BBGuy Essentials 073:
Implementing Trauma Whole Blood with David Oh and Mike Goodman
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David: This is David Oh from Hoxworth Blood Center in Cincinnati, OH, and this is Blood Bank Guy Essentials Podcast.

Joe: Hi everyone, and welcome back to Blood Bank Guy Essentials, the podcast whose one and only job is to help *you* learn the essentials of Transfusion Medicine. I'm Joe Chaffin, and I am your host. Today's episode is a discussion of how one large hospital and their local blood center worked together to implement low-titer, cold-stored, group O whole blood for trauma transfusion in their facility. I'm so excited about this interview, and I really think you are going to love it!

But first, you should know that this is NOT a continuing education episode. You can find other episodes where physicians and laboratorians can get those free continuing education credits at BBGuy.org/podcast. Just look for episodes there that end with the letters "CE." Simple, right? You can also find those continuing education episodes at wileyhealthlearning.com/transfusionnews. The continuing education episodes at Wiley Health Learning are brought to you by transfusionnews.com and Transfusion News is brought to you by Bio-Rad, who has no editorial input into this podcast.

In December of 2017, I released episode 040CE of this podcast, an interview with my friend Mark Yazer on using low-titer, cold-stored, group O whole blood for trauma transfusion. That episode has been one of my most popular, and over the past two years, more and more trauma surgeons have come to hospitals and blood centers and asked (sometimes politely, sometimes not quite so politely), "when can we have whole blood for our trauma patients?"

One facility that recently implemented this product with great success (by the way, I'm just going to call this product "trauma whole blood" to save words. I hope that's ok with you!) is the University of Cincinnati Medical Center in Cincinnati, OH. The drive to implement trauma whole blood there was led by a trauma surgeon and transfusion committee chair named Mike Goodman as well as the medical director of the transfusion service and the local blood center, which is Hoxworth Blood Center, that's Dr. David Oh. I am truly honored to have both of these doctors on the podcast today to tell us how they did it!

Before I tell you more about them, please keep this in mind, which is really important: What you are about to hear is how THEY did it in Cincinnati. Mike and David and their teams made some very specific choices, and they are going to outline them for you, that your hospital and/or blood center may not make (down to even whether or not to even bring the product in!). This is not meant to be a recipe and it's not meant to be a mandate either, it's rather one example of how implementing trauma whole blood CAN work.

Dr. Mike Goodman, my first guest, trained in general surgery at the University of Cincinnati. After a fellowship in surgical critical care at the University of Texas Health Science Center at Houston, he returned back to the University of Cincinnati, where he now serves as an Associate Professor in general surgery, trauma and surgical critical care. This position has allowed Mike to continue basic and clinical research, focusing on the relationship of coagulation to post-traumatic inflammation, especially in the setting of traumatic brain injury. Clinically, he serves as Chair of the Transfusion Safety Committee and focuses his clinical research on the appropriate resuscitation and care of the injured patient.

Dr. David Oh, who is my second guest, is the Chief Medical Officer of Hoxworth Blood Center in Cincinnati, where he has worked since 2017 after 13 wonderful years in California at the San Diego Blood Bank first, and the Stanford Blood Center. David trained in pathology at the Cleveland Clinic, and in Blood Banking/ Transfusion Medicine at the BloodCenter of Wisconsin. David has served in numerous leadership roles in the California Blood Bank Society as well as Blood Centers of America and America's Blood Centers.

So get ready for a super-practical look at how one facility implemented low-titer, cold-stored, group O whole blood for trauma transfusion. Here's my interview with David Oh and Mike Goodman from Cincinnati.

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Joe: David and Mike, welcome to the Blood Bank Guy Essentials Podcast.

Mike: Thank you.

David: Thank you.

Joe: So great to have you guys here. This is really a cool opportunity for me to get the chance to talk to both of you about how you implemented low-titer group O cold-stored whole blood (that's a lot of words!) at Hoxworth Blood Center and the University of Cincinnati. So I've already given everyone a little bit of background. So let's just hit the ground running. Mike, I wonder if you'd just start by giving us just a quick thumbnail of your trauma service there at the University of Cincinnati. What kind of things do you do? How busy are you guys? Things like that.

Mike: Sure. So, we average about 4,200 trauma activations a year, leads to anywhere between 20 and 40 patients on our service at any given time. And, when we looked at starting this process, looking at our own data, we do about 110 massive transfusion protocol activations a year.

Joe: Obviously before this point you were doing the kind of what's become traditional anyway, the "1:1:1" type of transfusion ratios?

Mike: Yeah, absolutely. So we were lucky enough to be involved in both PROMMTT and PROPRR and really started with the 1:1 as we went into PROPRR and have never really changed since then with the 1:1:1 transfusion.

Joe: I've mentioned to people already that trauma surgeons everywhere are hearing lots of things in your national meetings (and I'm assuming regional meetings) and literature about low-titer group O whole blood. So why don't you tell us a little bit about where your interest in that started and how you first...how it first came on your radar?

Mike: I think it's just, as you said, it started at national meetings and being involved in trials like the PROPRR trial, being one of nine centers in massive transfusion trials, and being sort of a mid-major program in a Midwestern city and just trying to keep up and stay at the leading edge of transfusion and trauma resuscitation. We felt like it was time to try to make the move. Simultaneously, we also have a mirrored basic science side, with blood research, that was right at the cusp of looking at whole blood, working with Phil Spinella and Warren Dorlac, we had a basic science project for testing leukoreduction with whole blood, and that actually dovetailed very nicely into our clinical initiation of the whole blood program.

Joe: When I told people that I was going to be talking today with a trauma surgeon and a blood center medical director about this program, one of the things that people shot back to me on social media, Twitter in particular, and I want to ask you this question: How do you view at this point in time, the use of low-titer, group O whole blood in the trauma setting? Do you view it as "investigational" still, or do you view it as...I guess the question is, is this something that we should be studying as we go forward or do you feel like the die is kind of cast?

Mike: Well, I think it's a standard that we forgot about. And I know you've done other interviews with Mark Yazer and talked about the history of the whole blood, and I think we forgot about it a little bit. And as we get back to it, I think that certainly the military data and civilian data that's come out of really the last couple of decades with resuscitation, I think we still owe it to ourselves to look at our outcomes and go forward and look at prospective trials, because I think we don't quite know who to give it, when to give whole blood, how much to administer to each patient, and what kind of stock you need, and what wastage is appropriate at each center.

Joe: I'm assuming that at least informally, you're evaluating those things as you go forward. We'll get to all the stuff that you've looked at in your transfusion committee, etc. But is it safe to assume that you guys are going to at least take an informal look at that at your center?

Mike: Absolutely.

Joe: So David, I wanted to bring you in and didn't want to ignore you, my friend! Obviously, the provision of low-titer group O whole blood involves some fairly heavy blood center work. But first, why don't you tell us just a little bit about Hoxworth Blood Center in Cincinnati?

David: Sure. So Hoxworth Blood Center is the really sole provider of blood in this area, the tristate area. I believe we service 31 hospitals in 19 counties. So it's great, because we actually have a perspective in terms of vein-to-vein administration and

follow up. The other great thing about being here at Hoxworth is I'm actually the transfusion service medical director at UC Health, and so I'm able to work intimately, not only on the blood collection side of things, but also in the transfusion administration experience, and to be able to work with Mike in terms of bringing whole blood to UC Health.

Joe: So why don't you tell us a little bit about how this came on YOUR radar, David, either before Mike started talking to you, or at what point did this become a thing for you that you figured, "We've got to try and take this on?"

David: It actually was very fortunate. I was at San Diego Blood Bank for a number of years and then at Stanford for about four or five years. And then came to UC Cincinnati area in October 2017, and my very first meeting with Dr. Goodman, he said, "Hey, we'd be interested in implementing whole blood. What do you think?" And I thought it was a great idea. There had been a lot of interest in the area and with a group of clinicians that are very interested in implementing a new technology like this, it was a great opportunity for us to go ahead and implement here in Cincinnati.

Joe: Mike, I want to come back to you for a second, and before we get into what David did at Hoxworth, you mentioned, I've already talked with Mark Yazer about this [NOTE: See BBGuy.org/040], but just for people that haven't heard that podcast, I wonder if you wouldn't mind thumbnailing from the surgeon's perspective, from the trauma center and the trauma room perspective, what is so great about whole blood?

Mike: So there are a couple of things. One is obviously the simplicity of it, a single unit of blood, 500 mL, so you're getting twice the volume of a red blood cell unit or a plasma unit. You don't have to hang another unit of blood. So you get the simplicity with twice the volume. And then really what we get concerned about from the trauma resuscitation side is the reversal of trauma-induced coagulopathy. Identifying those patients early and being able to reverse it early, not only with the whole blood itself, having the coagulation parameters of the complete blood product, but also having the platelet component, which even when we initiate 1:1, that platelet component, although we WANT to add it early, does come a little bit later than we would ideally like.

Joe: Logistically, is it simpler for you?

Mike: Absolutely. When we look at it in the trauma bay, we have a Level I transfuser, so we can hang two units of blood up next to each other. I joked previously, in 1:1, I joked that one side's for red stuff, the other side's for yellow stuff being red blood cells or plasma, but now we can just get whole blood as a single product. And actually, in initiating the process, we put a bright sticker on the blood that says "whole blood," trying to make these things sort of foolproof. But it's easier just to get one unit of blood. You know what it is. You're not thinking about what ratio are you giving, or when is time for the other product to be given? It's just the one product.

Joe: I've joked with people that I've never met a surgeon that doesn't like whole blood, but my understanding is that you've got a decent number of former military people or current military people practicing in your group. Was that some of the impetus for this as well? People that had come back from Iraq and Afghanistan with experience with whole blood?

Mike: Yeah, absolutely. We, even in our leadership, we have had a long history, since the "C-STARS program" started, (which is the Center for Sustainment of Trauma Readiness Skills [NOTE: See https://www.uchealth.com/education/c-stars/ for details]), we are lucky enough to be one of three centers in the country that work directly with the Air Force to train the teams that take care of patients in flight following their injury. And so we have active duty Air Force personnel embedded with us, including several trauma surgeons, and at any given time, we have one person usually deployed. And you know, I know the military has their mission. We try to match that mission pretty well. And when our deployed partners come back to the U.S. and to our practice, the military has their level of debrief and we sort of have our kind of research and clinical practice side of debrief. And so it used to be that the lessons we learned in civilian practice were then translated to the military. And I think in the last couple of decades, it's almost been the opposite, that we are able to provide extraordinarily high level of care through the U.S. Military and we try to mirror that back here with our military-civilian partnership.

Joe: That's fantastic. As a former Army physician, that warms my heart (except for the Air Force part. But that's okay. I'm good with that stuff. No, I'm kidding). Okay, well, I think that really kind of sets the table for what brought you guys to the place where you were having those discussions about implementing low-titer, group O whole blood. So David, I wonder if you would start us on how you, from the blood center perspective and, with your dual role as transfusion service director there at University of Cincinnati, how did you identify where you are going to go with this? How did you set out the steps that were going to be required to do this?

David: So, yeah, kinda took a look at the current state of blood products and whole blood use. And University of Pittsburgh, with Mark Yazer, Darrell Triulzi, they really have done a lot of work in the area. So kind of looked and saw what they did, and then proposed what would be most reasonable for the blood center to be able to provide, coming back to Dr. Goodman and the other trauma surgeons, and seeing if the characteristics that we felt were important and were reasonable to have with the whole blood would make sense and be acceptable for them. So really it's us kind of coming with a proposal of, "Hey, these are the characteristics we think we can provide to you," and seeing if that was acceptable for them.

Joe: Why don't we talk a little bit about those characteristics? Because as you know, David, and as I've talked about with Mark on a previous podcast, there are choices to be made. And again, I want to make it clear that the choices that you made may not be the choices that other places will make. Every center is going to have to make their own decisions on this. But there are some options as you go down the "choice tree," I guess you would say, in terms of how to make this product and how to provide this product. So why don't you talk to us a little bit about just the basics?

First, I want to make really clear, we're talking about temperature-wise, and I've said this, we're talking about "cold-stored" and not warm, fresh, whole blood. Correct?

David: Yeah. So that really was the first question, right? So if you look at the military model, my vision of it, and maybe this is simplistic, is a "walking blood bank," right? So, you need blood, you check the dog tags, you draw blood from an O donor, and then provide that. You know, no infectious disease marker testing, you give that to the guy who needs it right away as whole blood. That's a very different product than what we are providing now. And what I think in in the States, is the "typical" whole blood product.

So it is cold, it is not warm, fresh, whole blood. We do infectious disease marker screening and testing on all of these units. So, the risk of transfusion-transmitted infection like HIV or hepatitis is markedly decreased, about one in 2 million units because of the infectious disease marker testing that's performed.

So I think that was really the first decision that we made and the trauma surgeons and the blood transfusion committee understood that that was important for us to maintain. I don't know, Mike, if you have any comments on that?

Mike: I mean, you guys are right across the street and we, you know, we buy the blood from you, but I'll take what you can give me. I don't think that we have the logistics of warm blood and the timing. And I think when you look at it from a military standpoint, certainly...I have never been in the military myself, but when they initiate fresh, whole blood, they're usually already some blood into that resuscitation, which has been cold and stored and they have ongoing bleeding and then they get into the whole blood. And so the timing of it is something that we can't quite replicate on the civilian side.

David: Yes. So then the next, I think major decision point was whether we provide O positive or O negative units. And just from an operational, realistic, practical standpoint, we decided to provide O positive, because inventory management would be incredibly difficult if we're using O negatives for this particular product. And I think that that was an understanding also that the transfusion committee understood.

Joe: So David, just to be clear on that, because that is actually one of the questions that I got on Twitter as well, is whether you were, whether you had chosen to use O neg or O pos. Can you be a little more clear with me on why the inventory challenge would be so significant if you were trying to do O neg?

David: Sure. So I actually just attended the first national summit on whole blood use in San Antonio about a week ago. And Darrell Triulzi, a speaker from Pittsburgh actually asked the people there a great question. He said, "What percentage of people walking through the door do you think would be eligible that we would collect an O positive whole blood unit?" And if you just, on a "back of the napkin" calculation, have a hundred donors walk through the door, we are probably going

to use male donor blood (and we'll talk about that as we kind of go into the characteristics as well), but about 50% of the donors will be male, so those are the ones that we want to use. About, you know, 40-50% will be O pos. So you take out of the hundred donors who walked through the door, 20 to 25 were going to be eligible for O pos whole blood.

And then the other big thing that we do is, when we have an O pos or O neg donor who we KNOW is O pos or O neg, so a repeat donor, we will try to steer them to automated collection so that we can get a double red collection, you know, if at all possible. So that could be another third of your donors. So you go to about 10-15% of your donors who walk through the door, who would be eligible for O pos. And then if you look at O neg, it would be another, you know, 10% of that. So about two donors walking through the door would be O neg. And so that's a very difficult thing then to provide to the whole blood program. And then knowing that the vast majority of those would go to O pos recipients, and not be going to people who really need the O neg units.

Joe: And the blood bank nerd in me can't help but just making sure that everyone understands, why can you NOT use an apheresis product, an automated collection, as you said, in this program?

David: Yeah. So what they really want us the whole blood. So they have the plasma component and the platelet component. And so when we collect by a machine, if people are familiar with the way you donate, you either collect whole blood or you can collect with automation. If you collect with the machine, then you're really collecting just those components and kind of defeats the purpose in terms of the whole blood program.

Joe: So, you've got a cold-stored product that is fully infectious disease tested and is group O positive for reasons that you've spelled out. You had some further decisions to make. One of the big ones that places are working back and forth with is whether or not to leukocyte-reduce this product. How did you guys come down on that?

David: I think it was in discussions with Mike, where we really wanted to know more about the current FDA-approved leukoreduced filter that spares platelets. And if that filter, even though the numbers of platelets would be spared, would affect platelet function. And the decision by many other groups, it was very cutting edge at the time, but was, I think, favoring not leukoreducing so that you preserve platelet function if at all possible. And so I didn't want to do anything to disturb the platelets that were present in the whole blood.

I think another part of that is, why do you leukoreduce, right? So, the main reasons are to prevent febrile nonhemolytic transfusion reactions. So sometimes people who are transfused with non-leukoreduced products have an elevation in temperature, and then HLA sensitization, and that's important sometimes when people become refractory to platelets. And so in this population of people receiving massive units of whole blood, it's unlikely that those two would be really that

critical for them. And so I think the decision to go non-leukoreduced, I'd stand by that and continue to do that going forward.

Joe: Mike, with your background, I know you do decent amounts of research on coagulation issues, did you see that as a concern as David was mentioning, in terms of the residual platelet function?

Mike: Yeah, so it was interesting leading into this, and interestingly, as part of our, uh, basic science research, my partner and boss, Tim Pritts, does a lot of blood storage research. Now, some people might say, "Whoa! What are trauma surgeons doing with blood storage research?", and, you know, we've worked faithfully with our blood banking colleagues in this. And you know, for those who are actually listening and really have no idea of the relationship between UC and the Hoxworth Blood Center, I got to say, I am incredibly lucky that I can walk...I didn't even have to walk across the street. It's rainy here today and I walked across an elevated tunnel or an overpass just to come over to the regional blood center. So we're very lucky in that relationship. We do a bunch of blood-related research, and the timing of it, like I said before, we started our clinical program, three months before we started the clinical program, we were at the tail end of studying the Terumo "Imuflex SP" filter.

And so the way that we actually got to start recruiting and identifying potential donors and how the system was gonna work, and David, correct me if I'm wrong, this is in my mind how it went, but we were then getting donated whole blood units and testing them, and we looked at leukoreduction versus non-leukoreduction. And interestingly, there are some early changes, just in looking at the platelet aggregation, but other coagulation testing is really no different, leukoreduction versus non-leukoreduced (hopefully that paper will be coming out here soon). But so, for us, from a coagulation standpoint, leukoreduced versus non-leukoreduced I don't think makes a tremendous impact.

The other thing that we have to remember is even though we're looking at leukoreducing to try to prevent some of the transfusion reactions, at the time that we are massively transfusing a patient, I can't tell you how much of that whole blood is staying in them until surgical control is obtained. And so in my mind, I think some of that risk of non-leukoreduced product is probably reduced because it's not even staying within the vasculature until we have surgical control.

Joe: And before we leave that, Mike...thank you for that. But before we leave that, I want to get your perspective on something that I talked about previously with Mark. Many blood bankers are operating under what I view as a false assumption (and I think is kind of being stamped out), but we have this vision of our platelet products that are sitting there in the blood bank staying at room temperature, getting agitated nicely and the thought, oh my goodness, that platelets would ever be COLD is like horrifying to us. But I wanted to get your perspective on the function of cold-stored platelets and what we know about that now.

Mike: My hope is that the research moving forward, especially out of Dr. Capp's lab and other researchers, hematologists, blood bank community, is that in the near future cold-stored platelets would be an FDA-approved product. Because I think that it's been shown that the coagulability, the platelet aggregability is actually much improved compared to that room temperature product, which was really standardized based on the longevity that that product remains within the recipient. Now, as a trauma surgeon, I only care about how that platelet functions NOW! I don't really care what's going to happen in 10 days and how long it sticks around.

David: So let me chime in because I know your audience has a lot of "blood nerds" in it. So we actually can make cold platelets today. Mayo Clinic was actually doing a trial, but their expiration was 72 hours, which is very restrictive to try to use this product. And Dr. Cancelas, who works here at Hoxworth (he's actually my boss), he has been doing a lot of research with cold platelets as well. So we share the same vision, that we would be able to use cold platelets in the future and actually have a lot of reason to think that they're actually more effective than platelets stored in the warm for actively bleeding patients. They don't stick around as long in terms of half-life. But for an actively bleeding patient, cold platelets are probably superior.

Joe: Excellent. Yeah, I'm right there with you guys and I just wanted to make sure that that was clear to our audience. So David, I want to come back to you. You were making your choices in the blood center obviously in concert with, with Mike and the trauma group there. So we've talked about cold, we've talked about infectious disease testing, we've talked about O positive, and we've talked about the fact that you guys have chosen to do non leukocyte-reduced. One thing that we haven't mentioned, we've thrown around the phrase "low-titer," and I wonder if you'd just quickly talk us through that, in terms of the choices that you made with how to define someone as low-titer in your facility?

David: Yeah, so one of the impediments to being able to fully implement a whole blood program was that we are compliant with AABB Standards, and AABB Standards were changed in, I believe, April of 2018 to allow transfusion services to be able to use whole blood from O donors as long as it was low-titer, but there was no explanation or definition of what “low-titer” meant. So again, we kind of looked at the real pioneers in terms of people who were implementing whole blood, Pittsburgh, Mayo, and a couple other places, and there was some variability in terms of what they considered to be low-titer. So a titer would be a dilution, in terms of diluting the plasma from the donor, and then seeing if there's any reactivity or agglutination between the patient's plasma at a certain dilution with the ABO blood groups.

And so, Pittsburgh was very conservative and used a 1:50 titer, and other places used a titer of 200 or 256. So we decided to use a titer of about 1:100. And there have been some people who, recipients who have had reactions in terms of hemolysis related to anti-A or anti-B antibodies in the literature of those related to fatalities that have been reported FDA recently. I believe there were four or five cases and the titers that they're talking about in I think four of those cases was a

titer of 1:2048. So that's about 10 times more than using a titer of 1:200. So, I think that for the blood centers that are using a titer in any of those areas is very reasonable no matter what the titer is, 1:200, 1:256. We decided to use a titer of 1:100 to be a little bit more conservative.

Joe: And, David, just to be clear, I didn't want people to freak out; those fatalities that you were mentioning, those were not fatalities with this particular product? Those fatalities were with platelet products, right?

David: That's correct. Exactly. And larger plasma volumes with those. Yes, exactly.

Joe: Got It. Okay. Okay. So we've got a product that has a titer of about 100 and...less than 100, I should say. So David, how are you managing those donors that come in? Are you testing them every time? Those group O donors?

David: Yeah. So some studies have shown that the variability of the titers does not differ much from one donation to the next. So one person will be expected to have the titer at about the same range between visits each time they come in. But to track that each time is logistically difficult, and we want to be able to grab O pos whole blood that comes through the door. And so we just test each individual unit as we decide whether to use that unit or not for whole bloods.

Joe: And what has your experience been so far? Do you have an idea of what proportion...

David: Our experience has been, yeah, it's been very low in terms of the number of units that we're not able to produce for whole blood, less than 5%, which is lower than the experience for a lot of other places. We do end up using the titer...so again, it's, it's not well-defined how you do the titers. You can take a plasma sample from the donor "neat" in a test tube and test that. We decided to test the actual blood product itself and a segment from that blood product. And so there is a little bit of dilution that occurs, and that may explain part of the reason that our titer sensitivity...that we don't seem to have as many positive units as we're doing our processing.

Joe: David, a couple of things and maybe we'll just do these rapid fire. What product did you choose in terms of shelf life, in terms of expiration?

David: Yeah, so we decided to do 21-day expiration, and I think there are a number of good reasons for this. Number one, we don't typically use CPDA-1, which has a 35 day expiration, which some blood centers have decided to use when producing whole blood. To do that, since we don't collect a lot of product in this preservative to begin with, we would have to, when we collect a unit, kind of know that it's going to be directed towards whole blood use. And we would prefer to be able to collect our blood products in whole blood the way we normally do for all of the whole blood collections we do, which is about half of our collections. And then once they get to our processing laboratory, be able to identify the ones that are O pos from males and then use those for production.

And I think the other reason I feel like a 21 day expiration is fine is that we really do think, or I do think that some of the benefit from whole blood is, is from the active platelets. And whether those platelets are active in whole blood stored up to 35 days versus 21 days, I am suspicious that the platelets may not be as active as you get later in storage. So I think to get the bang for the buck from the product that we want to provide, a 21 day expiration, I think was adequate.

Joe: Some of the facilities that have implemented this product, the low-titer, group O whole blood, the 21 day product specifically, have done some creative things to try and minimize wastage such as once the product gets to 14 days or so, if it hasn't been used, they'll pull it back and make a group O red cell product out of it. Did you guys have discussions about doing that, and what did you decide if you, if you did?

David: So we decided not to do any additional manipulation to the product at that time. With the close involvement and really expertise that is obvious with Mike and his group, we made the decision if they had cases going that it was likely they would use a red cell and a plasma in a standard OR setting, that we could go ahead and use those units instead of having them expire, go ahead and use the O units. We did initially, I think after we implemented in July 18, have some expirations, more than....It was a new product and ordering difficulties and just miscommunications. But in the last three months we've had actually zero expirations that have occurred with the O pos whole blood. So I think that's been a success for us in terms of working closely and using them appropriately.

Joe: CMV testing and irradiation, what choices did you make on those?

David: So we do not do CMV testing. We do not irradiate. Hoxworth actually does not do routine CMV serologic testing. Many people feel like when you leukoreduce a product, you actually eliminate the need to do CMV testing. These are not leukoreduced products, so conceivably there would be risk of CMV transfusion transmission, but that's very low. And typically the patients you really worry about that are severely immunosuppressed patients. This is a population of trauma patients for the most part. So that really isn't an indication for CMV testing. And then, irradiation would be again for severely immunocompromised patients, to prevent transfusion-[associated] graft vs. host disease. And that again is not a major concern in this population.

Joe: Yep. Bigger problems than either CMV or TA-GVHD...

David: Exactly. A lot of the...you know, these are people who we're hoping will survive for the most part.

Joe: And the last thing that I want to make sure we cover is, you've said a couple of times, "male-only" donors. And again, just please give us the quick thumbnail on why that choice.

David: Yeah. So, AABB Standards, again, any product that contains a "large volume" of plasma, you want to make sure is at low risk for having anti-HLA antibodies

because of the association with TRALI reactions. It's easiest if you just use a male-only population for this type of product. And actually it was also a request from our clinical partners because a lot of the studies have been done in male donor blood. And so, to try to remain somewhat consistent with those studies have been performed in the past, we decided to just go with male only donations.

Joe: So Mike, coming back to you, I understand, and David told me this, I'm just flabbergasted! I have to make sure that this is true, that you as a trauma surgeon are the chair of your transfusion committee at your hospital! Is this, could this possibly be true?

Mike: I don't really know how it became true, but yes, it's absolutely true. I went from being no part of the transfusion committee to taking over to a very well respected hematologist in the area. I feel like they just made the heavy users now the responsible users,

David: That's not a bad way to do it!

Mike: So yeah, I get to keep my partners and everyone else in check, and it's it's been an interesting appointment. But I feel like we've been able to drive some of the leading edge on whole blood with this position.

Joe: And I will tell you my perspective on that, Mike, all joking aside: I've sat in a lot of transfusion committees in my life, and I will tell you that my perspective is the ones that do the most good and have the most impact on practice in hospitals are the ones that are led by a clinician who is a champion of doing it well. So kudos to you, man! That's awesome.

Mike: Thanks. I thought it was a joke when they asked me.

Joe: That's fantastic! Oh man. Well, so I assume that while all this was going on and David was doing his work and figuring out, making his choices at Hoxworth, that you guys in the transfusion committee were making some choices, as well. So I wonder if you'd just talk us through a little bit what the transfusion committee's role in all of this was, how you brought it to them, what kind of decisions you guys were talking about?

Mike: Yeah. So I think it started with really having to do with my homework and David's predecessor, who I have to give credit to as well, Chris Carey, was a phenomenal resource...

David: Definitely!

Mike: ...in getting the ball rolling. And I knew as a clinician and as a scientist a little bit, I had to come to the table with data. And so, we built a portion of data that we presented to the transfusion committee as a proposal. And basically what we did was we went back, and I again can't underestimate the value of my support team, especially I have Mary Shannon who's appointed as an employee with UC Health, who really does all the daily grind on the blood data for me.

We looked and we found that we had 110 massive transfusions for trauma in all of 2017. We were able to then show that 80% of these were male. And, we had only 20% female, obviously, and even a lower percent of female greater than 55 years old. And, and in looking at it and trying to define how much whole blood we were going to try to provide, we actually looked at the rounds of massive transfusion protocol through which each patient went, and found that 75% of our massive transfusion patients were done being transfused by the end of the second round, which for us here is, each cooler has six of packed red blood cells and six of plasma. And so we figured 12 would be a good upper limit to at least start with.

Now, being the trauma surgeon and maybe just being interested in my own population, initially, I did propose to the transfusion committee that we at least initiate the program in the trauma patients, with the caveats being trauma patients only, only males, and then females who are above 55 to exclude the females of childbearing age. And then proposed that we look at our data as we go through this, making sure that we're transfusing the right populations and that we're being responsible about our inventory versus wastage. And we brought it to the transfusion safety committee. It was approved.

There were, interestingly, some other groups that were interested in trying to be involved in this. Cardiac surgery was interested. Vascular surgery was interested. But I was very interested in really just starting with one service line, making sure we're doing the right thing for the right patient before we extend it further.

After making it through the transfusion safety committee approval, we did have to go to our medical executive committee as well to get approved at the hospital. And, getting their approval was excellent and fairly expeditious for a medical executive committee. And, then we initiated the program July of 2018 and went live with it.

Joe: You had talked a little bit about the male, that you decided to give this to trauma patients only and males and females over 55. Was there any discussion, or is it implicit in that, about using it for pediatric trauma cases?

Mike: So interestingly, UC Health does not have or see pediatric trauma patients. Children's Hospital Medical Center, so Cincinnati Children's is right across a small street, and it acts as a great clinical divide. And so we actually, we don't see patients under, 14, and so we haven't had to, within the walls of UC Health answer that question. David may actually have better knowledge for whether or not there's been a request from Cincinnati Children's back to Hoxworth to implement whole blood for them.

David: So we meet very frequently with the physicians over in the transfusion service at Children's Hospital. Stephanie Kinney is one of the primary people over there. She's been great to work with. They have not felt, at this point, a lot of impetus towards moving towards whole blood from the transfusing clinicians. That could change any minute, and so we're ready to have the product available for them as

needed. Use of whole blood in the pediatric population has been much slower to adopt than in the adult population.

Joe: So Mike, let's get real practical with this. So let's say that you're the trauma surgeon on duty and a patient comes in, I'm assuming in most cases comes in with some warning, but the patient comes in and you're the one that's having to make the...I'm assuming you're the one that's having to make this decision about what product to use, whether to activate MTP, etc. Can you just kind of walk us through how that decision process goes and what the logistics are behind it?

Mike: Sure, absolutely. We are actually fairly lucky and I didn't realize how lucky we were until I started talking to other centers that we have a small cooler, small fridge just for blood in our emergency department. And we routinely have four units of packed red blood cells, two units of plasma down there. And so when a patient comes in, if they meet certain criteria, if their blood pressure's less than 90, heart rate greater than 120, if they have a positive abdominal ultrasound suggesting that there's free fluid or blood in their abdomen, or they show any signs of massive exsanguination, plus some laboratory values. We get a fairly good point of care INR, a whole blood INR as well as a base deficit. So a base deficit greater than -6 or a point of care INR greater than 1.5, those, as well as a hemoglobin less than 10, those are our massive transfusion triggers.

Now, if a patient meets those criteria, I know it's going to be a few minutes before the first cooler gets down to us, we will be able to grab some of that blood from the emergency department cooler and start hanging the blood. For the patients who maybe meet one criteria, and we want to do a little bit of blood, we do have the component therapy. For those who meet those massive transfusion triggers, now with our group, since we started whole blood, those are the ones that we're going to start by hanging the whole blood while we wait for that first cooler to come to us. It's two floors away. It's usually a two to three minute delay in request to receipt of the blood. But if they meet those triggers, I'm reaching for the whole blood first.

Joe: And forgive me, I may have missed this, Mike; the whole blood is there in that trauma refrigerator?

Mike: Well, so it's an interesting story too! As we started our process, again, I want it to be very conservative and a little bit restrictive about it. We spent our first six months without having the blood in the emergency department. We had a little more wastage than we would've liked...and we started to think of, and you asked about what do we do if the age is about to, or the blood's about to expire. So one of the things we talked about is as we get to 14 days, maybe we could put it down in the emergency department knowing that it will have greater utilization. So in January, we added the two units of whole blood down to our emergency department refrigerators. Since we did that and we've changed the number of available units; we started with 12, we pared it back to 6. Now with the two in the emergency department, we went up to 8 available. And, in the last three to four months we've had zero wastage of whole blood. We're actually probably going to step it back up to 10 units, because having that blood available is critical. And I

know there are centers out there that don't have the blood in the emergency department, but I'll tell you that is a critical difference maker for us.

Joe: David, I know that there are blood bankers out there right now that are listening to what Mike is saying and going, "Blood in the ED?" And thinking, "big headaches" and all that. Can you soothe their feelings a little bit? How were you guys able to manage that?

David: Well, we've had components in the blood refrigerator down there before. I think, you know, our job is to provide the tools that are needed when they're needed and where they're needed. So, yeah, there are headaches, but I think it's worth it to be able to provide this needed product for them.

Joe: So Mike, back to your process. So, if the patient meets that criteria, if they're in the criteria that you mentioned, the physical and laboratory criteria, as well as if they're a male or a female 55 or older, you make the call to do the massive transfusion protocol. You might use the two units of whole blood that are in the refrigerator, but then what does the blood bank send to you?

Mike: So for those patients, the next thing we get is a cooler with six units of whole blood.

Joe: And is that the end of the whole blood or do you have the possibility to get another cooler after that of whole blood? Or do you go to component after that?

Mike: So for now, we turn over to component after that. Now half of our massive...almost half of our massive transfusion protocol patients don't even make it through the first cooler, especially with our hemostatic resuscitation. We also felt like by that time we often have units typed and crossed, and we had a little bit of ethical and moral debate about whether low-titer, O positive whole blood should be sent out to a patient who you now have an appropriate type and cross available. And we decided that when that is available, which usually coincides with the second cooler, that we're going to go ahead and send components of the correct blood type for the patient.

Joe: And I think that's a more than reasonable thing to do. David, do you have perspective on that?

David: Yeah, I think that you have to be practical in your approach. I think that, you know, if we sent out a pack of six whole bloods and we get the type back, we're not going to retrieve two back because now that we know that they're an A right, with the initial issuing of the six. Typically before we issue any additional, we will have that type. And so if we do identify them let's say as an A, then yeah, we want to go to component-specific, ABO-appropriate products for them.

Joe: So Mike, let's be, again, let's be really practical about this, and I realize that some of this I'm asking you for your somewhat anecdotal feelings on this, but among you and your trauma surgeon colleagues, what is your perspective on how effective this has been? And, you've had a lot of experience prior to whole blood and now

you've had a decent amount of time with experience with whole blood. What differences have you seen that you can at least try and quantify?

Mike: I think the biggest thing, and again I get the reports at least monthly of all the massive transfusions, the number of products of each type of product they got, my gut tells me that we're using less overall blood, and we are certainly using fewer units of platelets and Cryo since we started this. So if the patient's tip into that second cooler of components, they aren't really getting to that third cooler at all. So I think we've been a little bit more hemostatic in this resuscitation by starting with the low-titer whole blood

David: Joe, from my perspective, even if there's no clinical difference, I think the ease of administration and it's such a hectic atmosphere there where they're, you know, calling in a massive transfusion protocol that that alone I think is beneficial in terms of going to a whole blood program. So I think we are very confident that for sure outcome is not WORSE going to whole blood. And so if we can make it administratively easier for our colleagues, I think there is definite advantage to that.

Joe: One of the things that several people were concerned about, and these are blood bankers, they wanted to know how are patients being looked at for the possibility of hemolysis, when you do find out they're group A for example, and they've gotten, say, eight units of group O whole blood. What if any steps are you guys taking to make sure that they're not hemolyzing?

Mike: So interestingly, we don't have any different steps than we did when it was component therapy. So we have, you know, obviously these are the most critically ill patients. They are going to have serial lab testing more often than not, they're getting daily to every six hour labs. But we haven't added any specific hemolysis testing to our daily clinical labs, because of the preceding clinical data that's been so strong that says that it doesn't necessarily occur.

Joe: I think that that choice is something that a lot of places have made. We're blood bankers, so we're, you know, incredibly compulsive about this stuff. But I get it, again, that your goal here is to try and save the patient's lives and, not that you're ignoring it, I'm not suggesting that you are, but your priority is that, and to make sure that the patient gets through the, you know, gets through your trauma bay surviving on the other end, right?

Mike: Absolutely. And I think it would be, it would certainly be interesting academically, maybe not necessarily pragmatic, to compare the amount of hemolysis that may occur from a whole blood unit versus giving an additional six units of component O positive red blood cells and plasma that's matched at the time, because I don't think we, if we weren't giving the whole blood, we would still be giving O positive red blood cells to these patients.

Joe: So guys, I want to, as we close our time together, I want to give you both the chance to just kind of reflect a little bit on this process, and, including where you've

come from, where you are at this point, and where you are interested in going in the future. And David, let's start with you. First, I guess, well, again, I'll just throw this open to you, but is there anything you would've done differently or that you learned from this process that surprised you and where do you see this going forward?

David: Thanks Joe. So I think, you know, we discussed, kind of before we started this podcast, things to talk about. And I think transfusion committee was one of the things that I came up with, as part of making changes and trying to improve the process of blood transfusion. And I think the importance of a strong leader like Mike for us in our transfusion committee really makes a huge difference for us to be able to do the things that we want to do.

So partnering with the clinical teams, making sure that we as the transfusion service as well as the blood provider are able to provide the things that they need to help patients I think is the key. So, for places that don't have that, I think if you can somehow try to develop a strong transfusion committee, you'll be able to implement these types of advances. I think it's very difficult for those transfusion services where there's just not a lot of interest from the clinicians to be able to introduce something like this. Who's going to administer it? Even if you set up a great program for whole blood, if no one knows how to order it or how to use it. So I think that education, collaboration, those are the keys, I would say.

Joe: Mike, what's your perspective on that?

Mike: I've learned a lot about "herding the cats!" So you know, it's interesting when you implement a new technology and like David's saying, we are incredibly lucky to have such a close collaboration both on the transfusion committee side, and then the other thing that it can't undervalue is our trauma performance improvement side, where we're able in a multidisciplinary setting to present our quarterly reports about how our whole blood is going, where have we missed some opportunities to give whole blood, where have, maybe, we slipped and given whole blood to patients who shouldn't have gotten it, who weren't trauma patients, which has occurred as we've progressed the process a little bit. And I think the thing of tremendous value that maybe we should have started back in July, but we started since January is, I actually now get a better balanced report of who got the whole blood, when did they get it, what does our inventory look like?

And, we have this data that's being sent to us every two weeks. So almost real time, we have a better handle of how much is there, who's getting it, who's at risk, who could have gotten it. And then, education! Education is just tremendous to the trauma group, to the emergency medicine providers, to our blood bank techs. I think it was one of the few things that I've really moved forward on a multidisciplinary platform to try to implement. And man, there are a lot of challenges within a health system of when you want to start something new!

Joe: And Mike, let me ask you this. Do you foresee this, you had talked a little bit about this before, but do you see this expanding out potentially into use in, for example, cardiac surgery, or GI hemorrhages, or OB hemorrhages in the future?

Mike: I think there's the potential when you look at the retrospective data that came out of Pittsburgh and Mass General showing that only vascular surgery as compared to GI hemorrhage and other types of hemorrhage didn't benefit from the 1:1 ratio. I struggle a little bit with what the right patient population is. Yes, we all want hemostasis, but we know that trauma-induced coagulopathy is a fairly unique process compared to other bleeding populations. I think it will move out there to other groups. I think that they will have to have a better defined patient, right? Not necessarily physical exam, vital sign, or lab values, but more coagulation testing parameters that really show that there's an existing coagulopathy that would benefit from this product. And I think the other arena that other centers have moved to that we've somewhat intentionally been cautious about is the prehospital environment as well.

Joe: Right. And that's probably a topic for another podcast, the prehospital, because there's a lot to cover there, but let's leave it there for now.

Guys, this has been an incredible honor for me to talk to you today. It has been really enlightening. Thank you so much for sharing your experience with us, both from the clinical side as well as the transfusion service and blood center side. It's been great! Thank you both so much.

David: Thank you very much.

Mike: I appreciate you having us.

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Joe: Both Dr. Goodman and Dr. Oh are busy guys, so I'm very grateful to them again for their time. That was a blast! I admit, there are a few things we didn't have time to cover, like how to update your computer systems to handle trauma whole blood, or even how to update your protocols, but I think what we did discuss should help you get started if you really want to do so. Again, this is not meant to be a recipe, as I said at the beginning, but just a place to start for those who are interested in doing that.

Now, as always, you can hear past and future episodes of this podcast directly on the website at BBGuy.org, or you can go to Apple Podcasts or Google Play or Stitcher Radio, or Spotify, or really anywhere you find your podcasts. I really appreciate all of you who have given this podcast a review, especially the ones on Apple Podcasts, and especially to those of you that have subscribed. I'm deeply grateful. I do read all those reviews and appreciate the kind words you've given, and Apple also uses them to suggest the podcast to other learners, so thank you for that.

The next episode, which is coming in a couple of weeks, is a continuing education-eligible interview with my friend Dr. Chris Tormey from Yale. Chris and one of his fellows wrote an amazing article in 2018 on the ins and outs of irradiation and transfusion-associated graft vs. host disease, and I interviewed him about both those topics. The discussion is just jam-packed full of really useful info, so I hope you check it out!

But until that day, my friends, as always, I hope that you smile and have fun and above all, never, EVER stop learning. Thank you so much for listening. I'll catch you next time on the Blood Bank Guy Essentials Podcast.