Evaluation of Additive Manufacturing (3D Printing) in the Field of Prosthetics and Orthotics

John A Kesselring MSPO Student, Goeran Fiedler PhD, Jonathan Pearlman, PhD
University of Pittsburgh Prosthetics and Orthotics Program, School of Health and Rehabilitation Sciences

INTRODUCTION

The aim of this research is to provide substantial background information which the United States Association of International Development (USAID) can use to communicate the effectiveness of Additive Manufacturing (AM) colloquially known as 3D Printing in the field of Prosthetics and Orthotics (P&O). AM technology is predicted to become a $6.1 million industry by 2017 (Wohlers, 2013). The recent developments in technology and materials have led to excitement about products within O&P such as printed prosthetic sockets (Herbert, 2005). We investigated P&O practitioner knowledge about AM to determine attitudes towards AM and its usefulness in clinical practice.

METHOD

Subjects: Subscribers to an electronic mailing list, the OandP.com ListServe, were recruited as participants.

Procedure and Apparatus: This research used a ten question survey administered by an online data collection platform (Google Forms). The first part of the survey contained questions designed to estimate responders' knowledge level, using multiple choice questions with several incorrect and only one correct answer choice (Table 1). The second part of the questionnaire assessed opinions and attitudes toward AM (Table 2).

Table 1: Sample Multiple Choice question with answer choices

In your opinion, which of the following is NOT a 3D Printing manufacturing process?	
A)	FDM – Fused Deposition Modeling
B)	SL – Stereolitography
C)	DLM – Digital Light Modelling
D)	CLM – Calorimeter Laser Modeling
E)	Not sure

Table 2: Sample Opinion question with answer choices

3D Printing is a beneficial tool in the fabrication of prostheses and orthoses									
1-Completely agree	2	3	4	5	6	7	8	9	10-Completely disagree

Data Analysis: Preliminary data was analyzed and answer partitioning was performed to provide a scoring of the first four survey questions. Later analysis will evaluate remaining answers.

The methodology obtained IRB exemption status.

RESULTS

The research survey yielded 68 responses. Responses to the first four questions allowed a coarse rating of participant's knowledge about AM. The mean score was 46% with a standard deviation of 35 in a non-normal distribution (Figure 1).

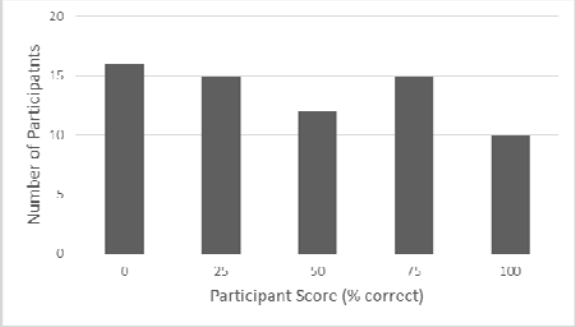

Figure1: Distribution of participant's scores.

Preliminary review of the opinion questions indicates that AM technology would generally be accepted in clinical practice. 51% of respondents disagree with the statement that AM would replace practitioners within the next 20 years. Similarly, 23% agree with the statement that AM is a beneficial tool in the fabrication of prosthetics and orthotics. Finally 27.9% stated that they would spend the time, money, and energy necessary to be trained to use a 3D Printer.

DISCUSSION

Our research found a more positive attitude on AM among P&O clinicians than anecdotal evidence may suggest. The results demonstrate a range in the level of understanding of the technology. Future use of this information can provide a baseline to monitor the attitude towards AM as it becomes a more intensely debated technology in the field of O&P. The acceptance of AM technology within this sample is higher than expected. However, specific technical knowledge is somewhat limited.

CLINICAL APPLICATIONS

The use of AM in the field of O&P holds promises of easier customization to patients at lower costs (Herbert, 2005). Currently the technology is used in a wide variety of applications (Gerbhardt, 2011). A background of the technology and opinions within the field of O&P will help guide decisions surrounding adoption in clinical practice or in USAID endeavours.

REFERENCES

Gebhardt, A. Understanding Additive Manufacturing, 27, 28, 2011. Herbert, N. JRRD. 42(2), 141, 2005 Wohlers, T. T., Wohlers Report, 2011 Wohlers, T.T., Wohlers Report, 2013