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Introduction and Summary

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INTRODUCTION

The Boston Elbow is an artificial arm, powered by battery and controlled by signals from an amputees' stump muscles (myoelectric). Electrodes located in the socket of the prosthesis detect the electrical charges that accompany contraction of the stump muscles. A computer in the prosthesis interprets these electromyographic signals and transmits orders to the motor to flex or extend the elbow. The elbow moves at speeds proportional to the intensity of the amputee's muscle contraction. The Boston Elbow thus imitates the flexion and extension of a natural elbow joint.

Despite this technological achievement, the Boston Elbow is worn by only about 100 of the estimated 30,000 to 40,000 above-elbow amputees. In the context of the OTA project entitled *Federal Policies and the Medical Devices Industry*, interest arose in whether this low level of use resulted from characteristics of the device or from policies regarding rehabilitative devices. The case study describes the development and use of the Boston Elbow and compares it to prosthetic and nonprosthetic alternatives. Public policies, such as veterans' benefits, Medicare, and workers' com-

pensation, are examined for their effects on the use of the Boston Elbow and other options. The study concludes that public policies have affected, but have not substantially impeded, the adoption and use of the Boston Elbow. Although the device has certain advantages, it is not clearly superior in price, appearance, and capability to alternatives available to amputees.

It is important to note what this study is not. It is not a discussion of the effects of industrial policy on the "lifecycle" of the Boston Elbow. Nor is it a controlled evaluation of competing above-elbow prostheses. Rather than organizing inquiry around the device, this study focuses on amputees and the social policies that bear on their use of the Boston Elbow. The reason for this approach is the complexity of the Elbow's purpose, i.e., to alleviate disability. Functional impairment due to structural loss, unlike other problems that invite technology's attention, is idiosyncratic, contextual, and, in a technology such as the Boston Elbow, highly conditional and only part of a disabled individual's compensatory strategy.

SUMMARY

The Boston Elbow is technologically distinctive, but it is only one way to compensate for the loss of an arm. The amputee may choose an alternative prosthesis: a body-powered, cable-operated device, an externally powered switch-controlled elbow, or another myoelectric prosthesis. These devices vary in several respects, and each has strengths and weaknesses. The Boston Elbow seems to maximize features that are useful in the workplace; it will lift a relatively heavy object and has the capacity for simultaneous movement of the elbow and terminal device (hook or hand). The Liberty Mutual Insurance Co., a major pro-

vider of workers' compensation insurance, financed design of the device and continues to develop and manufacture it.

Other alternatives to the Boston Elbow are non-prosthetic. First, many amputees learn to function without an arm. This does not mean that loss of an arm is trivial, only that humans are immensely adaptable and that prostheses are a poor substitute for the human arm. Second, monetary compensation for functional loss is common, taking the forms of indemnity and income maintenance. Cash benefits help to replace lost earnings

and allow amputees to purchase assistance if needed. Adaptation of the environment is a third nonprosthetic option. Vehicles and dwellings can be made more physically accessible to amputees, and legislation can prohibit discrimination against people with disabilities.

Distribution of the Boston Elbow and its alternatives is at least in part a function of public policy, especially the design and implementation of disability benefits. For policy purposes, adults with disabilities seem to fall into three groups—veterans, workers, and citizens—each with eligibility criteria set by law. The group(s) into which an amputee falls determines his or her eligibility for the Boston Elbow and other compensatory options.

The amputee-veteran has many alternatives to the Boston Elbow, including an elbow prosthesis that was originated at the Veterans Administration (VA). As of fall 1983, the Boston Elbow had not yet been approved for VA funding, although an evaluation of all externally powered prostheses was under way.

Amputee-workers face three sets of circumstances. If injured in the workplace, they are eligible for workers' compensation benefits, including monetary compensation and prosthetic devices. They are most likely to be fitted with a Boston Elbow if their employer's insurer is the Liberty Mutual Insurance Co. Workers with long-term disabilities who have paid into the Social Security system receive Disability Insurance benefits

in the form of cash payments and Medicare. The latter may provide a Boston Elbow, but program coverage begins 2 years after cash benefits commence. Disabled individuals judged to be potential workers are entitled to enter the Federal/State Vocational Rehabilitation Program and receive services required for their rehabilitation. Potential workers may thus be entitled to a Boston Elbow, but they must compete for limited Vocational Rehabilitation funds.

The amputee-citizen is unlikely to be provided with a Boston Elbow. The Medicaid program in most States provides low-income amputees with prosthetic devices, but these must be "medically necessary" and of reasonable cost. Federal policies do, however, support relevant research by the National Institute of Handicapped Research, regulation by the Food and Drug Administration, and new legislative approaches to disability issues, such as the Rehabilitation Act of 1973.

The Boston Elbow fares differently in different programs. This situation, which is the result of explicit mandates, institutional histories, and ongoing allocation of public resources, can be difficult for the amputee.

The Boston Elbow and other compensatory technologies will almost certainly benefit from the disability rights movement associated with the Rehabilitation Act of 1973. One result of this movement will be more self-aware and assertive consumers of rehabilitation technology.