

# DEVELOPMENT, VALIDATION, AND USER TESTING OF A RECUMBENT PATIENT WEIGHING SCALE FOR PEDIATRICS

Kayla Rettig,<sup>1</sup> Linda Thompson,<sup>2</sup> Alan Eberhardt<sup>1</sup>

<sup>1</sup>Department of Biomedical Engineering, <sup>2</sup>School of Engineering, The University of Alabama at Birmingham, Birmingham, AL 35294

Corresponding Author: Alan Eberhardt <aeberhar@uab.edu>

## ABSTRACT

Weight-based medications are difficult for emergency medical service (EMS) personnel to administer to patients, as they generally do not have the ability to obtain accurate weights during EMS rescues where patients may be unconscious and/or recumbent. Knowledge of weight is especially crucial when administering medications to children, as their tolerance for error is much less than that of an adult. Paramedics must rely on visual estimation and/or height- or age-based estimation tools to obtain weights of children. The present document describes the development, fabrication, and testing process for a recumbent weighing scale (RWS) for in-ambulance use. This RWS consists of three separate scales that attach to the base of an ambulance stretcher. A microprocessor combines the three weight measurements and displays the total weight on a liquid crystal display. RWS accuracy was established by comparing standing weights of participants on a validated scale. RWS measurements were then compared to estimations using the Broselow tape and Pedi-Wheel on a series of 32 and 53 children, respectively, demonstrating that the RWS measurement errors were comparable to those of the estimating devices.

**Keywords:** recumbent weighing scale, weight-based dosing, Emergency Medical Services (EMS)

## INTRODUCTION

Medication errors cost billions of dollars each year, harming some 1.5 million people [1] and killing between 44,000 and 98,000 [2]. In one study of 10,788 medication orders written over a 36-day period, there were 616 errors found, with 64 patients having three or more errors. Twenty-six adverse drug events resulted in injury from use of the medication [3] and many of these errors came from mistakes in weight-based dosing. All drugs administered to children are weight-based. One team of researchers, however, observed tenfold deviations in medication doses (corresponding to 1000% of the recommended dose) in as many as one of every 766 pediatric prescriptions [4]. A survey completed by just over one-thousand paramedics showed that 43% of respondents were familiar with a medication error for child [5]. Of these respondents, 35.5% indicated that they do not measure or estimate weight for children; they just administer a smaller dose.

For Emergency Medical Services (EMS) personnel, it is difficult to obtain accurate patient weights as ambulances typically do not carry any form of a weighing scale, and often times the patient is either recumbent (unable to stand) and/or unconscious. Thus, EMS personnel must estimate weights when administering weight-based drugs. Existing estimation tools include the Broselow tape and the Pedi-Wheel (Fig. 1). The Broselow tape is a color-coded measuring tape that is stretched along the length of the child; the colored box at the end of their feet corresponds to a pre-determined weight range and pre-calculated doses for various drugs, as well as equipment size for performing emergency resuscitation [6]. The tape is intended for children up to the age of twelve, but it is not applicable for any child taller than 58 inches. Studies have shown that the tape is accurate to within 10% of a patient's true weight for only half of the children on which it is used [7]. Others reported that the Broselow tape is 16-70% inaccurate