



2007-2008 National Student Design Competition

Open to programs in biomedical engineering, industrial design, and related fields

Programs receive up to \$2000 in reimbursement for design costs;

First prize: \$1000, Second prize: \$750, Third prize: \$500;

Additional \$500 award for registration/travel to present a related paper accepted at a major conference

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Design teams are welcome to enter in any of 3 target design areas described below, and designs must satisfy the needs of the hypothetical "clients" on the following page:

Accessible Pill Cap Dispensing/Cutting Device

Problem: Medication administration regimens cause significant dispensing and adherence issues for many individuals, often compounded by the necessity of slicing pills in half.

Aim: Build a pill cap that dispenses a set dosage of pills. The cap should be able to dispense the same dosage of ½, 1 or 2 pills at appropriate time intervals, once scheduled by the pharmacist. The device should automatically alert the client when to take a pill, and not release any pills except during the set dosing period.

Specs: The automated pill cap device should be easy to use by clients with diverse capabilities and safely assist with dispensing a single dosage during the prescribed interval. The prototype should be able to dispense any of ½, 1 or 2 pills at a time and be able to cut pills in half if required for ½ pill dosage. It should remind users to take their medications, record what medications have already been dispensed, provide multi-modal indicators of current status, and only dispense the pills within the specified time windows each day. The device should alert someone offsite if a dose is missed. The prototype can be larger than a normal pill cap for demonstration purposes.

Accessible Incontinence Control Device

Problem: Patients with incontinence are unable to control urine flow due to specific disease pathology, trauma, or other causes. Incontinence affects men and women, occurs more frequently with age, and can cause infection, skin irritation, and embarrassment. It negatively affects quality of life and many incontinent patients avoid activities in public, for instance due to the potential for a spastic bladder to spontaneously cause release of urine without warning.

Aim: Design a device to allow the patient (or caregiver) to control and manage urine flow. It should 1) be easily used by a patient with disabilities, 2) allow emptying of the bladder when desired, 3) prevent urine flow when not desired, and 4) provide an indication of the status of the bladder.

Specs: The device must comply with applicable sections of established industry standards for Foley Catheters and other related urological medical devices, a summary of which are provided on the RERC-AMI web site. It should be able to remain indwelling for thirty days at a time (with no adverse tissue reaction or material degradation) and then be replaced, or it can be an external device. It should be easily operated by a patient with disabilities or their caregiver. The prototype implantable device should be evaluated in a simulated environment, but the user interface should operate as the finished product would.

Accessible Weight Scale for Seated Users*

Problem: Many wheelchair-accessible weight scales are larger in size and more costly than traditional standing scales. Individuals who use wheelchairs or have difficulty standing often do not use scales in their home, and may find it difficult to determine their weight within medical facilities, unless an accessible or wheelchair scale is available. Regardless of disability, however, many people with health risks would benefit from monitoring changes in their weight at multiple times during a day, whether within their homes or at healthcare facilities.

Aim: Design an affordable and easy-to-use weight scale that is integrated into a standard toilet seat or shower chair, for home or clinical use. The device may also offer support for transferring on and off and for maintaining posture while on.

Specs: The weight scale should be accurate (to 1/5 pound), capable of weighing 500+ pounds, have a display that can communicate multiple stored readings, contain integrated balance aides (e.g., hand rails, grab bars), make a weight measurement within 10 seconds, and provide output in multiple modal formats. The weight scale should be easy to power, operate, and sanitize.

*Idea inspired by 2004-2005 weight scale competition entry by Catholic University design team: Thomas Seacrist, Lindsay DiRomualdo, Gowhar Iravani, Matthew Carnavos, and Binh Tran, PhD (Faculty Advisor).

Client list for design challenges on previous page:

1. Phylis is an active 77-year-old woman with rheumatoid arthritis that has caused diminished hand strength, joint stiffness, and pain. Phylis also has age-related macular degeneration and hearing loss, but she is determined to remain active and independent. Although she is outgoing and bold in general, she is easily intimidated by many of the high-tech gadgets her grandchildren use; she prefers simple interfaces.
2. Aaron is a 23-year-old man, a returning Iraq war veteran, with an arm amputation above the elbow, chronic neck pain and recurring headaches. Although Aaron sometimes wears a prosthetic device with a pinching mechanism, most often he improvises and uses one hand to complete tasks. He takes a number of medications, mostly for pain management.
3. Keisha is an 84-year-old woman who recently had a stroke, causing hemiplegia on her right side that has affected the function in her dominant hand. She has also experienced some memory loss after the stroke, so she appreciates the reminders her family provides her. Before the stroke, Keisha had minor hearing loss, and it has continued to worsen in recent years due to aging. Although she wears a hearing aid every once in a while if she's going out, at home and at most other times she does not use it. She also has occasional challenges with incontinence.
4. Jerry is an 82-year-old man with Parkinson's disease, which causes him to have tremor, rigidity, and decreased range of motion; he also has difficulty with urinary control. Jerry has recently started experiencing symptoms of Dementia, but with the help of his family he is determined to remain in his own home as long as possible.
5. Jamie is a 42-year-old woman with a T11 spinal cord injury. She mainly uses a manual wheelchair and is a serious wheelchair basketball athlete. She would like to have better control of her urinary function while participating in athletic activities..
6. Betty is a 65-year-old woman who has limited and asymmetrical lower extremity range of motion due to a bad hip. She also has limited strength in her right leg due to decreased use of her right leg because of the pain caused by her hip.
7. Violet is a 32-year-old woman of short stature who is on blood pressure medication. She is also a mother of 3, and is very active within her family and community.
8. Paul is a 43-year-old man with diabetes. The diabetes has caused neuropathy in his hands and feet, which eventually necessitated two below-the-knee amputations, and some loss of vision.

For more information about the RERC-AMI National Student Design Competition, go to:

<http://www.erc-ami.org/ami/projects/d/2/>