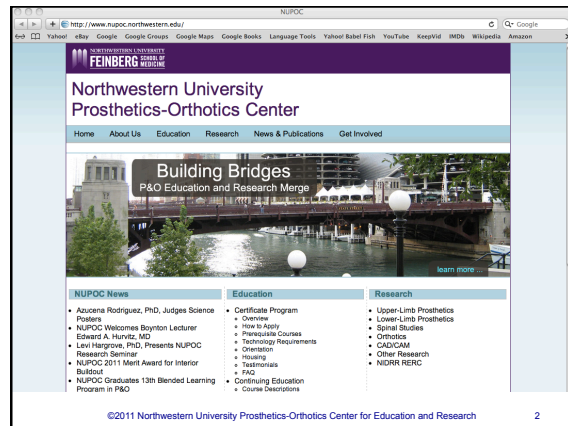


## Assessing and Responding to the Prosthetic Needs of Farmers and Ranchers – Update

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## Project Background

- Farming is a dangerous occupation: in 2009 in the USA, farming had the 5<sup>th</sup> highest fatality rate (*Forbes.com* 9/12/09)
- The National Safety Council reported that among agricultural workers *"one out of every ten... will suffer an amputation while on the job"* (*Kircher, 2003*)
- The National Institute on Disability and Rehabilitation Research (NIDRR) identified farmers with disabilities as an underserved population with regard to assistive technology (*Office of Special Education and Rehabilitative Services, 2008*)

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## Project Rationale

- Experiential documentation and qualitative research suggest that current prosthetics technology is not meeting the needs of farmers and ranchers with amputations.
- To better understand the prosthetics needs of farmers and ranchers with amputations, a descriptive qualitative study was developed to collect data with an engineering perspective.

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## National AgrAbility Project

- Our project is a collaboration with the National AgrAbility Project funded by the U.S. Department of Agriculture
- AgrAbility provides services to farmers and ranchers with disabilities, including technical assistance, information dissemination and professional training to consumers and professionals



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## Project Goals - I

- Identify activities in which prosthetic devices are either a help to farmers and ranchers or a hindrance
  - personal interviews with farmers and ranchers who have amputations whether or not they use prostheses
  - personal interviews with prosthetists who provide services to farmers and ranchers
  - broad (paper and online) survey of farmers and ranchers and prosthetists

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## Project Goals - II

- Promote appropriate clinical designs
  - Develop educational materials and tutorials for prosthetists in collaboration with NUPOC's education faculty

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## Project Goals - III

- Improve prosthetic componentry (I)
  - Collect and analyze failed devices
  - Disseminate failure data to manufacturers
    - This is very difficult!
      - Farmers often maintain their own devices
      - Farmers keep old devices and parts as backup
      - Farmers generally can't tell us what model device they are using
- Improve prosthetic componentry (II)
  - Identify and conduct engineering development projects to improve prosthesis designs

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## 26 Prosthetists Interviewed to Date

- |                 |                    |
|-----------------|--------------------|
| • Colorado (1)  | • Mississippi (1)  |
| • Georgia (1)   | • Nebraska (1)     |
| • Idaho (2)     | • North Dakota (2) |
| • Illinois (5)  | • Ohio (1)         |
| • Iowa (3)      | • Texas (1)        |
| • Kentucky (1)  | • Vermont (2)      |
| • Minnesota (3) | • Wisconsin (2)    |

Years of prosthetics experience: 5 – 35 years

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## 40 Farmers Interviewed to Date

- 23 with lower-limb amputations
  - 14 unilateral transtibial
  - 1 bilateral transtibial
  - 1 knee disarticulation
  - 6 unilateral transfemoral
  - 1 bilateral: transtibial and transfemoral
- 17 with upper-limb amputations
  - 1 partial hand amputation
  - 1 unilateral wrist disarticulation
  - 7 unilateral transradial
  - 2 bilateral transradial
  - 3 unilateral transhumeral
  - 1 bilateral transhumeral
  - 2 unilateral shoulder disarticulation
- 37 men and 3 women

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## I - Prosthetic Challenges

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## Farm Environments



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## Prosthetic Challenges - Environment -

- Walking on uneven terrain
- Getting caught in weeds or stuck in mud
- Exposure to dust and dirt
- Weather
  - Extreme temperatures
    - Heat – sweating and chafing
    - Cold – numbness and frostbite
  - Rain, moisture

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## Job Tasks


[www.epiac1216.wordpress.com](http://www.epiac1216.wordpress.com)

[www.agrabilityproject.org](http://www.agrabilityproject.org)


Screen captures of video "Farming with an Arm Amputation", Breaking New Ground Resource Center, Purdue University, copyright 1987

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## Prosthetic challenges - Job Tasks -

- Climbing – silos, tractors, ladders, fences
- Squatting, kneeling
- Driving / operating a variety of vehicles and machines
- Using wide variety of hand tools, power tools and farming implements
- Exposure to biological and chemical contaminants

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## II – Education Issues

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## Education Issues - Prosthetists Views -

- Prosthetists who work with farmers, especially those who live in cities, need additional education to understand the occupational tasks of farming
- There is too much theory, not enough fabrication experience; farmers need simple, customized devices (can't send device off to manufacturer for 3 weeks)
- Prosthetists would like web-based learning opportunities about prostheses for farmers and ranchers
  - Continuing Education Credits

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## Education Issues - Farmer Views -

- "Many people don't work with good quality prosthetists. People with amputations don't understand how good a fit you can have..." (drives 4.5 hrs to Chicago for care)
- One farmer tried seeing a local prosthetist but he did not have the expertise needed for a shoulder disarticulation (flew to Chicago from Missouri for a few years until he stopped using prosthesis)
- Many prosthetists work with only a handful of farmers; expert prosthetists are needed to give advice to new practitioners (suggestion: establish a hotline)

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## Education Issues - Farmer Views -

- One farmer with a transhumeral amputation believes that lack of education by his prosthetist resulted in frustration that led him to abandon his device
- Farmers generally do not receive training in work-related tasks
- The most helpful training received by lower-limb amputees was "learning how to fall safely"

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## III - Improve Prosthetic Componentry

### Lower Extremity Issues

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## Farmer with transtibial amputation

"If a manufacturer says a component should last one year, for me it lasts about 3 months."



Dairy and cash  
crop farmer in  
Janesville, MN

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## Farmer with transtibial amputation

"My prosthetist tells me that I am the only patient that tests all components to the limit and break components that others have had for years. Yes, my activity level is high because of my occupation but not everyone has low activity occupations. What do others do???" (Sept. 2010)

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## Lower-Extremity Interview Results

### Cause of Amputation:

- 10/21 (48%) were injured in MVA
- 7/21 (33%) were injured by farm equipment
- 1/21 (5%) secondary to ankle fracture
- 1/21 (5%) was injured when tree fell on him
- 1/21 (5%) amputation due to aneurism
- 1/21 (5%) congenital

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## Lower-Extremity Interview Results

- 17/22 (77%) report falling multiple times
- 17/20 (85%) report problems traversing uneven terrain
  - 14/20 (70%) report using an ATV or other mobility assistive device to traverse uneven ground

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## Adaptations

- In order to cope and function farmers often made adaptations to their farm equipment, routines, and attitudes.
- Examples:
  - adding hand controls to vehicles
  - rely on assistance to get up and into vehicles
  - *“First, you must have a good attitude, otherwise, you won’t use the device.”*
  - *“You have to believe in your leg.”*

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## Prosthetist Interviews - LE Issues/Challenges -

- 7/21 (33%) - bolts break in feet
- 6/21 (29%) - gel liners get holes too easily
- 4/21 (19%) - need better feet and ankles that adapt to uneven terrain
- 4/21 (19%) - poor knee control causes falls

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## Prosthetist Data

- The weight limit of lower limb devices is regularly exceeded
  - Farmers lift wheelbarrows loaded with >700 lbs.
  - Pick up 90 lb. bags of feed
  - Jump off tractors, over fences, etc.
- “Some farmers break every component.”
- “Every component needs to be beefed up.”
- Some prosthetists make poor component choices for farmers because they don’t know farming

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## Durability Issues

In general, components break catastrophically

- Can lead to serious injuries
- Prosthesis users need to be attentive
- Manufacturers should consider component designs that fail in non-catastrophic manner to give user warning

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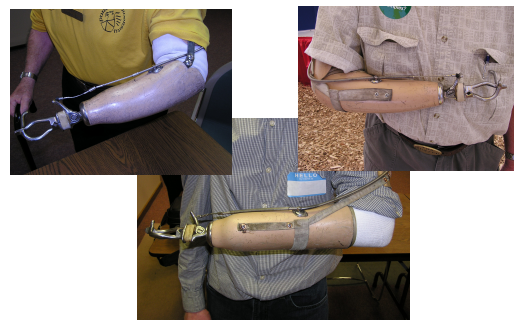
## III - Improve Prosthetic Componentry

### Upper Extremity Issues

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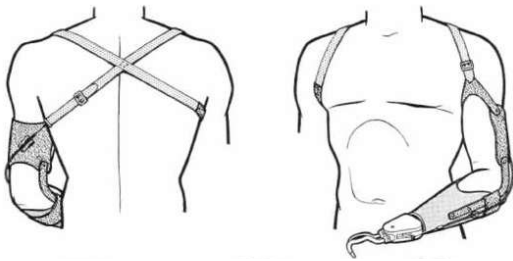
## Farmers - Transradial Prostheses



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### Transradial Figure-8 Harness



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### Upper-Extremity Interview Results

#### Cause of Amputation:

- 12/16 (75%) were injured on farm equipment
- 2/16 (12.5%) were injured in MVA
- 2/16 (12.5%) were injured when they came into contact with power lines

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### Upper-Extremity Interview Results

- 5/16 (31%) no longer wear a prosthesis
  - 2 SD, 2 TH, 1 Bilateral TH
- 7/16 (44%) own a myoelectric device, but do not use it for farming
  - 3/7 consider it cosmetic and use it only for social occasions
  - 3/7 no longer use the device
  - 1/7 uses it for bike riding only

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### Prosthetist Interviews - UE Myoelectric Issues -

- 5/25 (20%) have never issued a farmer a myoelectric device
- 5/25 (20%) have issued farmers myoelectric devices for specific farm tasks or for use when not farming
- 1/25 (4%) issued an iLimb to a farmer!
  - Uses iLimb to operate touch screens in tractor cab
  - Protects it with work glove
  - Needs frequent repairs
  - Believes it is the way of the future “at least in Iowa”

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### Prosthetist Interviews - UE Problems -

- 8/25 (32%) cables fray or fittings come loose
- 7/25 (28%) wrists are weakest link
- 3/25 (12%) hooks bend
- 3/25 (12%) suspension sleeves get holes

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### Prosthetist Interviews - UE Problems -

durability  
durability  
durability  
durability !!!

consistent performance within wide temperature range  
exposure to corrosive or damaging liquids  
exposure to airborne particulates  
maintaining healthy limb within closed socket  
removal of biological and chemical contaminants  
maintainability

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## General Issues

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## Simplicity is Preferred

- More complicated equipment is generally viewed as not durable
  - “parts that are too complicated fail”
- Mechanical devices are preferred because they can be cleaned with soap and hot water
- Most farmers interviewed do some of their own repairs or modifications
- When parts need to be repaired “time is money”
  - can't send prosthesis away because they don't have a back-up

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## Cost / Insurance Coverage

### Insurance coverage status (N=30)

- 15/30 (50%) - Private insurance
- 6/30 (20%) - No insurance
- 5/30 (17%) - Worker's comp
- 3/30 (10%) - Medicare/Medicaid
- 1/30 (3%) - VA

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## Cost / Insurance Comments

- “I have good insurance that paid \$30,000 for a device that now sits in a closet.”
- “My insurance gave me so much trouble, the community had a fundraiser for me.”
- “Yes, I have insurance, but I also have a \$5000 deductible.”
- “I own a private insurance policy that only pays for one leg per lifetime.”

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## Present and future work

- Developing 2 online surveys, upper-limb and lower-limb versions to gather data from a larger cohort
  - in final revision
- Further analysis and publication of qualitative data
  - manuscript ready for submission to publisher
- Create list of design initiatives; prioritize after collecting survey data

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