is obviously really critical, and not being afraid to look at things that maybe are thought to be settled science. If you have an interesting sort of angle or an interesting hypothesis, you know, I think I would encourage, you know, trainees to obviously, in consultation with their mentors, but not, not to be afraid to take on questions that are, that are potentially controversial, or you know, again, that sort of go against the common thinking, and if I could use that to just mention, you know, when I first started this line of research around sepsis surveillance, I mean, it took some time to get off the ground. We had some, some pretty bad rejections from some of the journals that some of our initial studies, and I think part of it, in reflecting on that, I think it's because, you know, sort of went against the common wisdom of the time. There were, you know, all the studies were sort of based on ICD codes and sort of talking about this ginormous ballooning of sepsis incidence over time, but also sort of dramatic declines in sepsis mortality rates over time, and sort of I was sort of coming at the angle with that, you know, some of that, or a lot of that might be ascertainment bias, and we need to sort of think about more, you know, rigorous and objective surveillance methods, and again, I'll say, I'll say, you know, it was not very well received at some of some other journals when we first submitted it, but yeah, I'm certainly glad you know I persevered on that, and it's sort of, you know, led to, I think, you know, for me, a very rewarding, you know, body of work over the past decade and more so.

Traci Wolbrink *34:05*
Well, that's great. I think, you know, you're both describing, you know, finding something that you're passionate about, finding good mentors, sticking with it, you know, one foot in front of the other every single day to kind of build this, this career, and I really appreciate both of you taking the time today to come and talk with me and share your experiences, share the findings from this study, and some really important tips for getting started, as well as for mentorship. So, thank you both for participating in this podcast and being our guest speakers today.

Frances Balamuth *34:36*
Thanks so much for having us.

Chanu Rhee *34:37*
Yeah, thanks so much for having us.

Sarah Marcley *34:39*
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Articles Referenced:

Rhee C, Balamuth F, Dysart K, et al. National Estimates of Pediatric Sepsis in US Hospitals Using Clinical Data. JAMA. 2026;335(15):1321-1331.