Supplemental File 1:
Codebook

SUPPLEMENTAL FILE 1: CODEBOOK

CATEGORY	#	CODE	SHORT DESCRIPTION	DEFINITION	EXAMPLES
Residual Limb Problems	1	**Pain**	Pain in the residual limb	Participant **describes** feeling physical suffering on the residual limb, or directly states that pain is a residual limb problem	Pain, phantom, neuromas, muscle cramps
	2	**Discomfort**	Discomfort of the residual limb	Participant **describes** feeling a lack of physical comfort on the residual limb, or directly states that discomfort is a residual limb problem	Itchiness, heat in socket, friction/rubbing between liner and skin, "bunching up behind the knees", "air between my skin and the liner "
	3	**Hygiene**	Hygiene of the residual limb	Participant **describes** a problem related to the cleanliness of the residual limb	Odor, sweating
	4	**Volume**	Volume fluctuation/shape change of the residual limb	Participant **describes** changes in size of the residual limb, or directly states that volume fluctuation is a residual limb problem	Volume fluctuation, shape change, "I was still in my temp, so the liner obviously had lost a lot of volume which I know now, but at the time I didn't."
	5	**Sensation**	Diminished Sensation	Participant **describes** situations where the prosthesis user is unable to sense a physical feeling on areas of or the entire residual limb	Diminished sensation, skin sensitivity, "...it can be difficult for patients to know when they're actually experiencing heightened areas of pressure or force", "You know, to have sensation, their eyesight, their ability to feel, to move their fingers."
	6	**Skin**	Skin issues on the residual limb	Participant **describes** directly or inderectly development of a breakdown, eruption, or disorder affecting the skin on the residual limb	Skin breakdown, invaginations, in-grown hairs, "I had the blistering and the itching issues. Usually it relates to the vacuum just barely being broken or not. In other words, it's sort of like a super hickey in a way. It just wants to pull the skin in. And it pulls the skin away and then it forms a blister."
	7	**Temperature**	Temperature within prosthetic socket	Participant **describes** directly or indirectly the temperature within the prosthetic socket environment being or causing a residual limb problem	"If I have perspiration, it's because I'm out cycling in 90 degree weather in which case it is really severe.", "I would say that my prosthetic adds about 20 degrees to my body temperature. So I think heat has a lot to do with it. There's no air flow.", "I need a cooler liner.", "But during the day I find that I have to adjust my prosthetic because the suspension starts going because it's just too warm inside.", "It is the perspiration, the suspension. Poff! It was gone."
Management of Residual Limb Problems	8	**Problem Solving**	Problem solving	Participant **describes** what he/she does or what instructions/education are given to the prosthesis user to address a residual limb problem when it occurs or to keep a residual limb problem from developing	Add/remove sock when volume of the limb decreases/increases, supply tools that can be used for troubleshooting, remove prosthesis, sit and take a break, apply ice pack, wipe down sweat, adjust the limb, apply deodorant or lotion, "...show them what it feels like if they have vacuum, or no vacuum...", "walk them through the steps of what to look for whether it's redness or feels like it's too long", "explaining the difference of this is tight, this is loose", "And I really recommend that everybody breaks in their prosthesis a little bit every day. Rather than: it feels good now and I'm going to wear it all day. So everybody sort of breaks it in slowly. Beyond that, break in schedule is a big key for making a change in a prosthesis or a new prosthesis altogether.", "Practice to me stands out to me as something I spend a lot time on, not just with new patients, but especially with new patients, but also with ongoing patients. Weaning [sic] of the prosthesis, especially with a new socket or new system is very important."
	9	**Influencing Factors**	Influencing factors	Participant **describes** that the prosthesis user's ability to self-manage residual limb problems are influenced by particular variables/factors	"Depends on etiology", "depends on age", "depends on time with amputation", "It's very patient specific, obviously, but there is a trend in etiologies that results in challenges for the patient to be able to self-inspect."
	10	**Patient-reliability**	Reliability of patient reports	Participant **describes** skepticism about the reliability of patient feedback	"I think the ones that would have an issue with it, to be honest, are the ones that we all know come in our office and tell us one story. And we know something else is going on.", "It's difficult for them, so bringing someone else who can take responsibility, and make them accountable for their limb health or at least monitor it is really important."
	11	**Education**	Better education	Participant **describes** education activities regarding prosthesis use	"The opportunity to meet others who wear prosthesis who experience similar problems. To be amongst a community of others who also experience what this person is experiencing and share ideas and trouble-shooting. Continued practice in a controlled environment, with not necessarily the prosthetists, but maybe with an OT or a PT or a skilled educator in terms of helping practice what the professional has said, 'This is the proper way to do it so let's follow those instructions', so that we can build some those kind of habits over time. And then continuing those things through the therapy regimen for new patients and for continuing patients as well.", "Peer support is also good if they have other people in the community."
	12	**Communication**	Communication between clinician and patient	Participant **describes** the methods or technology he/she uses to contact the prosthetist/prosthesis user to extend patient care outside of the clinic	Call, email, text, send pictures, "I get lots of pictures, videos. FaceTime and Skype. I did a lot of that when I was on vacation. As well as being involved with other allied health people. So, being in contact with their therapist, with their home nurse, and letting them know they can contact you as well."
Proposed Methods to Better Manage	13	**Technology**	Technological change/advancement to prosthetic component	Participant **suggests** ideas/ways to change or improve prosthetic components	Adjustable socket size, bladder, temperature control in socket, moisture remover in socket
	14	**Objective Info**	Use objective information to minimize reliance on patient feedback	Participant **suggets** or directly states the need to gather objective information that will minimize reliance on patient feedback when diagnosing residual limb problems	"It'd be great if there were some sort of tool that could take it out of the patient's hand and us relying on their feedback"

Better Manage Residual Limb Problems	15	**Detection**	Early detection/identify problems sooner	Participant **suggests** need to identify residual limb problems sooner	early detection, reduce time required to troubleshoot, "It'd be great if there were some sort of tool that could take it out of the patient's hand and us relying on their feedback", "To tell them if they're not lined up right or too far in it or the app would buzz me saying this patient's, so it would detect a problem before they really get to be severe and waiting 2 or 3 months for the wound to heal."
	16	**Better Education**	Better education	Participant **suggests** increasing or improving education regarding prosthetic care	"If therapists were better trained to be able to recognize some of the fit issues that would be tremendous...", "To be able to continue with patients, their education, with the things that they can do to prevent..."
Receptivity Towards a Residual Limb Monitoring System	17	**Potential Clinical Benefit**	Potential benefits of sensor system for clinical practice	Participant **suggests** potential benefits of the sensor system on prosthetic care that may attract prosthetists and/or prosthesis users to use the system	prevention of skin breakdown, improve check socket process
	18	**Reimbursement Justification**	Ability to justify or substantiate reimbursement requests	Participant **suggests** potential benefits of the sensor system on reimbursement of prosthetic care	"...we could do track stops, and how fast they're walking, or how slow. I mean that also validates us for insurance reasons, K2, K3 levels. I mean."
	19	**Health concerns**	Possibility of health issues related to sensors	Participant **suggests** concerns about health issues and safety related to wearing sensors and other electrical components on residual limbs	"I don't feel like all these waves and stuff going through us and stuff is really a healthy thing. With all these wireless devices...I wonder what the long-term effects are..."
	20	**Potential Inconvenience**	Potential inconveniences of sensor system	Participant **suggests** potential inconveniences of the sensor system on prosthetic care that may diminish interest from prosthetists and/or prosthesis users to use the system	extra step, cost, doubts about benefits, doubts about ability of sensor to stay adhered to skin, "...there are times when you could be wrong.", "'Cause you don't want a lot of false alarms. But you do want to have an alarm that there is a fire, you know."
Vision for Residual Limb Monitoring System	21	**Desired Measurements**	Desired measurements	Participant **suggests** ideas for what to measure with regard to residual limb conditions within the socket	Pressure, temperature, socket fit/alignment, wear time, "X-ray vision. If there was any way to be able to see. You know, in Duraplex or a clear check socket, it's real easy with certain liners to see, oh, you're tight. You're loose. I have gapping. We have too much pressure here. We have splayed fabric."
	22	**System Goals**	Desired system goals	Participant **suggests** goals or direct outcomes that could result from using a residual limb monitoring system	Minimize reliance on patient feedback, assist in diagnosis, early identification/problem prevention, assist in check socket fitting process, "I'm thinking in the office, plug them in to this really cool thing that somebody who knows what they're doing builds. Or, you know, putting it inside the interface.", "...the recommendations would have to be very targeted and accurate, or not be recommendations at all and just say, hey something going on, do you need to reach out?"
	23	**Sensor Characteristics**	Desired sensor characteristics	Participant **suggests** physical characteristics of a sensor that would be used to monitor residual limb conditions	Small, unobtrusive, "invisible", reusable, inexpensive
	24	**Measurement Sites**	Sites on the residual limb that measurements are taken	Participant **suggests** sites on the residual limb they want measurements to be taken	Bony prominences, distal end, fibular head
	25	**Sensor Location**	Sensor location in prosthetic system	Participant **suggests** where within the prosthetic system the sensor could be located	In the socket, in the liner, on the residual limb, "wearing it on your hip, putting it in your pocket, wearing it on your wrist, putting it in your purse, or um even bra strap, I think following sort of what commercial technologies solutions"
	26	**Length of Use**	How long the prosthesis users wear the sensors	Participant **suggests** the amount of time the prosthesis user should wear and use the sensor system that might allow for improvements in residual limb health	"Oh yeah, a couple of days and that's why I said even if it's, you know, going grocery shopping, going home, the way they step in their house, how much are they getting up off their couch, are they going up and down the stairs.", "...so it's hard to determine where, how much is enough capturing their daily life to really be representative and help with some of the socket issues."
Configuration for a Residual Limb Monitoring System	27	**Data Collection**	Data collection	Participant **suggests** how data from the sensors should be collected	On-going monitoring, real-time data, "Yeah, your app sounds like a nightmare. That's a lot of shit.", "If it were just used in the office, would it really be that valuable of a device, that information we're getting?"
	28	**Data Viewing**	Data viewing/data source	Participant **suggests** methods to view the data/information collected from the sensor system	Plots, charts, color scale for level of severity, summary report, video feature
	29	**Data Sharing**	Data sharing	Participant **suggests** who should have access to the data/information collected from the sensor system	Share with clinicians, keep data with patients, "patients should be able to access the data", "Some of our population is really – that technology they, they want to embrace it but they cannot. So that's the one problem with – I agree, I, like the – that we collect the data, that eliminates that factor of it."
	30	**Data Storage**	Data storage	Participant **suggests** how the data/information collected from the sensor system should be stored	In an app (phone, tablet), website (online)
	31	**Alert**	Alerting/notification	Participant **suggests** ways to alert prosthetists/prosthesis users if a residual limb problem will/has occur(red)	Vibration, sound, email, phone call, make this a customizable feature, "I wouldn't want it going off on its own. I'd want to have to access, you know, going into the information rather than getting multiple dings in the night...We have access to it anytime, but having that ability where we would go in, say every Monday morning, or you know, every morning we kind of follow these, you know, we can look at the certain patients or go into that program versus it just dinging."