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Public Adventures in Diabetes: Personal Activity in a Modern Science Center

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ABSTRACT

About 100 million Americans visit science centers each year to participate in experiential science and technology activities. There is great potential for diabetes awareness and education via the several hundreds of science centers in the United States. Most science centers tend to avoid medically related topics in part because of the difficulty in meeting the interactive goals of science center activities. The Utah Science Center (USC) is addressing these difficulties by creating environments for personal interactive activities in a range of medically related topics, including diabetes. The USC will open in early 2005 in Salt Lake City. The design of diabetes activities for the USC is reviewed: (1) activities (aims, description, stages of development, and partnerships); (2) specific stage I activities (body mass index, "feeling" hypoglycemia, and urine chemistry); and (3) conclusion.

INTRODUCTION

DIABETES HAS CLEARLY become prevalent in the United States. There are approximately six individuals with prediabetes, four diagnosed with diabetes, and two with undiagnosed diabetes among every 100 Americans. Moreover, there is a 6% yearly increase in diabetes incidence in the United States. The cost of treating diabetes and its complications is over $130 billion per year in the United States.[1] Public awareness of diabetes is needed to encourage prevention, create a supportive atmosphere for disease management, and hopefully counter the rising expenditures for diabetes care.

The Utah Science Center (USC) will be a new center for health awareness and health education in an objective, informal, non-threatening, open, and free environment. The USC sees itself as the first "third generation" science center[2] in that it will take visitor interactivity to entirely new levels. It has three main themes: (1) **You** are the experiment; where visitors will have the opportunity to make measurements of their own physiologic parameters; (2) **Energy**; from solar energy to personal bioenergetics, including nutrition, exercise, obesity, and diabetes; and (3) **Home**—Planet Earth and its resources, environments, and changes. In addition, the USC will likely become a center for networking communications, including an extensive database, which will provide unique opportunities for researchers, health care providers, and patients. The USC will open in early 2005 in Salt Lake City, and expects about 400,000 visitors a year (http://www.utahsciencecenter.org).

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ACTIVITIES

Our objective is to help develop more aware, educated, empowered citizens, particularly in relation to health awareness and education. Diabetes risk factors, prevention and control, the seriousness of having diabetes, and the promotion and support of diabetes self-management will all be emphasized. Given the growth in the incidence of type II diabetes and the national concern with diabetes education and awareness, we are developing a cluster of interactive exhibits related to diabetes. We are in the design, prototype, and testing phase (2003–2004). Prototype exhibits will be tested in different public settings.

We presented, discussed, and tested two prototypes at the Diabetes Science and Technology Conference, held in San Francisco, CA, in November 2003.[3]

Activities in the USC will consist of main floor interactive exhibits; main floor demonstration carts and small "theatre" demonstrations; and special supervised activities in basement laboratories, shops, and classrooms. In addition, the USC will also develop a range of online activities for its website.

Stage I activities (2005)

- *Body measurements*: weight, height, heart rate, and blood pressure; compare personal data with general public data, with an emphasis on populations, statistics, and distributions
- *"Feeling" hypoglycemia*: activities that enable visitors to "feel" the physical effects of being hypoglycemic
- *Simulation*: games and related computer-based activities, which incorporate multiple parameters, blood glucose levels, insulin dosing, food intake, and physical activity in the management of diabetes
- *Diabetes chemistry cart*: demonstrations of simulated blood and urine chemistry measurements

Stage II activities (2006)

- *Bioenergetics*: nutrition, food as fuel, exercise, conservation of mass and energy, and energy utilization—all personal and highly interactive
- *Smart toilet*: interactive toilet measuring the user's urine glucose, pH, and density via visual colorimetric and fluorescent qualitative assays
- *Sensations*: what you can and cannot sense with your fingers—the role of peripheral nerve issues in chronic diabetes
- *Games*: where do you stand among the public in terms of diabetes awareness?

Stage III activities (2007)

- *Modern noninvasive glucose measurement technologies*
- *Diabetes and the eye*: vision issues associated with chronic diabetes
- *Diabetes story room*: watch and listen to the personal stories of individuals with diabetes
- *Database*: a collection of personal measurements and other input from the interactive exhibits—a potential resource for researchers, health providers, and students in the fields of diabetes prevention and therapy

Partnerships

We are establishing partnerships with diabetes-related organizations to deliver additional activities by their professionals. Partners will regularly operate screening stations and related activities. USC laboratories and classrooms will be used by health partners to present demonstrations of new methods and technologies for the management of diabetes.

SPECIFIC STAGE I ACTIVITIES (FIG. 1) F1

- *Pseudo-body mass index*. The visitor steps on a force plate, facing a height detector. Each visitor's mass and height are obtained in units of kilograms and meters, respectively. Measurements for every visitor are voluntarily entered into a software program, which presents a histogram of population measurements, generating pseudo-body mass index measures (an approximation to the formula used in calculating the body mass index: weight in kilograms divided by squared height in meters), and the data are correlated with diabetes risk factors. The histograms and

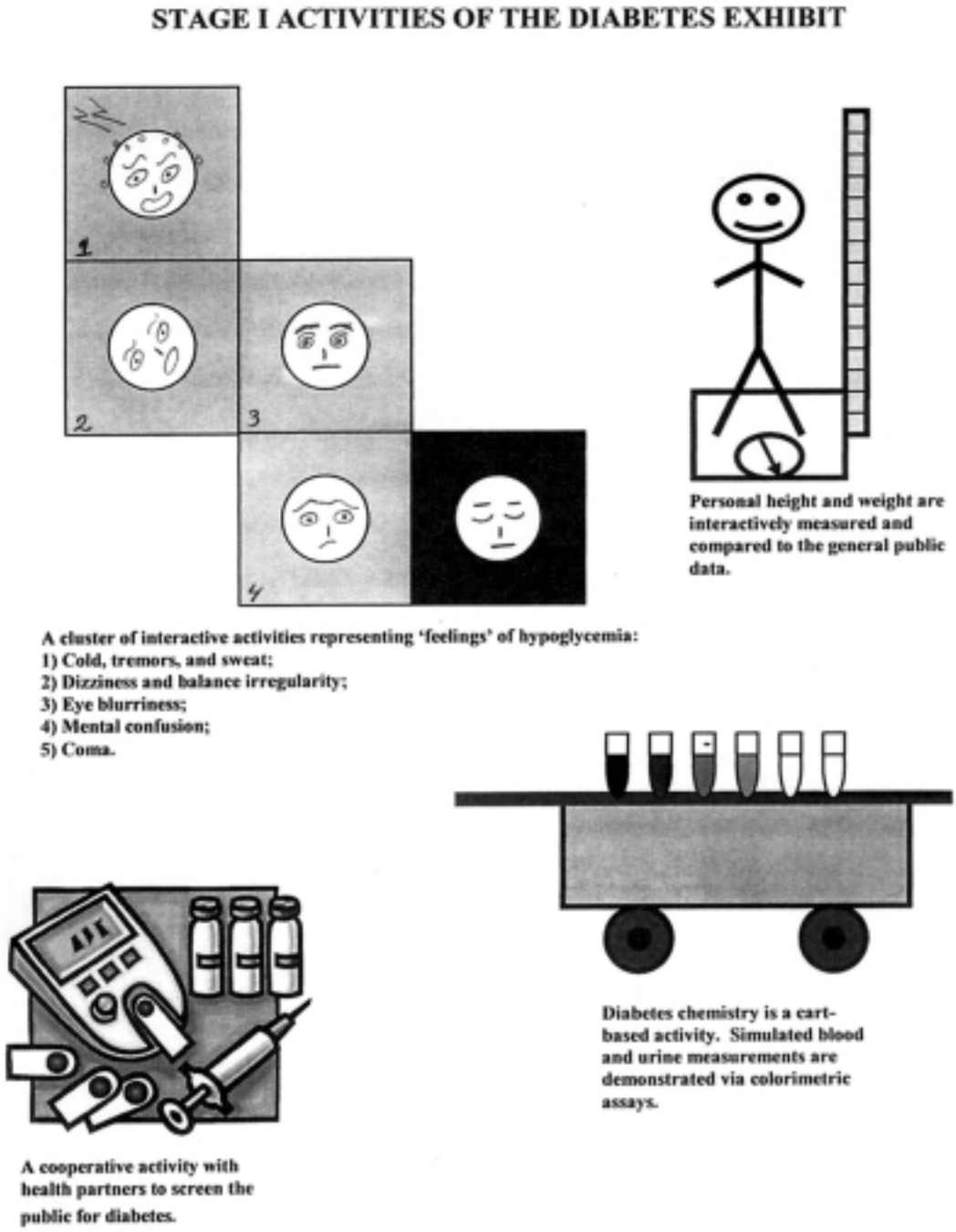

FIG. 1. Schematic presentation of stage I activities. Height and weight, "feeling" hypoglycemia, simulations, and public screening for diabetes are distributed over four zones: personal data, experience of persons with diabetes, awareness, and partnerships, respectively. In addition, there will be a diabetes chemistry demonstration cart.

other information are dynamically projected for the visitors to view.

- "*Feeling" hypoglycemia.* The visitor "enters" the world of a patient with diabetes by "feeling" certain hypoglycemic symptoms, including cold, tremors, sweating, dizziness, vision blurriness, mental confusion, and sense of balance irregularities. Although it is chemistry that is largely responsible for these feelings in individuals with diabetes, visitors without diabetes will "feel" hypoglycemia by means of changes in their physical environment. The visitor will enter the first segment of the activity, where he will

feel cold, start to sweat, and probably shake. This will be achieved by generating cold and humid air, along with spraying drops of water on the visitor. The next zone will involve rotation and vibration of the walls and floor to simulate dizziness. Balance irregularities are felt and measured by standing on a mechanical table. Looking at hazy mirrors, lenses, and glass plates simulates vision blurriness. Mental confusion is encountered when the visitor experiences unfamiliar sounds and visions that he cannot interpret. Finally, the visitor enters a dark room, where he recognizes flashes and audio alarms warning him that he is reaching the stage of hypoglycemic coma.

- *Diabetes chemistry*. Cart-based demonstrations include measurement of blood glucose and of urine ketones and other urine analytes using a GlucoWatch® (Cygnus, Inc., Redwood City, CA) and urine dipsticks, respectively. Urine will provide a medium to show food and drug metabolism in the body. The demonstration will also allow the exploration of urine drug screening, including the technology related to drug screening in competitive sports. Specific urine metabolites will be included and examined in test tubes, containing artificial urine. Charts of urine color in various physiological conditions will also be demonstrated to the visitor.

CONCLUSION

The purpose of this brief paper is to inform the reader of the potential for enhancing the public's awareness and education regarding diabetes, using science centers and museums available throughout the country. We also solicit your feedback on the design of activities, exhibits, and demonstrations. We would like to exchange experience and form links with other science centers and health-related institutions. Your participation and input are especially needed in the following topics:

1. What noninvasive blood glucose measurement technologies are likely to be available by 2007, and which one of them would be most applicable in a public science center environment?
2. What activities could most effectively demonstrate the links between lifestyle and diabetes?
3. Are there existing diabetes activities similar to what we are developing?
4. What diabetes-related activities should be presented to elementary and high school children?
5. What other diabetes issues or concerns should be included?
6. Are you interested in being a partner?

Send your input to Joseph Andrade or Youssef Al-sheikh at the addresses given below.

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1. American Diabetes Association: National Diabetes Fact Sheet 2000. http://www.diabetes.org
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