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Series: Mild TBI Diagnosis and Management Strategies

Session: A Prediction Model of Military Combat and Training Exposures on VA Service-Connected Disability: A CENC Study

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Dr. Ralph DePalma: It’s a pleasure today to introduce Libby Clara Dismuke a PhD who’s a Research Service Specialist in the VA Health Economic Research Center. She’s the PI on the health economics study for the LIMBIC DoD Symposium and she’s also funded by other NIH, VA, and DoD grants. She’s done research and has taught in Portugal collaborating with the Ministry of Health. She has also been active in helping us get coding of primary blast injury as a code or ICD-10. She’s joined by her associate Barry Eggleston who’s a Statistician who will be discussing some of the methods. And he is a Statistician at the Research Triangle Institute in Durham, North Carolina. Libby.

Dr. Libby Dismuke: Thank you so very much, Dr. DePalma for inviting me to present today. And I am grateful to be here with Barry Eggleston who is the lead author actually on this study, due to his very innovative methods. And I am also honored to represent the Health Economics Resource Center at the Palo Alto VA and thank them for their support. As well as the CENC LIMBIC team who is headed up by Dr. David Cifu.

So today what we would like to do is acknowledge first of all the VA and DoD funding that has gone into all of this work.

And also all of our coauthors, in addition to Barry and myself who are a tremendous team and brought tremendous amounts of work to this study.

Our study has been already published in the journal called Brain Injury and you see that reference for anyone who wants to read the study in detail. So based on some of the previous work that we had undertaken for CENC, the Chronic Effects of Neurotrauma Consortium, we became interested in what were the potential associations or impacts of various military exposures whether in combat or in training with VA service-connected disability. We are in the context of a study relative to traumatic brain injury but the cohort as you see, we have some of them have mild traumatic brain injury, others do not have mild traumatic brain injury. And we wanted to understand the independent effects of the military and combat exposures.

So the first slide I’m showing you is just the, to give you the sort of idea of the type of impact exposures that our military do undergo in their careers as military service members. So the first slide you see is a tank blast exposure which you can almost feel just looking at this slide of how powerful it is.

The next one is artillery exposure. So these are weapons that are being fired obviously sometimes in combat but also in training. So all of these things you’re seeing are done constantly in training in order to be able to deploy them in combat by our military. So looking at the, just the photos you can see that there’s this tremendous impact.

The third one is what’s called a mine-clearing line charge. And so this weapon on the left-hand side makes all of this fire and smoke on the right-hand side. So you can only imagine what the impact of that force, blast waves will be from that. And again these are all used in training as well as in combat.

So the outline today of our study, we’ll present is in this sort of typical study order.

And I wanted to give you a little bit of background on traumatic brain injury if you’re not aware. There’s a very simple definition, a very complicated diagnoses, so it’s just an event in which an external force disrupts the normal function of the brain and could cause some sort of alteration of consciousness, loss of consciousness, seeing stars, various consequences in the immediate. Depending on what happens to the individual it then becomes categorized as mild, moderate, or severe based on the loss of consciousness or the type of alteration of consciousness, post-traumatic amnesia, or also on imaging, when imaging is done often findings from imaging will lead it to become moderate or severe traumatic brain injury. But even mild traumatic brain injury can be associated with many different short and long-term consequences, physical, cognitive, behavioral, and emotional dysfunction including personality changes and mental health disorders such as depression.

So it’s a very important injury and it has been identified as a significant injury in the post-Gulf War conflicts which we’ve been going on now for 20 years. And so roughly an excess of 384,000 service members have been diagnosed with TBI since the year 2000, about 82% are categorized as mild. Sometimes people call that concussion. We do know that while deployed military service members, it’s been documented over and over in the literature, are at risk for improvised explosive devices what’s commonly known as IEDs, landmines, mortar rounds, grenades, incoming fire, and so forth. There also other types of injuries such as motor vehicle accidents, falls, and assaults that they are exposed to. We also know that, and this is what we’re going to be highlighting today as well that hasn’t been studied really in the literature is the training exposures. The training exposures when they are on military posts in the United States training to be deployed. So many OEF/OIF/OND post-Gulf War combat Veterans who have had at least one mild TBI experience persistent symptoms over a short or a long period of time for which they are seeking health care. But the VA databases that we have access to, the administrative data does not contain normally the mechanism of injury of the individual.

So what is, what are we studying here that long-term outcome. Well the outcome that we’re very interested in is the VA service-connected disability rating. Why is this important? Well service-connected disability ratings in the VA are done by pension and compensation, physicians who are specifically trained to evaluate Veterans for all the potential service-related disabilities they may have. That is things that may have occurred in service whether an injury or some sort of illness that they may acquire in training or in deployment while they are serving their country in the military. In about, in 2016 the VA spent $64.71 billion dollars in disability compensation to about 4.4 million Veterans. So it’s also a very important economic question, service-connected disability. A combined disability rating that a Veteran will receive will go from zero to 100% depending on what they have been assigned. So Veterans can be assigned disability ratings for various conditions like TBI or PTSD or post-traumatic stress disorder, for other types of injuries they may have incurred, injuries to their ear, injuries to their physical limbs, so amputations and so forth. It is also important because Veterans who have been assigned greater than 50% service-connected disability don’t have copayments in the VA. So the ones who do have less than service-connected, 50% service-connected disability in the VA will have to make copayments. So again it’s another economic impact on the Veterans depending on their service-connected disability rating. And we know about 76% of Veterans with 100% service-connected disability rating have used VA health services.

So the objective of our study, I apologize for going too fast there, was to create and test a model of the top military and training exposures that predict service-connected, greater than 50% service-connected disability among Veterans who were combat deployed in either OEF that’s Operation Enduring Freedom in Afghanistan, Iraqi Freedom in Iraq, or Operation New Dawn, and now there is another new operation since that; with or without a history of mild traumatic brain injury.

So we’re going to have our first poll question here to help us presenters to understand who our audience is. So we want to know, what is your interest in Veteran traumatic brain injury? Are you a clinical provider, are you a compensation and pension provider, are you a health services researcher, or a basic sciences researcher, or a clinical sciences researcher?

Whitney: All right. Thank you, Libby. So the answers are streaming in. Just to keep everyone aware that if you are having trouble selecting a poll answer, please exit out of full-screen mode and you should be able to select an answer at that point. All right. Seems like things have slowed down and leveled off so I’m going ahead and, go ahead and close the poll and share the results. So, 58% of those who answered said clinical provider, 0% compensation and pension provider, 19% health services researcher, 8% basic sciences researcher, and 15% said clinical science researcher.

Dr. Libby Dismuke: Great. Well we’ve got a nice distribution there of different types of researchers and clinical providers. So that’s great, great to hear. So let me tell you a little bit about the general study from which this study is based. So there was a huge study called the Chronic Effects of Neurotrauma Consortium that has a longitudinal piece. And the PI of this particular study is Bill Walker who was also on our study of course. And they began enrollment in 2015 of individuals in the Iraq or Afghanistan theaters of war. And the initial data came from four VA Medical Centers in Houston, Richmond, San Antonio, and Tampa. And eligibility was based on being greater than 18 years old, combat deployed to Iraq and Afghanistan after 2001, and exposed to combat based on a combat score that is used the DRRI-2-D. They did exclude histories of moderate or severe TBI because they were concerned with mild TBI and any major neurologic or psychiatric disorder.

They used in this study some very important tools to get a really gold standard identification of mild TBI which can often be challenging. So they used the lifetime potential concussive events instrument which is from the Ohio State University TBI Identification Method. And they used their own developed tool at Virginia Commonwealth University, which is the academic institution that houses, home of the CENC and also the LIMBIC study that is now going, at Virginia Commonwealth. So this Virginia Commonwealth instrument which is used to potentially diagnose each blast-related and non-blast related potential concussive event, PCE, as a mild TBI based on the DoD/VA common definition. And this has been published elsewhere, information on this longitudinal study by Bill Walker and colleagues. So the outcome of interest here was service-connected disability which we obtained from the VA Computerized Patient Record System, CPRS, for those of you who are in the VA, to give us the total percent service-connected disability amount in, from that field. We did dichotomize again based on being greater than or equal to 50% service-connected disability because of that cutoff for copayment, that’s a critical cutoff, in order to model service-connected disability.

So these, is the list of the exposures that were obtained by the CENC study. They gave the Veterans in the study a checklist to go along and tell them whether or not they had been exposed to any of these particular weapons or other types of exposures and how many times they had potential, total number of exposures and also the potential concussive events from those exposures. So you can see in this table and the following table all the different types of, there has been work in the literature talking about blast and non-blast but this is the first study that we are aware of where we have been able to get into very specific types of weapons. So we’ve got everything from bombs to C4, grenades, IEDs, blast, landmines, other types of detonations.

And if you look at the following table, and this is where I need to correct an error. I had several of these repeated in the slides that you have but they are corrected now in the archive slides. So you may want to get those. Mortars, rocket missiles, training in general. Also the different type of exposures whether or not they lost consciousness. Falls, dazed, so the type of alteration of consciousness they may have had. And the number of combat mild traumatic brain injuries. So all these exposures will go into the model. And the next thing I would like to do is introduce my colleague Barry who actually is going to explain to you how he used machine learning methods to be able to include all of these exposures to look at their impact on service-connected disability. So Barry I’m going to turn it over to you.

Barry Eggleston: Thank you, Libby. Yes and when we were doing the modeling of, for this project an initial modeling goal was to identify a modeling type, a particular type of model that would fit this data well or predict this data well. As well as identify a set of predictors that would be very useful in that model. And so going into this analysis we didn’t know which model type would be best. And we didn’t know, we didn’t have any clear understanding of what the exact set of predictors to use in our machine learning model. And in those situations, machine learning methods can be very helpful. So in the process that we followed is, in this project, is illustrated in the diagram. We took the CENC data and as a team we discussed and identified a set of variables, a set of predictors that we thought would be very useful for predicting percent SCD. Once we worked through the issue of selecting a subset of variables, because even though machine learning methods can really dig into data and find patterns that are very much data-driven, it’s not the case where you just want to throw everything and anything that you can think of to it. It really makes sense to think about what predictors you’re going to use and consider. So once we selected the subset of predictors from the CENC database that we wanted to use we moved onto a data preprocessing step. And these next steps the preprocessing, tuning, validation, and deployment these are standard steps in machine learning tasks. Within the data preprocessing step in that we covered issues, or took care of issues such as handling, identifying and assessing and handling the issue of missing data. You know in such cases we may have wanted to use a variable but unfortunately it was so, it had so much missing data that we had to exclude it. There’s also the issue with machine learning models, lots of times or if nothing else the software that you use, when you fit a machine learning model you have to process a categorical data, a variable. So the process that we did was convert categorical variables to a set of indicator variables. So if you’ve got a categorical variable that’s three levels you’ll create two indicator variables, two or three depending on what kind of, what model you’re going to use. Where those three or two indicator variables completely identifies the three different groups that you had in your original categorical variable. Also machine learning models, not all but many machine learning models require you to standardize the variables, if you’ve got a continuous variable so you center it at zero and standardize it to a variance of one. And then of course at the end, one tenant of machine learning is, and building predictive models is that you train your data or train your models on a training dataset. And validate your model on a test dataset. And so we split the data into training and test datasets. The model tuning step is just using the training data. When you fit a machine learning model within any particular software you’ve got two types of parameters. You’ve got parameters that you can estimate by running, passing the data into a fitting algorithm. Then there’s other parameters where in order to figure out what the best value of those parameters are you have to do a grid search. And so what you end up doing is setting a grid of values for these what are called hyperparameters and then you use ten-fold cross-validation or K-fold cross-validation if you don’t want to use ten folds. And on each combination on the grid and you end up doing a grid search where each combination of the hyperparameters is assessed and the predicted accuracy is assessed using 10-fold cross-validation. And the tuned model is the hyperparameter combination that gave you or gives you the best predictive accuracy whatever your assessment might be. You see like we used in our case or maybe recall precision something like that. Okay. And then the model validation step. That step so once you take your, have your tune model or in our case a set of tune models we looked at logistic regression model, a single classification tree, an ensemble of classification trees, random forest, support-vector machines, what’s called an elastic net which is it’s regularized logistic model in our case and then what was a gradient boosting classifying ensemble. And we consider all of these models because there is not, in machine learning it’s not the case that one model is always going to be the best. Each model has its unique nuances of how it interacts with data. So one model can be better than another model for one dataset and the circumstances can change when you apply it to a different context and a different set of data. So once we tuned a set of different types of models we assessed those models on the test dataset. And it’s always important to assess the models on the test dataset because anytime you assess a model on the same data that you use to train a model you’re going to be overoptimistic in your predictive accuracy. Once you have validated your model or set of models then you can go into a deployment state which in our case was to report in our paper the model type that tended to give the best predictive accuracy. And the model predictors within that model that were most important. Next slide.

So some, we had also, I have mentioned several of the exposure variables that we used. We also included variables such as age and gender and then some information about rank, study site because this was the first time looking into this data so we were interested in whether or not there was any site effects. Some measures of depression as well as some individual combat exposure questions from the DRRI-2-D. We had 359 records, we had to remove 18 records due to missing data. As mentioned before we used 10-fold cross-validation and the AUC under the ROC measure as the assessment measure for predictive accuracy. Once we had gone through the training and testing of validation since we weren’t at the point where the model that we would deem the best we would, it wasn’t the case that we were going to propose it for immediate implementation in clinic use. So we actually took all of our data combined it into one dataset and went through the models again using 10-fold cross-validation as a whole single dataset just to see how our predictive accuracy measures would maintain their ranking among models and their value, measure of predictive accuracy. When we applied the models on the entire dataset and assessed those models using cross-validation, 10-fold cross-validation again, the best model was the random forest model that had 30 variables in it, 30 predictors, with an AUC of point seven-eight. And then also as I mentioned before earlier when it came to the random forest models we were able to look at the important scores to determine which variables were being most influential on the predictive accuracy of the models. I’ll pass it back to you Libby.

Dr. Libby Dismuke: Thank you so much, Barry. Really appreciate you giving that tremendous explanation of the methods that only you as the statistician who did this could provide. So I’d like to provide the results then of our study based on the work of Barry and all of our team. Descriptively 13% of the Veterans in our study were female, 88% were enlisted, 68% had served in the Army, 73% had reported exposure to land/water mines, booby traps, or roadside bombs, 89% had reported exposure to hostile incoming fire, 69% had reported being in a convoy under attack, 97% reported at least one potential concussive event, 62% reported a mild TBI with amnesia or loss of consciousness while deployed, 84% Veterans reported at least one mild TBI from blast exposure during military service. So these are just the overall descriptives. So you can see a very heavy, heavy exposure to many different mechanisms in this cohort.

So this is the table that shows you the order of importance that as Barry said his final model that he used after going through so many test models and recalibrating and testing and recalibrating. The best model was with 30 predictors and he gave us the rank of those predictors. So the most important predictor which may not be a surprise to anyone was age at baseline for service-connected disability. This is not a surprise in given that the older the Veteran was the more likely they were probably exposed and had some service-connected disability. Number two is where we’re going to spend a lot of time talking about. So number two is the number of controlled detonation experiences while deployed or non-deployed. And look at that word controlled. This is what really jumped out at us and surprised us. If you look down at number three you’ll see total number of blast exposures while deployed or non-deployed including controlled and uncontrolled. So this would not have surprised us because we’ve heard all of the exposures to the IED blasts while they were in Iraq/Afghanistan. Sort of the blasts that were not in control by our military. The blasts done by the enemy for example. But number two is really what we found to be so surprising and important. That this is their own controlled detonations. This is within the control of our military and our Department of Defense. We’ll talk more about that later in discussion. Number four was asking about whether they had been injured. Number five is uncontrolled blast and impact exposures. Number six we also think is important. Number six is study site, a particular study site. So we weren’t really expecting to find differences in service-connected disability by study site. And this may need to be something that we look into further from a VA policy standpoint to make sure that service-connected disability based on all these different exposures is not being reported or recorded or assigned differently between VAs. We may need our pension and compensation services to sort of review policies and make sure that they all are assigning service-connected disability ratings based on similar exposures and impacts. So this was a potentially important finding. We also see important exposures from things like C4 which is very commonly used in breaching. Our military uses C4 a lot in both training as well as combat. Blast where dazed, IEDs, those we again are, we’re not surprised about. Go to the next slide to show you a few more on here.

Falls, mortars, incoming fire, we did also see ranked number 23 their PHQ 9 based on depression. And we do know that depression has been, come to be considered as a secondary condition to mild traumatic brain injury. That has been recognized by the VA as a secondary service-connected condition to mild TBI. Again more exposure to water mines, booby traps, roadside bombs, rocket-propelled grenades, mix of explosives. Also was important number 29 was being a Marine service member was ranked number 29 in importance.

So this gave us an important result in that we are wondering what’s going on in terms of military training and combat. And that leads to my next poll question to see if you were listening and understanding. So the next poll question is, which combat or training exposure ranked highest in importance in predicting greater or equal to 50% service-connected disability? Is it IED blast, uncontrolled detonations, is it controlled detonations, rocket launchers, or incoming missiles?

Whitney: All right. And that poll is now launched. Answers are coming in, I’m just going to give it a few more seconds to level off before I close the poll. Once again a reminder please if you cannot make a poll selection please exit out of the full-screen mode and you should be able to do so. Okay. So it seems like things have slowed down so I’m going to go ahead and close the poll and share the results. So 26% of those who answered said IED blast, 9% said uncontrolled detonations, 59% said controlled detonations, 6% said rocket launchers, and 0% for incoming missiles.

Dr. Libby Dismuke: So 59% of you were right. The answer is controlled detonations. And I’m glad that you were listening and comprehending.

Very complicated modeling we did and a lot of exposures to listen to and to take into account in a very short amount of time. So our main conclusions are that using this very novel model testing algorithm we found that the most important predictors of VA service-connected disability being greater than 50% was number of controlled destinations. That was number one, followed by the uncontrolled blasts that occur in combat deployment or non-deployment military settings. Now it was one thing to find this controlled detonation and we really thought about it and we were like what are we seeing here? Why are we seeing this? And we were just so surprised wondering about this. So we did some research and we found there was some other studies going on at the same time by groups at Walter Reed and the U.S. Army and also in Australia looking at breachers. And breachers are individuals in the military that repeatedly explode things. They’re exploding, they’re knocking out doors, they’re knocking out, they’re exploding buildings, you know various maybe ammunition supplies, whatever. So they are, in training they are repeatedly exposed to blasts, to some form of blast waves. And so we did find some studies that are consistent with what we are finding by them. Tate, one of the lead authors on a study, found that repetitive low-level blast exposure was associated with a brain biomarker response, at the time. So they were doing these breaching’s and then they would test their brain biomarkers immediately. They found this brain biomarker response poor cognitive performance that they then followed them and impairments after multiple blasts. They then did another follow-up study, this same group, and they found that changes in training doctrine which reduced blast overpressure exposure to less than four psi may have mitigated measurable effects associated with long-term low-level blast exposure. So they first did one study where they were finding all these bad effects and these brain biomarkers. They then suggested to train, to change the training doctrine to only allow blast overpressures less than four psi and then they found that those effects went away. That was in those studies. Another U.S. Army study of peak overpressure from various, this is at Fort Leonard Wood, from various exposures found that the current minimum safe distance calculations which what I understand are quite a few years old. I’ve heard as much as seven years old, there’s the, the Army sort of has this back of the envelope calculation for safe distance from blast when they are the ones that are controlling the blasts. And they’re very, very old sort of back of the envelope calculations. So they found that these current calculations are often inaccurate as true environmental exposure consistently exceed the four-psi incident safe threshold prescribed by U.S. Army doctrine. So there is continued studies on this. And also understanding whether the Army and maybe other military doctrine concerning what a safe distance is, needs to be reevaluated and perhaps changed in the future.

So the limitations of our study is that of course these combat and training exposures are self-reported by the Veterans. The methods that we used as Barry said allow only for ranking of importance so contrary to most medical studies that you’re used to seeing, we don’t have some additional magnitude effects of the exposures. We don’t have tests of significance for the exposures. The study is limited to four VAs and limited to OEF/OIF/OND Veterans.

However the study has several strengths. Very rigorous and standardized method for categorizing mTBI based on Ohio and the VCU method for identifying mild TBI. Identifying combat and training exposures to our knowledge we’re the first to do something like this. The ML, machine learning methods that Barry employed allowed us to include a large number of combat and training exposures in a not terribly huge sample of Veterans. And we feel that this information can provide valuable guidance to both VA and DoD for planning and policy for the future. It is consistent with other studies of breachers regarding the PSI pressure, blast wave pressure exposures. Of course this is one study and it needs to be replicated in larger amounts of Veterans and hopefully more, even more rigorously.

So the future directions are, we hope to work with DoD to improve feedback loops between the VA and DoD on this type of studies and information so that prevention efforts can be put into place if indeed training exposures are causing service-connected disabilities in the VA, it would be helpful for the DoD to understand that so that they might mitigate that. Also there is a new study that is an extension of CENC called LIMBIC. Also the overarching PI is Dr. Dave Cifu, the PI on the longitudinal study is Dr. Walker. And this study is now going to include eight VAs and four military treatment facilities with at least 3,000 Veterans and service members. And I apologize on the slides you got this morning, I think there was an extra zero in there that said 30,000. I’m sure they would love 30,000 but it’s really 3,000. So that will be corrected in the archive slides.

I would now like to say here are the references for today. I’m so grateful that Barry was on the call to help me.

And also, as always thank you to our Veterans, our military Veterans who are giving us a reason to do this research.

And you may contact me at HERC at clara.dismuke@va.gov for any further questions or information. So I thank you Whitney and Dr. DePalma.

Whitney: All right. Thank you, Libby. We have a few questions here and just a reminder to the audience if you have any questions please send them over in the questions panel in your GoToWebinar dashboard. So we have one question here, how would this relate to reservists who did not deploy but were in artillery units?

Dr. Libby Dismuke: Oh, this is just my opinion and this may be for Dr. DePalma also to comment on, but if they are reservists and they are in artillery units they are being exposed to these same types of weapon systems, that anybody who is deployed. And that’s what was so important about the controlled detonation findings. The implication here in controlled, while there are controlled detonations in combat and deployment much of the controlled detonations are being done in training. So reservists who are in artillery units they are potentially exposed to these same exposures.

Whitney: Okay. And then this next one is just more of a comment, variation of SCD ratings and awards does vary by rating office. It shouldn’t, but it does. That has been documented so it’s not odd to see here.

Dr. Libby Dismuke: Thanks for that comment whoever made that. And you know, if you have, whoever made that comment if you want to send me an email to see how we might interact to hopefully try to more standardize service-connected disability ratings, that may be a whole different issue to talk about. But I appreciate that comment and would love to hear from you.

Whitney: Okay. Thank you. This next one, it appears that overall service-connected was used as an outcome which can include PTSD and physical injuries. Were there any secondary analyses done to look at TBI, brain disease, or other related conditions such as headache, vertigo, or similar residual symptoms?

Dr. Libby Dismuke: Well for this study all we did was look at the service-connected disability rating independent of whether they had a TBI or not in here. So some of these service-connected disability ratings will include TBI. They will also include PTSD and others but we did not separate. I think this is where the question is coming from. We did not separate the type of service-connected disability rating. So I think that questionnaire has an excellent idea that in the future we should separate out what type of service-connected disability ratings they are. Like how much is TBI, how much is PTSD, how much is potentially vertigo, or other types of disabilities. So thank you for that, I’m going to write that down.

Whitney: Thank you, Libby. This next question is, my understanding is that C&P exams are increasingly being shifted to contracted community providers. But are there questioning their reliability and accuracy?

Dr. Libby Dismuke: I have heard that is the case. But that there is a lot of, there’s been some VAs who have privatized their C&P services. I haven’t seen yet any studies about that and I would love to see that. I too wonder whether there will be differences between private contractors for C&P versus the services that are contained within the VA. And I would welcome an email from that individual as well about that.

Whitney: All right. Thank you. This next question, how do you reliably define blast exposure given the different sizes of ammunitions, distances of exposure, protective gear, and issues of subconcussive blast, doesn’t meet TBI requirements.

Dr. Libby Dismuke: That sounds like a clinical question. So can you repeat that question for me?

Whitney: Definitely. How do you reliably define blast exposure given the different sizes of ammunitions, distances of exposures, protective gear, and issue of subconcussive blast?

Dr. Libby Dismuke: Okay. I see where you, thank you. So for this study all we were able to do was identify the type of weapons, right. So all we could do is say they were exposed to mortars, they were exposed to breaching, C4, rockets, whatever. We don’t have information in this study on distance. We don’t have information in this study on protective equipment. However that type, those types of studies are being done by teams Kamimori at Fort Leonard Wood and others who are doing sort of controlled studies looking at distance, protective equipment, measuring the blast pressure, and the type of weapons.

Whitney: Great. Thank you, Libby. It looks like that is all the questions we have for today. So do you have any closing comments to make Libby?

Dr. Libby Dismuke: I just want to thank everyone for attending and for the wonderful questions. And I hope, feel free to contact me with any additional questions or suggestions such as separating service-connected disability or measuring other things that could be measured in these longitudinal studies. And I will pass them onto the LIMBIC PI who are the clinical people in charge. I also want to thank Barry for all his hard work on this and all my coauthors who are out there. And I’m just honored to present on their behalf. And also Dr. DePalma for inviting me.

Whitney: All right. Thank you. Dr. DePalma do you have any closing comments?

Dr. Ralph DePalma: Yes. Libby and Barry thank you very much. And so I understand it, the total outlay for the major disabilities related to blast exposure are 74 billion, did I have that right?

Dr. Libby Dismuke: That’s for total service-connected disability Ralph. All service-connected\_

Dr. Ralph DePalma: Yes.

Dr. Libby Dismuke: \_it’s not just blast. It’s all service-connected\_

Dr. Ralph DePalma: Yes, it is.

Dr. Libby Dismuke: \_disability, 64 billion paid to 4.4 Veterans for all service-connected disabilities.

Dr. Ralph DePalma: Yes, thank you very much. Well you know this has been, I realize that the statistics have been, we’ve really got to thank Barry for showing us how to derive the questions in the variables into a model that allowed these accurate calculations. One of the things that has interested us and David and as well as the DoD and the VA is mechanism, the basic mechanisms of what happens with these blast exposures. And what is becoming clear from Libby’s analysis of the breachers is that primary blast exposure occurs in the absence of head motion in which the primary blast just traverses the brain to cause it difficulty. So as a non, and basically most of the time if we look at it carefully and for the clinicians that’ll be seeing these patients you can get an idea that this, certainly with the breachers little or no head motion and most often with the combat blasts too sometimes it’s head motion, sometimes not. So this is an important thing to understand that the DoD is working on very hard. I’d also like to comment that I’m aware that the DoD is working on blast sensors that will include monitors in the front of the helmet, the back of the helmet, and two shoulders that will allow not only calculations of the blast overpressure but also its impulse and it’s duration. So this is a very important topic and I hope that clinicians on board can start you know looking at their history’s in a more detailed way. And I thank Libby and Barry for bringing this to us. I’d like to see if Libby has any more comments.

Dr. Libby Dismuke: Thank you, Ralph. I did want to follow-up on your mention previously of the primary, the need for a primary blast to the brain injury code. I worked with you at the beginning on that because we were surprised to find that while there is ICD-10 Lexicon there are blast injury ICD-10 codes to just about every organ in the body but none to the brain. So Ralph DePalma, Dr. Ralph DePalma has provided a leadership to request from CDC, right, and ICD-10 Committee this code. And so we are hoping that that will go forth. If you wanted to speak more to that.

Dr. Ralph DePalma: Well thank you. But I should emphasize that the DoD and Health Affairs is intimately involved in that. Kathy Lee and Dr. Rauch’s office have become aware as a result of the Kamimori studies. So and then the DoD for the last two years has had an NDAA to look at it. So it’s a joint effort which is what we have to do all the time. Because the DoD sees the acute injury and we see the chronic. But Libby has been a big help in getting the details of that code through. Thank you very much.

Dr. Libby Dismuke: Thank you. I do hope that that code goes through so that it can be documented in administrative data because that’s been the challenge with administrative data is there are no blast codes, there was no blast to the brain codes.

Dr. Ralph DePalma: Yeah.

Dr. Libby Dismuke: So we had to find other ways to find out what was the mechanism of TBI or injury and so I think if that happens and hopefully it will we thank you. Because that will change our ability to track blast, injury to the brain in administrative data which will be fabulous.

Dr. Ralph DePalma: Thank you very much.

Whitney: All right. Thank you, Libby for taking time to put this together and present for us today. And thank you Dr. DePalma.

[ END OF AUDIO ]