

ENGN2226 Individual Portfolio

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Executive Summary

This portfolio is an analysis of prosthetic lower limb assessment, manufacture and fitting in Canberra, Australia. The cost, human, time, control, energy and material elements of the system were investigated and, alongside qualitative and quantitative analysis, were used to produce recommendations for the improvement of the system by the clinic and ACT Health, but also for similar clinics and governments. The most important recommendations produced were that:

- 1) All patients have 3D scans of their residual limb performed.
- 2) The service trains and hires more prosthetists to deal with current demand and the expected future growth in demand.
- 3) ACT Health invests more money in supplying advance performance limbs.
- 4) More information on limb types and the ACT Health system is provided to clients.

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Introduction

The process of requesting, manufacturing and fitting a lower limb prosthetic (LLP) in the ACT has potential to be efficient, fair, affordable and informative. However, it is not living up to this potential and there are obvious improvements in quality and efficiency that can be introduced. This report is an analysis of key areas related to the system, with the aim of recommending and justifying improvements.

Portfolio Scope

This report follows the process from the client first needing a new limb to obtaining the limb. It focuses on the ACT Health system for obtaining a LLP for the ease of assessment. It produces recommendations for two different stakeholders: the ACT clinic, and the ACT government as represented by ACT Health. However, the recommendations are more widely applicable than this group, and general lessons for all prosthetic limb services can be found.

Current System

Referral to the service is required through the Community Health Intake (CHI) from a General Practitioner, Health Care Provider, carer or the client themselves. The following steps are then followed:

- Appointment with clinic for assessment. The clinic decides whether the client needs a new leg.
- Appointment with clinic doctor for script. This script enables it to be covered in part by Medicare.
- Three or more appointments with the prosthetists. These are for a cast of the stump to be created, an initial fitting and then at least another follow up fitting.
- Trial period (optional). New sockets may be given a trial period before being finalised.

The cost and time associated with these steps are provided and analysed in the body of the report.

Parts of the Limb

The following terms are useful for understanding this report.

- The liner – sits over the residual limb to protect it, some have a pin that clips in to prosthesis.
- The socket – a rigid shell that surrounds the residual limb.
- The prosthesis – the main mechanical component of the limb.
- The joint – some feet will have an ankle joint built in, and some will not.
- The shell – goes over the foot of the prosthesis. This is optional and generally a cosmetic addition.
- Sleeves – stocking-like covers for cosmetic purposes.

Summary of Recommendations

For the clinic

- Create 3D scans of clients' residual limbs, rather than creating casts that are destroyed each time.
- Start 3D printing sockets for clients who are willing to participate.
- Write or compile information booklets for clients covering key areas: the clinic's process, FAQs, the limb options available, and maintenance of their limb type.
- Conduct a pre-appointment survey and a post-process survey (see feedback section for details).
- Prescribe more modern technology (this would be based on the results obtained by the feedback).
- Review of process by which some people get better feet (again, this would be based on the results obtained by the feedback).
- Choose manufacturers who use recycled materials.

For the ACT Government

- Hire more prosthetists. Ideally the recommendation is to triple the number of prosthetists, however a preliminary doubling would provide a good intermediary step.
- Negotiate more funding for prostheses with the Artificial Limb Scheme (again, this would be based on the results obtained by the feedback).

- Review the decision of who has to pay maintenance fee, with the removal of fees for full time students in mind.

Demand and Supply (Quantitative Analysis)

Quantitative analysis was conducted to determine the state of demand and supply in the system and to determine the likely future growth in demand. The following quantitative analysis relies on the assumption that the percentages of American, UK, and Australian citizens with amputations and prosthetics are similar. This is reasonable as the countries have similar demographics and enjoy similar standards of living while data is not as readily available for Australia as other countries.

Estimation of People with Prosthetic Limbs

The Amputee Coalition (AC), an American research and support organisation, estimates that in 2007, 1.7 million Americans were living with limb loss (AC 2012). This is in line with an estimate from the American Congress of Rehabilitation of 1.6 million in 2005 (Ziegler-Graham et al 2008). These represent 0.56% and 0.54% of the population, respectively. If we assume these percentages are similar in Australia, this indicates that approximately 130,000 Australians, or 2,000 Canberrans, live with limb loss. This is based on a national population of 23.9 million and Canberran population of 360,000 (ABS 2015).

Not all of those with limb loss require or are able to use prosthetics. Documented rates of prosthesis vary significantly. They land between 27% and 56% in upper limb amputees (ULA) then 49% and 95% in lower limb amputees (LLA) (Ziegler-Graham et al 2008). If we average these and simplify, we can estimate that 4/10 of ULA and 7/10 LLA are compensated for by prosthetics. These numbers are not precise, however are a safe indication for our purposes. Advance Amputees (AA), an American research and development group, states that 71% of amputations are below the knee (AA 2012). Using a weighted average, we can then estimate that 6/10 amputees require a prosthetic. This leaves our estimates of Australians and Canberrans using prosthetics as 78,000 and 1,250 (0.35% of the populations), respectively.

Expected Growth in Amputations

Surprisingly, the number of amputations is expected to rise significantly in the coming decades. It is projected that from 2005 to 2050, the number of people in the US with amputations will double (Ziegler-Graham et al 2008). This is due to the climbing numbers of Americans with diabetes. Diabetes and peripheral arterial disease cause approximately 54% of amputations, compared to trauma at 45% (AA 2012). This trend is seen worldwide. While 8.3% of Americans are affected by diabetes (AA 2012), 7.4% of Australians have diabetes too (DA 2012), so we can expect that large growth will be seen in Australia too.

Supply of Prosthetists

At the supply end of prosthetics, there is already a deficit of prosthetists. The British Association of Prosthetists and Orthotists in the UK recommends that the ratio of prosthetists to population is 3 to 100,000 (NHS 2005). The National average in Australia is 1.09, and the ratio in Canberra is 0.8 (AOPA 2012), approximately one third of the recommendation. The NSW Health audit of the prosthetic system stated that prosthetists were in “short supply” and that attracting prosthetists is a difficulty (Stewart et al 2004). In addition, the Australian Government’s Job Outlook initiative predicts that job growth in the field will be “very strong” in the following 5 years (Australian Government 2014a). In light of this statistic, and the long waiting times experienced in Canberra, it would be appropriate to higher more prosthetists. By first doubling the number as an intermediate step, ACT Health can determine whether a ratio of 3 would be excessive or appropriate. This needs to be addressed to deal with the deficit now, but also the future problems associated with an increasing number of amputees. Currently La Trobe University is the only university with a prosthetics program.

Outcomes

- (ACT Health recommendation) Hire more prosthetists. Ideally, the recommendation is to triple the number of prosthetists, however a preliminary doubling would provide a good intermediary step.

Client Satisfaction (Quantitative Analysis)

Qualitative research was conducted in multiple stages. Preliminary questions were designed for an online interview with a client of ACT Health and QLD Health, which was used as a starting point for more comprehensive research as well as two follow up interviews with the same client.

Current Satisfaction

The online interviews were conducted with the client's permission and full knowledge of the project. Open ended questions were used as this was a scoping exercise. Three main problems were identified from her answers. There were (1) the waiting period is long (3 months wait followed by 1 to 3 months for manufacture), (2) minimal information is provided on the process and the technologies, and (3) the limbs given are of low quality. Transcripts are found in annex 1. On it's own this might lead to sampling error, however additional resources identify similar issues. The RACC division within which the prosthetic clinic operates received consistently low satisfaction ratings (3.2 out of 5) for "the length of time you had to wait to get an appointment with the health service" in the 2013 ACT Health annual report. The division confirms that the wait time is about 13 weeks, which is a reduction from the 20 weeks that clients waited for before it was reduced in June 2013 through administrative improvements (ACT Health 2013).

An independent NSW assessment of their limb scheme identified common problems. These were that not enough information was provided, there was a lack of attention due to high work load, and there was a lack of available prostheses. (NSW 2002).

In a survey by Limbs4Life, an Australian organisation, it was identified that many people were paying in the order of tens of thousands of dollars in order to "improve their quality of life" through a better limb. In addition, 90% of participants wanted to know more information about available technology. (L4L 2011). In addition, a comprehensive assessment of socket technology identified that more than 95% of amputees experience socket discomfort (Natak et al 2010), demonstrating the need for quality sockets.

All of these studies reinforce the issues surrounding the quality of the limb and socket, waiting period and accessibility of information. Accessibility of information is easily improved by providing information booklets to clients on key areas: the clinic's process, FAQs, the limb options available and maintenance of their limb type.

Outcomes

- (Clinic recommendation) Write or compile information booklets for clients covering key areas.

Human Factors Analysis

This section of the report justifies the recommendations by demonstrating the responsibilities that stakeholders have to implement them, and also by estimating the social impact that the recommendations will have.

Rights and Responsibilities

Of Prosthetists and Clinics to Clients

There are professional standards that prosthetists in Australia should meet. This report will assume that all prosthetists are sufficiently trained for their role, and as such will focus on responsibilities outside of their skill level. ACT Health's professional standards state that clients have the right to "receive accurate and up to date information about their care and treatment, and the services and options available to them" (ACT Health 2004). The client satisfaction analysis indicates that this responsibility is not being met.

Of Governments to Amputees

Formally, Australia is bound by the 2007 UN Convention on the Rights of Persons with Disabilities. It states that people who are disabled have the right to "live independently and take part in all aspects of life" (article 9), and that measures will be taken to ensure personal mobility using quality aids at an affordable cost

(article 20). (UN 2007). Within Australia, the 2010 National Disability Strategy outlined key areas for future action between 2010 and 2020. These include:

- Improving access and increase participation of people with disability in sporting, recreational, social, religious and cultural activities (1.1). This is a response to the statistic that 64% of people without disabilities take part in physical activities (as a spectator or participant) compared to only 50% of those with disabilities and 28% of those with profound or severe core-activity limitation (ABS 2006).
- Support the development of assistive technologies and more access to aids and equipment for people with disability (4.4)

(Department of Social Services 2010)

Both of these demonstrate a commitment to providing better quality limbs and care.

Safety

Amputees are more susceptible to certain kinds of health problems and injuries than other people. Some of these are not completely preventable, but there are some things that can be done to decrease the risk. If the socket is not correctly fitted, clients can experience areas of high pressure. This can lead to breakdown of the skin, irritations, or even infection. Risk can be reduced if the client is well informed about limb management, which includes correct donning procedures, relevant exercises, socket positioning, stump monitoring, stump care and hygiene (McPhan n.d.).

Advanced Technology

While prosthetic technology is becoming more accessible, there are certain technologies that are so advanced that utilising them is outside the scope of the public health system. For example, Osseointegration. This is the process of joining live bone and the surface of the artificial limb. It involves 2 surgeries in a private clinic, but then negates the need for sockets. It is a niche technology with associated risks (as it creates a permanently open wound and surgery is required) that it is not *yet* considered a mainstream technology. (Laux 2012). This is, however, something that the clinic should provide information to clients on, as some may be eligible, interested and able to finance it.

Social Impact Assessment

A social impact assessment measures the social utility that is gained by implementing a system, and how it can be monitored (UNEP 2009). It has been conducted in order to identify potential areas of negative social impact, and also social hotspots - high impact areas within the system that could be focused on. These are ranked from high positive social impact (3) to high negative social impact (-3).

Table 1

Stakeholders	Impact Categories	Indicators	Expected Impact in an Improved System
Client	Comfort	(A) Clients experiencing socket discomfort (%)	(1) Better quality sockets reduce the risk of irritation and infection
		(A) (B) Time client has to wait once limb is no longer appropriate (weeks)	(2) Reducing the wait period means amputees do not have to wait unreasonable periods for care
		(A) Patient satisfaction with comfort and movement	(3) Providing a comfortable solution for amputees is of the highest importance and has the biggest impact on daily life and engagement
	Health and Safety	(A) Clients who experience injury or related complication (%)	(1) Better socket design and higher quality legs reduce the risk of injury
		(A) Clients experiencing socket discomfort (%) - decrease	(1) Better quality sockets reduce the risk of irritation and infection
		(A) (B) Time client has to wait once limb is no longer appropriate (weeks)	(2) Reducing the wait period means amputees do not have to wait unreasonable periods for care

	Feedback mechanism	(B) Waiting period to have a small adjustment or short consultation (days)	(1) Addressing small issues when they arise prevents them from becoming significant (e.g. irritation to infection)
		(A) (B) Time client has to wait once limb is no longer appropriate (weeks)	(2) Reducing the wait period means amputees do not have to wait unreasonable periods for care
	Communication between client and clinic	(A) Client feels they made informed decisions	(2) By providing more information, clients will feel better about their decision
		(B) Client was provided with comprehensive information on the process, limb types, care, injury prevention	(2) By providing more information, clients will feel better about their prosthesis and will be better able to maintain it
	End-of-life responsibility	(A) Components recycled	(0) This is neutral, as its effect depends on whether the employer recycles each component
	Equal opportunity at work	(A) Client's own perceived ability to contribute at work	(1) With more advanced designs and cosmetics, integration into the workplace will become easier
Engagement in recreational activities	(A) Number of amputees engaging in recreational activities	(3) To have amputees engaging in the community and normal lifestyle activities is the ultimate goal of the system	
	(A) Clients of low socio economic background do not have to forgo basic goods or activities to pay for limb	(1) By increasing the access to prosthesis by people in need, the process becomes more fair	
Prosthetist	Working Hours	(B) No additional hours should be worked	(0) No additional pressure should be placed on prosthetists in order to carry out recommendations
	Fair Salary	(B) No decrease in pay should be given	
Local community	Local engagement in recreational activities	(A) Number of amputees engaging in recreational activities	(1) The community has a lot to benefit and learn from amputees, and the more they can join in, the better off the community is
	Opportunity cost of implementation	(B) Additional resources allocated to service	(-1) See "inequity and decision making" below

(Adapted from UNEP 2009)

Indicators can be qualitative, semi-qualitative, or quantitative (UNEP 2009). Indicators marked (A) can be assessed using data from the recommended survey to be conducted in the future by ACT Health. Indicators marked (B) can be assessed using data available internally to ACT Health. This highlights that the biggest impacts are expected to occur through increasing the lifestyle activities that clients can do and increasing the comfort of the limb. These are directly relevant to the goals of the National Disability Strategy to engage people with disabilities in sport. A reduction in waiting times and an increase in information provided will have a moderate positive impact. These are directly related to the above mentioned responsibilities of the prosthetists. This tool also highlights that good working conditions for prosthetists should not be compromised when the recommendations are implemented.

Inequity and Decision Making

The process of allocation of resources in health care involves many compromises and value judgements. The last impact category in the impact assessment identifies an area for potential negative social impact - the cost of providing resources to amputees that could have gone elsewhere. One amputee may be awarded a higher quality leg over another, or another division of ACT Health might not receive support that it otherwise would have had. This is another reason why feedback should be improved (see the feedback analysis) as surveys will allow the clinic to assess whether they made good decisions by looking at the benefits clients

see. It is, at the end of the day, a funding decision made by governments, but they should consider providing addition funding to all the services rather than reallocating existing funding.

Outcomes

- The benefits of the recommendations are in line with the responsibilities and formal goals of the government.

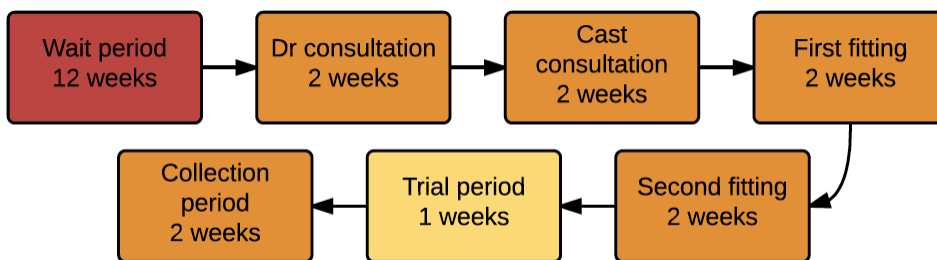
Time Factors Analysis

With the extremely long waiting period, time factors are of great importance to the analysis.

Program Evaluation and Review Technique (PERT) Chart

A challenge surrounding improving the system’s process is that all the tasks are sequential. There are 7 steps and each can only be completed once the preceding step is finished. This is demonstrated by the below PERT chart (figure 1), as there is only one path for the clinic to take.

Figure 1

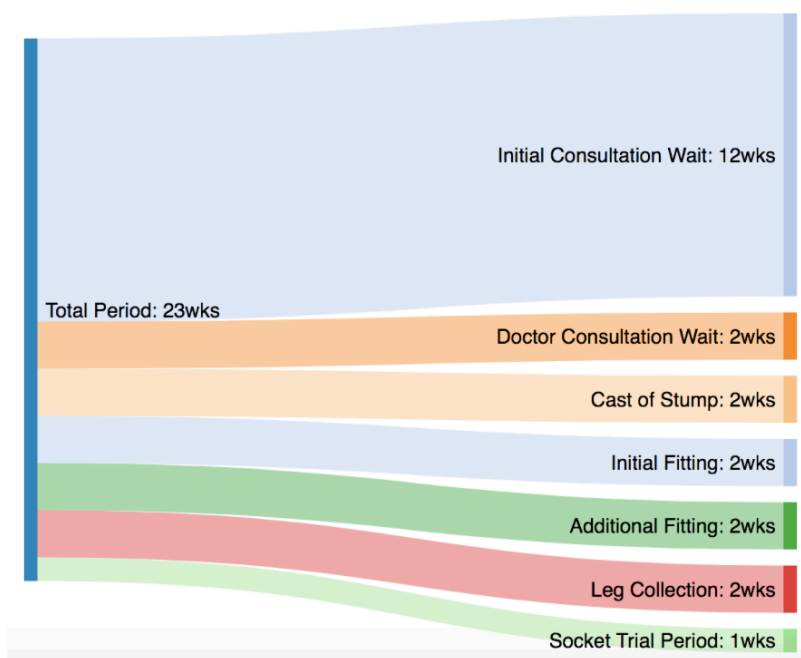


The sequential nature does mean, however, that by focusing on improving individual step we will definitely see an overall improvement.

Sankey Diagram

Sankey diagrams are usually reserved for energy flow analysis, however this diagram does an appropriate job of demonstrating where time flows in the process and therefore which steps we should target. The diagram (figure 2) is based on the minimum time for each step of the standard process.

Figure 2



The initial consultation wait is the most obvious target for improvement.

Time Savings of Recommendations

Descriptions of the estimated temporal impact of the recommendations are included in table 2.

Table 2

Recommendation	Time Period Targeted	Explanation
Create 3D scan of limb	Cast of stump	This step would be unnecessary if patients had permanent records.
Print 3D socket	Initial fitting	It would not take the prosthetist as long to prepare the socket.
Create online survey for pre-appointment	Wait period and initial consultation	Greater information flow means certain cases can be prioritised and less information needs to be gathered within a consultation setting.
Hiring more prosthetists	Wait period	This will be the most effective measure at reducing the wait period.

A 3D scan of the residual limb would enable a permanent and precise record of the stump geometry to be stored, as casts are currently destroyed when the foot is made (Nayak et al n.d.). This would mean 2 weeks could be saved where a cast does not have to be remade. It is important to note, however, that stump geometry can change over the long term, so these changes need to be reported to the prosthetist. 3D printing sockets would also be faster and more precise. (Nayak et al n.d.). This would require less time before the initial fitting with the client, and could save 2 weeks as an additional fitting would not be required. (Bonici 2012). Creating an online survey could help target the 12 week waiting period. This survey could be a detailed assessment of whether the client meets the requirements to get a new leg. It would at least provide a good filtering function for the clinic, even if some cases were too difficult to determine. Example questions and a more detailed description can be found in the feedback analysis section of the report.

Queue Theory

Queue theory is a useful tool for determining how changing service mechanisms influences the length of queues. As there is a steady stream of arrivals into the system and completed limbs from the system, we can assume that the arrival and service patterns are consistently distributed and therefore that we can use deterministic models (Blanchard 2006). Arrivals per week (λ), based on the BoTE estimations, is approximately 9. The completed services per week (μ) would need to be determined by the clinic (either from their own records or the proposed feedback method). Queue theory has been applied over two levels. There is an initial wait (12 weeks) for the first half of service (4 weeks), then there is a second wait (2 weeks) while the product arrives from the manufacturer prior to the second half of service (4 weeks) by the prosthetist. Based on the AOPA figures, Canberra currently has 3 prosthetists and therefore 3 channels. As previously, all these numbers are a guide only. They do, however, demonstrate the desired patterns for this context.

As above, the nature of the service mechanism needs to be further defined by the clinic itself once data is collected. There are two possible outcomes depending on this. The first is that the service is able to deal with clients just as fast as they arrive. This would mean the 12 week wait period was simply a backlog that needs to be cleared once. If this is the case, we would see something like the graph in figure 3a (see over). The horizontal gap and the vertical gap between the lines represent the queue wait and size, respectively. The joining of the lines represents a clearing of the backlog.

Figure 3a

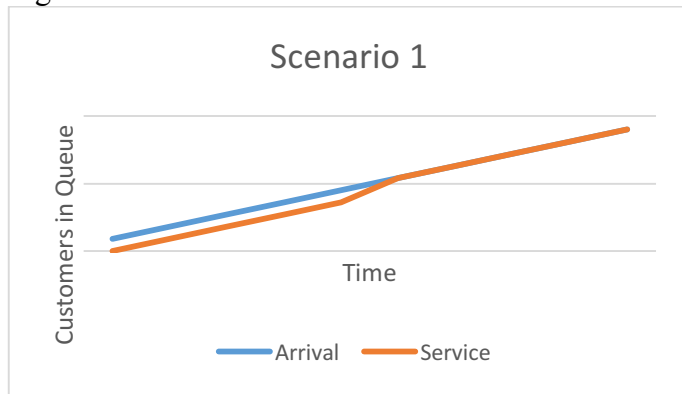
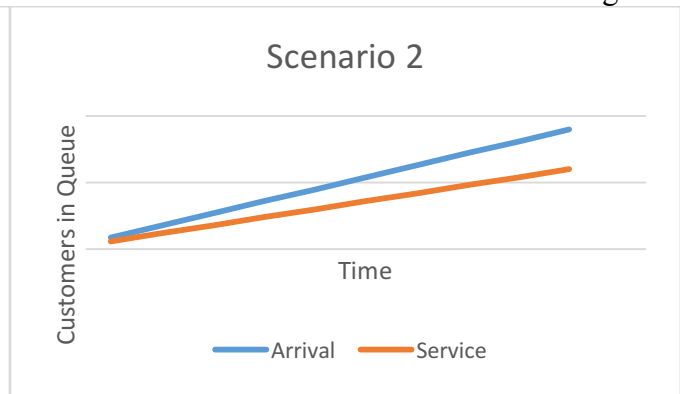


Figure 3b



Based on the low supply of prosthetists and the common long waiting periods, it is more likely that the wait is due to the service mechanism being unable to respond to demand. This is represented by figure 3b where we see a growing gap between the arrival and service frequencies. This requires a change in the service mechanism. Doubling the number of channels (prosthetists) would allow for the service period to be 1.7 times faster, as 8 weeks (where the prosthetist is doing work and not just waiting for parts as in the second level) would become twice as efficient. If the number of prosthetists was tripled (to be equal to the recommended number) then the service period would be 2.1 times faster. This could be optimised based on the clinic's measured service rate. If 2-3 weeks could be saved by implementing the other recommendations, then the service mechanism (red line) would be shifted closer to the arrival mechanism.

Outcomes

- (Clinic recommendation) Create 3D scans of clients' residual limbs, rather than creating casts that are destroyed each time.
- (Clinic recommendation) Conduct a pre-appointment survey and a post-process survey (see feedback section for details).
- (ACT Health recommendation) Hire more prosthetists. Ideally, the recommendation is to triple the number of prosthetists, however a preliminary doubling would provide a good intermediary step.
- (Clinic recommendation) Start 3D printing some sockets for clients who are willing to participate.

System Feedback and Dynamics Analysis

Dynamics and control analysis is helpful in examining where qualitative and quantitative feedback can be improved.

Feedback Mechanisms

The below chart outlines the feedback mechanisms of the system. It has been adapted from the PERT chart above. The red steps of the process are the steps where little feedback from the patient is given. The green steps are where the patient interacts with the prosthetist and therefore provides feedback on the design. The blue steps are the proposed additions. Currently, there is a high level of interaction at appropriate stages of the process as the prosthetist sees the patient multiple times to test the prosthesis. There is, however, very little contact outside of these, so the beginning and end of the process have been targeted.

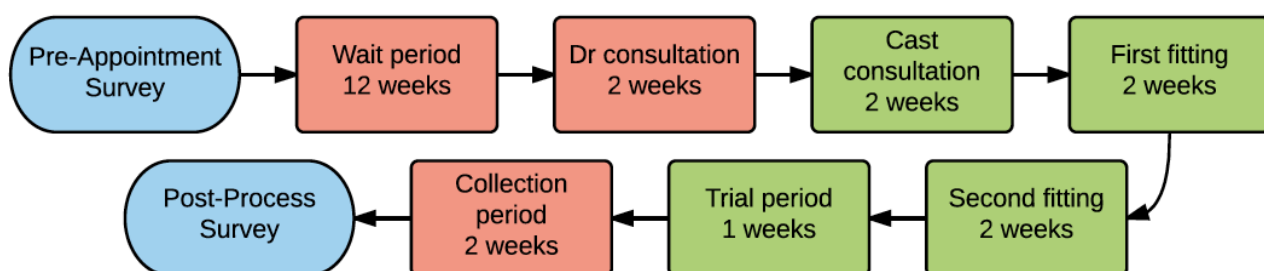


Figure 4

Pre-Appointment Survey

There are multiple purposes of introducing a pre-appointment survey. Firstly, it allows information to be gathered by the clinic in the patient's own time and reviewed by the clinic later. It means that information gathered can be more factual and comprehensive, which means that decisions about what kinds of prosthesis to supply to different people can be more informed, thorough and equitable. It also means that more urgent cases can be objectively moved up the queue. Below are the categories and types of information the survey ought to gather to meet these ends.

Table 3

Category	Type of information gathered	Purpose
Measurements	Weight, height, age.	The client's weight and height must be in the safe range of their equipment (AC 2012)
Activities	Level of activities engaged with, how often their prosthesis is used.	This can inform the decisions about what kind of prosthesis to supply.
Health complications	Whether they have experienced broken skin, infection or injury. Whether another doctor has referred them to the service.	Sockets or limbs that are not the right shape can cause broken skin or infection, which can be serious and alteration is required. If an outside medical professional has judged that the limb, or at least the socket, is no longer suitable, that opinion should be valued.
Prosthesis condition	Whether the prosthesis has cracks, how old it is, how often it is used.	Structural integrity is compromised by cracks or parts that have changed sized (AC 2012)

It is expected that the clinic would design this is tailor to their current decision making processes and the variables they generally take into account.

Post-Process Survey

Currently very little information is gathered after the client has their prosthesis. Satisfaction surveys are vital to determining whether service has been appropriate. They provide a way to determine whether decisions in the past were acceptable, whether the satisfaction of patients is acceptable, and also which kinds of products have been the most effective.

Table 4

Category	Type of information gathered	Purpose	When to be taken
Biomechanics	Functional independence measure (FIM), mobility and mortality, walking activity index	They provide a technical view on the appropriateness of prostheses (Stewart et al 2004)	These are official measures that can be taken by the clinic at the out patient stage for all patients.
Satisfaction with prosthesis	Rated satisfaction and comments on comfort, activities they can complete.	To gauge how appropriate the choice of prosthesis was, whether the socket was made well and whether adjustments are needed.	To be given to patients a few months later, voluntarily.
Satisfaction with process	Rated satisfaction and comments on the staff, wait times, steps of the process.	To identify areas for improvement within the clinic.	To be given immediately after the process, voluntarily.

System Archetypes

The dynamics of the system consists of people and therefore behaviours. System Archetypes can be helpful to explain why certain patterns, such as consistently long waiting times, occur repeatedly (Braun 2002). There are two relevant system archetypes in play. Firstly, shifting the burden where short term solutions are sought rather than long term solutions. Secondly, the attractiveness principle whereby certain challenges are tackled over others because they produce easier, or more attractive, results. These should be kept in mind by ACT Health as it analyses the feedback and during decisions about leg types.

Outcomes

- (Clinic recommendation) Conduct a pre-appointment survey and a post-process survey.

Production Factors Analysis

It is important at this stage to consider the manufacturing factors behind the choice of limbs. This section of the report looks at the materials, energy and sustainability surrounding the process.

Life Cycle Analysis (LCA)

A life cycle analysis looks at the impact of a product or process over its whole lifetime. A social assessment has already been completed, but here we will focus on the environmental considerations surrounding embodied energy and the end-of-life phase of prostheses.

Embodied Energy

While manufacturing processes of the feet are not being examined, results like these will assist the client in deciding which leg is the most environmentally friendly. The results in blue are for non-prosthetic items.

Table 5

Type	Component	Material	Approximate Quantity	Embodied Energy of Material (MJ/Kg)	Embodied Energy in Component (MJ)
SACH foot (basic)	Heel	Rubber heel wedge	30g	110 [3]	3.3
	Foot shell	Rigid foam	300g	100 [1]	30
Elastic keel feet (basic)	Foot shell	Rigid foam	300g	100 [1]	30
Cosmetic foot (e.g. OB Light) (basic)	Inside chamber	Fibre-glass reinforced plastic	200g	95-100 [1]	19-20
		OR wood		8-13 [1]	1.6-2.6
	Foot shell	Rigid foam	220g	100 [1]	22
Single-axis (articulate)	Foot shell	Rigid foam	300g	100 [1]	30
	Ankle joint	Steel	100g	20 [1] (35/9)	2
		Aluminium	100g	155 [1] (218/29)	15.5
		Titanium	100g	361-745 [1] (258)	36-75
Multi-axis (articulate)	Foot shell	Rigid foam	300g	100 [1]	30
	Ankle joint	Steel	150g	20 [1]	3
		Aluminium	150g	155 [1]	23
		Titanium	150g	361-745 [1] (258)	54-112
Carbon fibre (e.g. Triton) (dynamic)	Foot Shell (optional)	Rigid Foam	220g	100 [1]	22
	Inner	Carbon Fibre	460g	183-286 [2]	84-132
Plaster of Paris		Calcinated gypsum	100g	1.8 [1]	0.18
Padding		Silicon	10g	2355 [1]	23.6
Traditional Socket (thermoset resin)		Epoxide Resin	75g	137 [1]	10
Reinforced sockets (e.g. with carbon fibres)		Carbon fibre reinforced resin	75g	200 +	15 +
Thermoplastic socket		Low density PE.(polyethylene)	75g	78.1 [1]	5.9
Traditional Socket (thermoset resin)		Polypropylene	75g	100-115 [1]	7.5 – 8.6
Sleeve		Silicone	10g	2355 [1]	23.6
Covers		Polyurethane	100g	101-102 [1]	10

[1] (Hammond 2011) [2] (Howarth 2014) [3] (Milne 2013)

There are limitations to the use of these numbers. They are calculated by specific companies for specific production processes. Changes in production methods, transport arrangements, and composition of the components will influence the embodied energy. The numbers do, however, give a good indication of which

materials are more likely to have an impact on the environment than others. If embodied energy was the only consideration, these are the outcomes:

- Steel is the best choice of metal for joints, followed by aluminium. Titanium is drastically worse.
- Carbon fibre feet require a significant amount of energy to be produced. Most other feet, which have mostly metal and foam components are better choices.
- Using plaster of Paris for casting (as is currently done) generates negligible embodied energy.
- Silicon for sleeves or padding has extremely high embodied energy, but if small amounts are used, it is more realistic.
- Reinforced sockets by carbon fibre are not as good a choice as other sockets.

End-of-Life

An important fact about embodied energy is that recycled materials often have much lower embodied energy. For example, the virgin embodied energies of steel, aluminium, and titanium are 35, 218 and 361-745 MJ/kg. While the recycled embodied energies are 9, 29 and 258 MJ/kg. (Hammond 2011). So significant savings can be made when recycled materials are used.

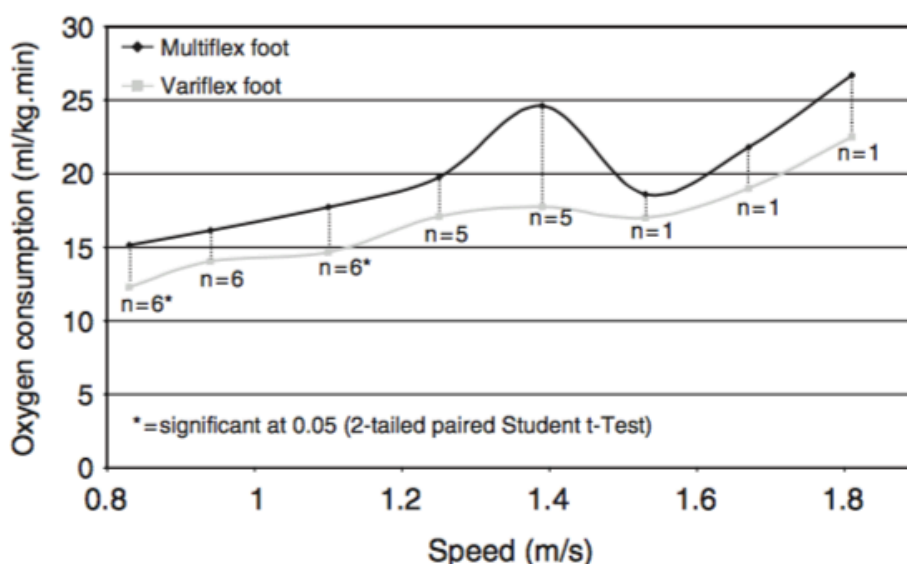
Limbs themselves can often be reused too. They can be broken down and recycled, especially if they have metal components (Orthometals 2015). The best option is that they are reused. This can be in a local context if someone requires a temporary limb, but the largest use is in developing countries where limbs are donated. There are several charities such as ‘Legs4Hope’ and ‘Stand with Hope’ set up to facilitate this (Zhang 2014).

Energy Efficiency

Dynamic limbs enable more efficient walking and running by being more energy efficient in their design and materials. Limbs that store more energy are smoother, and those that return more energy are often very efficient. The largest difference is usually seen between dynamic carbon fibre feet (e.g. variflex foot) and more conventional feet (e.g. multiflex foot).

The below graph shows the difference in oxygen consumption when amputees wear these two different kinds. The dynamic foot consistently correlates to less oxygen consumption from the person and therefore higher efficiency. These are walking paces too, which highlights that this does not only apply to highly active amputees, but low to moderate level amputees as well.

Figure 5



(Graham et al 2008)

Preferred walking speed is also a good way to measure energy consumption. Humans naturally walk at a pace that is energy efficient for them, and so with more energy efficient feet you would assume to see higher

preferred walking speeds. Below is a table comparing multiflex and variflex feet again. For the same subject, preferred speed is higher, and chosen “fast” speed is higher for variflex than multiflex (about 5-10% higher). Step-length ratio is ideally close to 1, as this represents the case when the step length of the normal limb is the same as the prosthetic limb. For both speeds, the variflex provided ratios closer to 1 (1.06 +/-0.05 compared to 1.16+/-0.12). So it was both closer to 1 and more consistent (indicated by smaller variance in values).

Table 6

Subject	Preferred Speed (m/s)		Fast Speed (m/s)		Step-Length Ratio, Preferred Speed		Step-Length Ratio, Fast Speed	
	Multiflex	Vari-Flex	Multiflex	Vari-Flex	Multiflex	Vari-Flex	Multiflex	Vari-Flex
1	1.43	1.50	1.62	1.69	1.36	1.10	1.26	1.06
2	1.18	1.27	1.45	1.54	1.11	1.16	1.28	1.13
3	1.3	1.25	1.52	1.64	1.10	1.02	1.08	1.06
4	1.19	1.38	1.63	1.68	1.17	0.96	1.01	0.98
5	1.27	1.34	1.62	1.66	1.07	1.08	1.08	1.05
6	1.36	1.55	1.64	1.66	1.10	1.10	1.26	1.10
Mean ± SD	1.29±0.19	1.38±0.13	1.58±0.20	1.65±0.07	1.15±0.11	1.07±0.07	1.16±0.12	1.06±0.05
P	<.001		<.001		.176		.03	

The same study also found that the variflex foot provided significantly more flexibility in the foot, higher ankle power and greater comfort, but no more symmetry or alignment while walking. Another study found that energy saving feet create more mechanical work on the centre of mass when trailing (33%) and less negative work when leading (13%) (Wezenberg 2014). These lead to a reduced step-to-step transition cost, better pushoff power generated and therefore an improvement in walking economy.

A similar study examined the mechanical power outputs of SACH, Seattle, and flex feet at walking pace. The demonstrated that the SACH foot generates negligible energy during the “pushoff” phase of the motion (when the prosthesis leaves the ground). To compensate for this and less energy absorption at the knee, an increase in energy generation in the hips is required. (Gitter 1999).

All studies indicate that energy storing feet are beneficial not only for athletes, but for low to moderate walkers too.

Outcomes

- (ACT Health recommendation) Negotiate more funding for prostheses with the Artificial Limb Scheme for more energy storing feet.
- (Clinic recommendation) Avoid providing prosthetic limbs with high carbon fibre content or high embodied energy metals like titanium.
- (Clinic recommendation) Conduct a pre-appointment survey and a post-process survey (see feedback section for details).
- (Clinic recommendation) Prescribe more modern technology (this would be based on the results obtained by the feedback).
- (Clinic recommendation) Review of process by which some people get better feet (again, this would be based on the results obtained by the feedback).
- (Clinic recommendation) Choose manufacturers who use recycled materials.

Cost Factors

Cost is the largest restricting factor in the process as it is what stops high quality products being provided.

Cost Life Cycle Analysis (Current Costs)

Table 7 outlines estimations of the largest costs that are incurred in the process.

Table 7

Stakeholder paying	Cost Description	Amount	Fixed or Variable
Client	Maintenance fee	20% (maximum \$200)	V
	Upgrade	\$1000s	V
ACT Health	Prosthetist rate per client per limb	\$500*	F
	<i>Prosthetist annual salary</i>	<i>\$71,200</i>	<i>F</i>
	Basic limb	\$1000-2000	V
	Additional components	<\$500	V

*Based on weekly salary of \$1424 (Dept of Education 2013) and 11 clients per prosthetist per month (an estimation made from the quantitative analysis).

From this, it is clear that the largest cost is the limb and that most costs are variable, which means effective decision making processes need to be in place.

Impact of Recommendations

Table 8 outlines the expected effects of implementing the final recommendations. Green cells represent positive impact, yellow neutral and red negative.

Table 8

Recommendation	Impact	Amount
Creating 3D scans of limb	Saves time and therefore money on prosthetists	\$80 per client per limb*
3D printing of limbs		
Pre-appointment survey	These surveys and booklets will require time investment from existing staff.	These costs can be considered as part of the current administration budget.
Post-process survey		
Information booklets provided		
Review of process by which some people get better feet		
Eliminating maintenance fee for students	Up to \$200 per person will have to be paid by ACT Health	**\$13,400
Hire more prosthetists	Doubling or tripling the staff would be a significant cost	Double staff – \$213,600 Triple staff – \$427,200
Prescribe more modern technology (based on survey satisfaction rates)	High cost to ACT Health for quality products	\$5-50,000 per patient (CBM 2015)

*Based on saving 2/12 weeks by using 3D scans and printing.

**This assumes that the percentage of amputees who are students is the same as the percentage of the general population (5.6% - Australian Government 2014b). The cost is likely to be lower than this because people tend to have amputations at an older age.

Unsurprisingly, prescribing more modern technology is the most expensive, but also the most variable. This emphasises the need for stronger feedback on limbs from clients and improvement of the decision making process when allocating limbs. This is because it needs to be determined whether clients have a reasonable satisfaction level with their foot and their quality of life, or whether high costs would be justified in improving these levels as targets in satisfaction and health are not being met.

Cost-Benefit Analysis

Once the clinic begins collecting feedback, they could take the cost assessment further by conducting a cost-benefit analysis. The clinic could put a very high benefit on improving patient satisfaction from very low to

acceptable and then a low benefit on improving it from high to very high, for example. At this stage, too little information is known, so the values attributed to benefits would be arbitrary.

Investment in Prevention of Diabetes

As diabetes is going to have such a high impact on the future growth of amputees in Australia, it would be a good measure to invest in diabetes research, prevention and management. This could see a reduction in the number of people requiring prosthetics in the future. In America, it is estimated that a 10% reduction of diabetes estimates for 2050, would lower the number of prostheses required by 225,000 (Ziegler-Graham et al 2008).

Co-Payment

Currently there is no means testing for determining whether a client must pay the maintenance fee. Currently full time students are required to pay it as the only condition that allows it to be waived is that the client has a health care card. This co-payment only exists in the ACT, no other states. (Sutton 2015). A more comprehensive check is required to ensure low income earners are not adversely affected.

Outcomes

- (Clinic recommendation) Create 3D scans of clients' residual limbs, rather than creating casts that are destroyed each time.
- (Clinic recommendation) Start 3D printing some sockets for clients who are willing to participate.
- (Clinic recommendation) Conduct a pre-appointment survey and a post-process survey.
- (Clinic recommendation) Prescribe more modern technology (this would be based on the results obtained by the feedback).
- (Clinic recommendation) Review of process by which some people get better feet (again, this would be based on the results obtained by the feedback).
- (ACT Health recommendation) Negotiate more funding for prostheses with the Artificial Limb Scheme (again, this would be based on the results obtained by the feedback).
- (ACT Health recommendation) Review the decision about who has to pay maintenance fee, with the removal of fees for full time students in mind.

Conflicting Recommendations

The following recommendations from the production from the production factors section

- (ACT Health recommendation) Negotiate more funding for prostheses with the Artificial Limb Scheme for more energy storing feet.
- (Clinic recommendation) Avoid providing prosthetic limbs with high carbon fibre content or high embodied energy metals like titanium.

Energy storing feet are inherently more expensive and less sustainable, however they are also better quality. At this stage, the quality of life of the amputee is considered more important than the small environmental impact of using higher embodied energy materials. The social impact assessment demonstrated that these things were likely to have big impacts on amputee wellbeing. This conflict further emphasises the need for the post-process survey. Once satisfaction levels and opinions on quality of life are gathered, the clinic can make better decisions about what is and is not necessary.

Conclusion

This report has provided guiding recommendations that are intended to provide ACT Health and the ACT clinic direction in improving their services within the context of lower limb prostheses. It has not tried to do things that the clinic should be assessing, which is why one of the most important recommendations is that the clinic improves its feedback mechanisms in order to make better decisions. The recommendations produced are applicable not only to the ACT, but to all Australian states or even to any prosthesis clinic.

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Appendix

Appendix 1 Interview 1

What kind/brand of prosthetic/s do you currently use?

So, I have an Otto Bock Axtion foot, you can read more about it here

http://www.ottobock.com/cps/rde/xchg/ob_com_en/hs.xsl/2037.html

There are a few main companies that develop and manufacture prosthetic components. The two most commonly used ones in Australia are Otto Bock and Ossur.

I think I have always had an Otto Bock foot, and I have had about 4 or 5 in 10 years.

Each foot comes with components and I'm not sure if they are all Otto Bock brands or how that works.

The prosthetic clinic builds each leg from scratch, depending on your requirements, from your stump (where it is, the condition like skin grafts etc), to your age, activity levels, weight etc.

I'm pretty active, and usually have a foot that suits being able to run.

This foot is brand new, I have had it about 2 weeks. It's not as good as the one I used to have, which was very good for running on. I haven't taken this one for a spin (run) yet as I've been getting used to walking first. I am feeling unsure about it! But, I will give it a good red hot go.

The reason it's not as good is that ACT Health isn't willing to spend as much on my foot as QLD Health was (which is where I have come from), we amputees are often at the mercy of the government!

In Australia, there is a federally funded 'artificial limb scheme' that funds prosthetics. In America, they are not so lucky, and funding is also being cut quite severely - there has been a bit in the (amputee) news about that lately.

If you use more than one, what are the different purposes of them?

I do have another leg, which is because I could afford to self fund it a little while ago. I recycled an old foot to do so (made it cheaper for me).

The reason I got another was that I wanted a fall back one, incase something happened to my regular one. I was moving overseas for awhile and it seemed like a good option.

The other reason is for cosmetics - my regular one is cute but it does have the pole visible which makes it lighter and nice to use all day. The second leg has a full cosmetic cover. It's really nice (has artwork on it) but it's getting old and no longer very comfortable. I pretty much only wear it for photo shoots or going out to dinner somewhere fancy.

If you use just one, is that because of:

- No use for more

There is always use for more! Some people have water legs they use at the beach, in the pool, in the shower. I prefer not wearing a leg in water, it's a really nice feeling.

Others, usually self funded, have a cheetah leg (the sprinting leg) and I'd love one of those too :)

- Financial restrictions

It is very expensive. The leg I pay for is the most expensive thing I own, aside from my car. Now as a student, I can't afford to self fund another, so when this extra one I have kicks the bucket that's it until I'm working full time again and can save enough. :(

- Never considered it

We always consider it. Every amputee would love choice. It's like shoes. It's always nice to have more than one pair..

- Other..

Are there any activities that you cannot currently do with your prosthetic? Would you like to be able to do these?

As mentioned my current one is brand new, so I'm not 100% what I can and can't do with it yet.

So, let's pretend I'm talking about my old one. I could sprint quite well on it, good for cardio exercise.

However, it was so good for long distance running. Not sure I am fit enough for that, but I'd love to give it a go, but

lack of leg is holding me back for sure.

I wish there were more cosmetic options in Australia where I could clip on something that I can then wear tights over, so I didn't need 2 legs. I prefer the pole day to day but I do love dressing up and wearing nice clothes that don't necessarily go with poles..

I'm otherwise pretty ok with my leg - it's good quality, comfortable, reliable.

The one thing that I do do is have it built quite high around my knee to the 'suggested' designs, which helps my tiny knee stay stable and walk well. However, it means I can't squat so well in it or ride a bike - because the back is too high and it digs into the back of my knee. The skin there isn't as sensitive as it used to be, but I think that's because I've been so very careful to avoid rubbing it and doing squats! But, if I could, I'd love to be able to ride a bike. Even if it's just at the gym. Some people use a regular leg for this, and then, there are the paralympic cycling legs which are AWESOME: <http://www.telegraph.co.uk/sport/olympics/Team-GB/9283442/ParalympicsGB-technology-behind-prosthetic-cycling-legs.html>

I know that above knee amputees (I am below the knee) have more problems due to replacing the knee joint. If an above knee amputee doesn't have a decent leg (such as the "c-leg") they experience a lot of difficulty and discomfort.

And of course, hand amputees are completely different again, they want to be able to eat, go to the bathroom, dress themselves etc.

A lot of people assume I would love a bionic foot - but in all honesty I'm not too bothered! Sure, one day that would be nice, but for now, it would be super heavy and that's not for me. What it would be super great for, I hope, is different terrains. Walking on rocks and pebbles can be tough, I always look drunk and unco.

Be sure to check out Osseointegration too - it's fascinating! Basically, I now wear a silicon sock with a pin in it, that clicks into my leg and keeps it all on me. Osseointegration is where the pin is surgically implanted into the bone and you can click the leg on and just go. The only place that does it in Australia is in Sydney. I think one day I will consider this, mostly for the comfort of not wearing a liner, which is very hot and can cause problems like ingrown hairs, heat rash etc.

<https://en.wikipedia.org/wiki/Osseointegration>

I met a guy years ago who used peg legs and I asked why and he said that they were "better for shootin' an' fishing" - a regular foot would get stuck in the mud, you can't flick the mud off as easily... :)

Now and then you see someone with a peg leg - not so much the pirate style but with a small square is foot at the end.

How long did it take for you to get your prosthetic?

This was quite funny, because it was the first time I had gone to ACT Health. Here, they have a 3 month waiting list for an appointment, which I am sure you can imagine is NUTS. I think I actually said WTF when they told me that on the phone. So, first step is you have to meet the clinic / prosthetist (i.e., wait 3 months) and they have to agree or assess that you need a new leg, then you have an appointment with the doctor who gives you a script for a new leg - as it's all paid for by medicare. I don't take the script home, it's all internal clinic paperwork pretty much.

The guys here were very confident and said it would take about 3 appointments over 6 weeks. That was (1) take a cast of my stump (2) have a fitting (3) collect the leg

It took quite a few months in the end, and I think it shattered this guy's soul!!! My stump is very difficult to cast/fit because I have no fibula. They have ways of taking the cast that are not suitable, so he had to go back to an old fashioned way with sting and weights and well... it still didn't go so well. I had so many fittings, all crap. Finally we had a breakthrough and I could walk well and was happy to give it a go. Part of this was the guy being really stubborn and not listening to me. For example, I said how I have it built higher for my knee and he just wouldn't do it - but I was almost falling out of the leg and really wobbly, he gave in, built it up higher and that helped tremendously.

I would love to have a 3D cast done one day, I bet that would be easier and would fit me!! One day one day...

I should note, that when you first lose your leg you have to desensitise your stump and your scar has to heal a fair amount before they even take a cast. You need to be able to wear the leg (the pressure is on the side of your knee for a below knee prosthetic) but also to cope with the socks and what not. I used a range of fabric from a cotton ball to velcro to get used to sensations. My scar took awhile to heal because one stitch didn't dissolve as it should have. They like you to be well healed otherwise your stump can bust open - omg! I thought this was an old wives tale, until a

friend of mine had a fall not long after her amputation and BAM her scar burst open. It was a godsend in the end, because it turned out her bone was dying and the hospital had missed it?! She lost more of her leg but she would have lost a huge amount more if it wasn't caught so soon.....

Briefly, what was the process (from first needing it to being able to use it)?

So, like shoes, legs can breakdown over time, wear and tear basically. Or, your stump can change. Kids can get taller too. Everyone can put on or lose weight which can effect your stump.

All of these reasons can impact why someone might get a new leg.

Or, sometimes they just break too. Especially if you're pretty active, or if you have had it for ages and ages.

I've sort of explained a lot of this above anyway, but they take a cast, and then from that make a socket (the bit your stump goes into) and then attach to the foot and pole.

To get the height they take your measurements but it's never quite right. And the foot alignment can take a few goes to get right.

To swap from leg/foot to another leg/foot can take a few mins to adjust. At first you're wobbly, almost like a drunk walk.

To then swap back and go home I'm usually left with a sore back for a day or so. It can be pretty taxing.

So, after a few fittings, sometimes clinics get you to take home a test socket - so, daggy thing you wear for a week or so before agreeing it's ok.

Sometimes I've done this, sometimes I haven't. I didn't this time. Instead, I walked a few kms around the clinic with the prosthetist to test it out.

Then, you get your actual socket/leg and with cosmetics. I provided the clinic with some fabric to use to spruce it up a bit.

You can use anything really - soft floppy material. T-shirts are good to use, or just fabric from Spotlight etc

Which companies/health providers/government bodies were involved?

You don't really get involved in a lot of this here in the ACT, you go to the one clinic, you see their doctor, their staff and they process everything. There are no private clinics here, it's only ACT Health. Which is good and bad. Good because it's less running around, bad because there is no choice.

In Qld it's a bit different. When you first lose a limb you get your first prosthetic from the hospital clinic, it's called an interim. It's about as cheap and shit as you can get, but it's to get you walking.

After that, you graduate to a definitive one, which is made by a private clinic and funded by medicare. You do have to see a Qld Health doctor (at the amputee clinic at the public hospital) to get the script, and then you go to the private guys, and once it's all ok you can get signed off by the hospital to process payment.

In ACT, it's also interesting to note, that we have a copayment system. I have to pay a % towards my prosthetic equipment and maintenance each financial year.

In Qld, and all other states, it's 100% covered.

If you have a health care card, you're exempt. I am a full time student with a part time job, no health care card, I have to pay the fee.

They always hope a leg lasts you at least 3 years and they think this copayment system helps people care for their leg more. But again, there are so many factors from wear and tear and body changes than can effect this. And if someone is a rough nut, they will still be a rough nut.

Hopefully that's not too much. Thank you so much again for your help!!

Not at all. If that has raised any further questions feel free to email again or we can meet up on campus, Tuesdays and Thursdays are good for me.

A few other things that might help are:

A TEDx talk that I did a few years ago <https://www.youtube.com/watch?v=yzDXK6yvS70>

An exhibition about prosthetics I do from time to time: <http://icollectspareparts.com> (there are heaps of news articles for each year)

An FAQ story I did for the ABC a few years ago: <http://www.abc.net.au/rampup/articles/2012/06/05/3518515.htm>

And this is my new leg (photo below)! I took this at work the first day I got her. So, I'm in my uniform and there is kangaroo shit everywhere - haha!! But, I was pretty excited and didn't notice at the time.

You should also google my friend Viktoria Modesta and also our friends that make her legs - amazing stuff <http://www.thealternativelimbproject.com> (they are all UK based)

And these guys in Canada do amazing cosmetics also - <http://www.alleges.ca>

The 'mechanics' of legs are obviously the most important. But, no one wants an ugly leg, so the cosmetic stuff is really important too :)

Interview 2

1. Would it be ACT health that made a 3D cast for you? Or would you have to organise that yourself? It seems like a great way to save time/hassle. Would that be the main benefit for you?

As 3D casts aren't currently available, this is just a guess, but yes it would be ACT Health that do it. There is talk of a private prosthetic clinic opening in the ACT, with the introduction of the NDIS here. If that was to happen, that clinic would be more likely to do something like that, I think anyway.

To organise it myself, I would have no idea where to go, and even if I had the scan, I don't think ACT Health would know what to do with it. It's pretty backwards there :(

It would be MAGICAL to have, and I think in the case of my stump being very difficult to get a cast of, it would be wonderful to utilise. My stump is difficult because I don't have a fibular bone, and there is a sort of lump here it might start, and a lot of clinics have had trouble casting because of that, and my short stump itself was a problem for the guy here in the ACT (never for the guys in Qld!).

2. Did ACT Health supply you with much information before the process began? Or was it all given over the phone?

I've been an amputee for 10 years, so they didn't go over much with me, there were a lot of assumptions. When I asked questions and also questioned decisions it was awkward, I think a lot of amputees don't ask and are left in the dark :(

When they decided to buy me the cheaper foot, he rang me to tell me, and I was in the library at ANU going "WTF" on the phone. I was one of *those* students that day!

Aside from that depressing phone call, it was all done in person. They don't give any written info about the foot, I had to research it myself.

3. Can I just grab the people you dealt with at each stage?

Initial consultation =

Prosthetist

Appointment for script = Doctor (a GP or one of their doctors?)

Dr at Prosthetic clinic - no idea if they were a specialist, I barely caught their name! We are herded in like cattle... it's the same in Qld too.

Cast of stump = Prosthetist

yes

Initial fitting = same.

yes

Other fittings = same.

yes

4. Do they decide whether you need a new leg based on how worn it is? Or by asking questions about how long you've had it and things like that?

For me, it's always been that my stump has shrunk or changed enough to warrant a change. I haven't ever had one long enough for it to be worn down, but that is a common aspect for many amputees.

For others it may also be weight gain, weight loss, growing (kids), shrinking (oldies!).

They always ask how long we'd had the leg, they often like them to last at least 3 years. The one I just replaced was the oldest I ever had and it was about 3+ years

5. If you had to pick a few things that ACT health could do, what would you say could improve the whole process? Or, what would you say were the worst parts of the process!

I'd like better staff to be honest. The guy who makes my leg is nice, but REALLY depressed. I find it quite draining to be around him. The dude needs some perspective/help. I walk in happy and say "Hi how are you?" and he says "Oh been better. Life is awful" and I think, cheer up mate, you've got all of your limbs for gods sake!! hahah!!! Crikey hey.

The front desk staff are cold and rude, they don't give a shit. Other clinics have really impressed me, they are warm, friendly, welcoming, caring. Not at ACT Health. They barely look at me when I say I'm there for an appointment.

One day, I cancelled my appointment by voicemail really early, like 6am, when I was super sick and unable to come in. No one passed it on, and amputees who were waiting (the wait list is 3 months!) could have been called to come in. They didn't do a welfare check on me until about lunch time to see if I was ok, because I usually turn up to appointments. The guy was frustrated no one told him about the voice mail as well.

The funding is shithouse, I have to co-pay, even though it's only a little, it was explained to me that it will make amputees "care more" and not wreck their legs expecting a replacement, which I just find insulting, and I think it's just scabby... ! I have been meaning to call the Chief Minister on one of his 666 ABC chats to ask him about this!! Seriously!!

In addition to the co-payment, they wouldn't match the quality of foot/leg I had made in Qld. I got the poor cousin, which is still good, just not the best. Perhaps I have high expectations! They also bought me cheaper parts, which have already had to be replaced (that's since my last email). The leg is brand new and clicking like it's going to fall apart when I run - he didn't believe me, and I wore my running shoes in replicate and show him... he was shocked. It's a 2 week wait to get the 'better' and new parts in!

I probably sound a little cranky tonight, but I'm not! Just need to win the lotto so I can get some proper whiz bang mates to make some legs for me instead of this ACT Health stuff I have to use, because I am without all of the money! :))