

RESEARCH HIGHLIGHTS

Highlights the most important articles across the spectrum of topics relevant to the field of diabetes management – focus on healthcare IT

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Online diabetes self-management program: a randomized trial

Evaluation of: Lorig K, Ritter PL, Laurent DD *et al.*: **Online diabetes self-management program: a randomized study.** *Diabetes Care* 33(6), 1275–1281 (2010).

With the growing epidemic of Type 2 diabetes, currently available clinic-based education resources are insufficient to meet the demand for diabetes self-management education. Web-based programs offer a potential solution to this problem. Lorig *et al.* conducted a randomized controlled trial of an innovative internet-based diabetes self-management program (IBDSM) versus usual care (no program) for 6 months, with an 18-month follow-up. The IBDSM consisted of six weekly educational sessions, online bulletin boards, personalized feedback from facilitators, exercise and medication logs, meal planning and glucose-monitoring tools, and links to other diabetes-related websites. A total of 761 participants with Type 2 diabetes were randomized to three arms: first, the online diabetes self-management program; second, the online diabetes self-management program with email reinforcement; and third, usual-care (no online self-management program). Since reinforcement was

not associated with any improvements at 6 months, reinforced and unreinforced intervention arms were combined into a single treatment group and compared with controls. Interestingly, the analysis of the reinforced group showed statistically significant greater reduction in health distress at 6 months, and a significantly greater reduction in depression at 18 months compared with the unreinforced group. At 6 months, treatment participants had significantly lower hemoglobin A1c (HbA1c) and improved patient activation and self-efficacy (self-reported knowledge, skill and confidence for managing their chronic condition). This significant improvement was also observed in subgroup analysis of participants with baseline HbA1c of 7.0% or higher. At 18 months, IBDSM participants had significantly greater improvements compared with usual-care participants with self-efficacy to manage diabetes and patient activation. Noncompleters of the trial were noted to be younger with higher baseline HbA1c and higher health distress. The limitations of this study include low baseline HbA1c and unknown durability of glycemic effect as HbA1c at 18 months was not assessed.

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future
medicine

Working towards an artificial pancreas

Evaluation of: El-Khatib FH, Russell SJ, Nathan DM, Sutherlin RG, Damiano ER: **A bihormonal closed-loop artificial pancreas for Type 1 diabetes.** *Sci. Transl. Med.* 2(27), 27 (2010).

Tight blood sugar control in patients with Type 1 diabetes is extremely demanding. Even with meticulous monitoring and treatment, most Type 1 diabetes patients experience substantial hyperglycemic excursions after meals and episodic hypoglycemia with the current basal-bolus insulin-only regimens. In this study, El-Khatib *et al.* report their results with a closed-loop blood glucose control device that uses frequent measurements of blood glucose concentration through continuous venous glucose monitoring coupled with subcutaneous delivery of both a fast-acting insulin analog (lispro) and glucagon. Controlled by a computerized algorithm, the device automatically computed insulin and glucagon doses in 11 human subjects

with Type 1 diabetes and no endogenous insulin secretion for 27 h, during which time subjects ate three standardized carbohydrate-rich meals. Six subjects obtained mean blood glucose concentrations of 140 mg/dl (American Diabetes Association recommendation is ≤ 154 mg/dl) and had no hypoglycemia. The remaining five subjects had hypoglycemia requiring treatment and were noted to have slower lispro pharmacokinetics (time-to-peak plasma concentration mean 171 ± 48 min vs 64 ± 6 min) than the nonhypoglycemic group. When the slower pharmacokinetics were adjusted in the computer algorithm and the test readministered, this group achieved a mean blood glucose concentration of 164 mg/dl and no hypoglycemia. This study demonstrated the feasibility of a closed-loop blood glucose control device in humans and highlighted the need for customization of the computer-based algorithm to account for individual differences in insulin pharmacokinetics.

Trial of online diabetes self-management in teens

Evaluation of: Mulvaney SA, Rothman RL, Wallston KA, Lybarger C, Dietrich MS: **An internet-based program to improve self-management in adolescents with Type 1 diabetes.** *Diabetes Care* 33(3), 602–604 (2010).

As children with Type 1 diabetes enter adolescence, their glycemic control typically worsens. Mulvaney *et al.* set out to study whether an internet-based self-management program designed to enhance problem-solving barriers to self-management would improve HbA1c, self-management skills and problem solving ability. A total of 72 adolescents were enrolled and randomized to usual-care-plus-Internet support or usual-care alone.

The internet-based self-management intervention used was YourWay, an 11-week

course with four multimedia stories depicting various barriers to self-management. Participants completed problem-solving cycles via their personalized homepage and could network with peers via an online forum. They were also provided input from a problem-solving expert and weekly emails to encourage participation. YourWay was highly rated by study participants for its content.

Intention-to-treat analysis found no statistically significant differences in HbA1c, problem-solving and self-management skills over time. Using as-treated analyses, there was a statistically significant improvement in self-management with intervention (standard deviation: 0.64; 95% CI: 0.53–0.79; $p = 0.02$). There was a trend toward improvement in problem solving and HbA1c but given the low

power, the improvements were not statistically significant. HbA1c in the intervention group remained constant (-0.01%) while the control group increased (0.33%).

Although limited by the small sample size and short duration of follow-up, this

study is suggestive that Type 1 diabetic adolescents can be engaged to improve their glycemic control and improve self-management and problem-solving skills without the need for face-to-face intervention time with clinicians.

Telehealth-based diabetes education in a rural community

Evaluation of: Davis RM, Hitch AD, Salaam MM, Herman WH, Zimmer-Galler IE, Mayer-Davis EJ: **TeleHealth improves diabetes self-management in an underserved community: Diabetes TeleCare.** *Diabetes Care* 33(8), 1712–1717 (2010).

African-American (AA) diabetic adults in rural communities have poor access to specialized care and almost 50% higher complication rate than that of non-Hispanic Whites [1]. Davis *et al.* reported on a 1-year, randomized clinical trial of poorly controlled diabetics in three rural community health centers in South Carolina, serving a predominantly AA population. These investigators compared usual care to a comprehensive diabetes self-management education intervention administered remotely via interactive videoconferencing, telephone calls, faxes and a telehealth-enabled retinal camera. Their intervention (Diabetes TeleCare) consisted of 13 sessions (three individual and nine group), with all but three sessions conducted by interactive videoconferencing led by a nurse/certified diabetes educator and a dietician located more than 100 miles away at an academic medical institution. Retinal imaging was performed using the remotely operated retinal camera. Patients randomized to usual care received a 20-min diabetes education session based on American

Diabetes Association materials with a research licensed practical nurse who remained on-site to help coordinate care, collect data and perform retinal imaging. Follow-up was performed at 6, 12 and (for two thirds of the subjects) 24 months. Improvement in HbA1c was significantly greater in the intervention group at 6 and 12 months. The proportion of individuals receiving eye examination was significantly greater in the intervention group. There was no difference in blood pressure, BMI or albumin:creatinine ratio. Mixed-model 24-month *post hoc* analysis showed a significantly greater improvement in HbA1c in the intervention group. This trial is proof-of-concept of the effectiveness of a combination of individual and group videoconferencing sessions in a rural health center environment to improve HbA1c in a durable way. Confounding the results is the addition of an licensed practical nurse to the health centers, who the authors note was ‘critical to effective study operations and was paramount to the relationship between the academic center and the community health organization’.

Reference

- 1 US Department of Health and Human Services. Center for Disease Control and Prevention. National diabetes fact sheet (2007) www.cdc.gov/diabetes/pubs/pdf/ndfs_2007.pdf

Reducing insulin administration errors: an online educational module

Evaluation of: Sullivan MM, O'Brien CR, Gitelman SE, Shapiro SE, Rushakoff RJ: **Impact of an interactive online nursing educational module on insulin errors in hospitalized pediatric patients.** *Diabetes Care* 33(8), 1744–1746 (2010).

Insulin administration errors are responsible for 39% of serious medication errors causing harm to patients [1]. Sullivan *et al.* reported on the effectiveness of a mandatory online insulin administration teaching module on insulin administration errors on a pediatrics hospital floor. All pediatric nursing staff at an academic teaching hospital completed a three-part module teaching insulin pharmacokinetics, insulin order sets, including dilution of insulin, and 15 interactive cases. Chart audit was used to determine the number of possible and actual insulin-related medication errors in the 6 months preimplantation and 2–6 months postimplantation. Errors were defined as omission of an insulin dose, wrong dose or type of insulin, wrong time of administration, blood glucose not checked as per physician order or hypoglycemia protocol, and blood glucose not documented in the record. There were 24 patient charts reviewed preintervention

and 22 patient charts reviewed postintervention. The total number of insulin-related medication errors preintervention was 131 out of a possible 882 opportunities identified by chart audit. Postintervention, there were only 19 errors out of a possible 1119 identified. There was a significant reduction in insulin-related medication errors after administration of the online insulin teaching module, with error rate decreasing from 14.8 to 1.7% ($p < 0.001$) after intervention.

This study was limited by the reliance on retrospective chart review, potential investigator bias as the same group collected the pre- and post-intervention data, and generalizability as it was limited to an academic pediatrics hospital. Despite these limitations, the results provide support for greater integration of health IT teaching tools to reduce medication-related medical errors related to in-patient insulin management.

Reference

- 1 High-Alert Medications: Error Prevalence and Severity. Patient Safety and Quality Helathcare. July/August (2009) www.psqh.com/julyaugust-2009/164-data-trends-july-august-2009.html