Comparing the Effectiveness of CDSS on Provider's Behaviors to Implement Obesity Prevention Guidelines

Diane J Skiba, PhD[1], Bonnie Gance-Cleveland, RN, PhD[2], Kevin Gilbert, PhD[3], Lynn Gilbert, RN, PNP-C, PhD[1]& Danielle Dandreaux, PhD[2]

[1]University of Colorado College of Nursing, Aurora, Colorado USA; [2]Arizona State University School of Nursing, Phoenix, Arizona USA; [3] HeartSmartKids LLC, Boulder, Colorado

Abstract

Obesity is a global epidemic demanding the use of clinical decision support tools to help clinicians in the identification, assessment and management of healthy weight gain in children. Over the last decade, numerous systematic reviews have shown that clinical decision support systems (CDSS) have positively impacted clinician's performance for drug ordering/dosing and preventive care reminders. CDSS that are built into the clinician's workflow at the point of care also have a positive impact on provider's performance. There are limited studies that examine CDSS in nursing practice. This paper describes a comparative effectiveness study being conducted in school-based clinics to examine the impact of web-based training with and without a CDSS that contains tailored recommendations. The study involves the use of a CDSS tool focused on cardiovascular risks, HeartSmartKids™. This research is an important example of an interdisciplinary team using information technology to address the global issue of obesity prevention.

Introduction

Obesity is a global epidemic that affects both developed and developing countries. According to the World Health Organization (WHO) [1] in 1995, there were approximately 200 million obese adults worldwide and another 18 million children under the age of five years old estimated to be overweight. In 2000, another 100 million obese adults were added and WHO also estimated over 115 million people in developing countries had obesity-related health problems. In 2011, the results of a worldwide comparative analysis of long-term trends of body-mass index (BMI) were published.[2] This study, conducted across 199 countries and territories, found that worldwide obesity doubled since 1980. According to this study[2], there are 205 million men and 297 million women in the world considered obese. One of the developed countries with an increasingly high proportion of obese adults is the United States.

There is also substantive data to support the overall increase of overweight and obese children on a global scale. In the United States, the prevalence of overweight youth nearly quadrupled in the past four decades.[3-5] The global issue of obesity has led to the increase of associated co-morbidities for youth such as hypertension, type 2 diabetes, musculoskeletal disorders, respiratory conditions, emotional problems and increased risks of cardiovascular disease and cancers as adults.[6-12] To address this epidemic, evidenced based practice guidelines were developed by several national organizations.[13-15] These guidelines are focused on the identification, assessment and management of healthy weight gain for children and adolescents.[15] Despite their availability, relatively few providers have changed their behaviors for identifying, assessing and managing healthy weight in this population.[16-19] This is not unusual given the mixed results reported on the integration of evidence based practice EBP guidelines into clinical practice.[20-23] Studies have identified lack of adequate tools,[21] knowledge [17, 21] and lack of time[17, 19] as potential barriers to the use of clinical guidelines. Although there has been relatively limited success with using guidelines, the introduction of clinical decision support systems (CDSS) that incorporated clinical practice guidelines offers some promising results.

The purpose of this paper is to describe an ongoing study that examines the use of a CDSS tool along with web-based provider training on the process of care focused on the prevention of obesity-related chronic conditions of poor, underserved minority youth in school-based health centers (SBHCs). To start, the paper presents the most current systematic reviews of CDSS tools and electronic clinical guidelines. It will also describe the use of HeartSmartKids ™, a clinical decision support tool and a brief description of the study protocol.

Computer Support: Clinical Decision Making

The 2001 publication *Crossing the Quality Chasm: A new health system for the 21st Century*[24] noted that computer systems lead to an improvement in implementation of clinical guidelines [25-27] and better patient outcomes.[24] CDSS has been developed to promote the use of current practice guidelines by aiding the provider in identifying and assessing overweight/obese children and facilitating clinical decision making. This support uses computerized evidence-based algorithms to match individual patient risk factors to patient-specific recommendations.

Over the last decade there have been several systematic reviews of CDSS and their impacts. In 2005, a systematic review[28] of features critical to improving clinical practice yielded 70 studies. The analysis indicated 68% had significant positive impact on clinical practice and four factors that statistically predicted this positive impact: part of the clinician's workflow, provision of recommendations and not just assessments, availability at the point of care and computerized CDSS. Another systematic review[25] investigated if computerized CDSS improved practitioner's performance and patient outcomes. "Of the 97 controlled trials assessing practitioner performance, the majority (64%) improved diagnosis, preventive care, disease management, drug dosing, or drug prescribing." [25 (p. 1229)] Too few studies examined health outcomes to make any conclusions. Only one systematic review[29] examined the impact of CDSS on nursing performance and patient outcomes. With only 8 studies, the review concluded that the effect of CDSS was inconsistent and more research was needed. In 2011, a synthesis of systematic reviews [30] examined the effects of CDSS on practitioner performance and patient outcomes in hospital settings. Using the Assessment of Multiple Systematic Reviews (AMSTAR) tool, [31] two reviewers rated the methodology quality of their selected 35 studies. Of the 17 reviews with an AMSTAR score above 9, 57% of the studies found CDSS significantly improved the practitioner performance. Most of the positive impacts were related to computer reminders for preventive care and computer assisted drug ordering. There was a smaller impact on patient outcomes with only 30% of the studies reporting positive results.

There were relatively few reviews focused specifically on the effectiveness of electronic clinical guidelines. One systematic review[32] assessed the effectiveness of electronic guidelines in ambulatory settings. This particular review examined "electronic multidimensional guidelines versus usual care (comparison one) and electronic multidimensional guidelines versus other guideline implementation methods (comparison two)." [32 (p. 82)] The term, multidimensional guideline, refers to a multi-step guideline. The results found that 40% of the studies demonstrated improvements in process of care variables in comparison to the usual care group that was not using guidelines. There were no differences in either process or patient outcomes when comparing electronic versus paper guidelines. Thus, after more than a decade of development of numerous electronic systems, evidence on the most effective implementation strategy for multidimensional guideline-based decision support systems is still lacking. Another review[33] examined the impact of computerized versus non-computerized clinical guidelines on the process of care. The researchers also examined the systems features similar to those in a previous review[31] and excluded studies included in two prior reviews.[25, 28]The review found if electronic guidelines were part of a clinician's workflow, there was a statistically positive impact on the process of care. The other positive predictor was the date of publication that can be interpreted that the later the date, the more automated the computerized clinical guideline system.

Overall, there is positive support for the use of CDSS and the impact on practitioner performance, especially for preventive care reminders. There is less evidence to support CDSS's impact on patient outcomes. In addition, CDSS tools need to be part of the clinician's workflow and contain recommendations at the point of care. Given the limited evidence for implementing practice guidelines, it is important that more studies examine the impact of CDSS on provider adherence to current recommendations. In response to this need, a team of researchers led by Dr. Bonnie Gance Cleveland received funding from the Agency for Healthcare Research in Quality to conduct a comparative effectiveness trial evaluating the implementation of obesity guidelines in school-based health clinics (SBHCs) with or without CDSS. This project is described in the following section.

Comparative Effectiveness Study

The study is a comparative-effectiveness trial evaluating the impact of web-based provider training with and without HIT for provider decision support with tailored patient recommendations. The goal is to translate into practice the current evidence-based guidelines for the prevention of obesity and related chronic conditions. HeartSmartKids™ is a health care decision-making tool that integrates patient health information with evidence-based guidelines and generates graphic trends of cardiovascular risks and tailored recommendations to improve patient outcomes. The study is being conducted in School-Based Health Clinics (SBHCs) across several states that provide care for populations of poor, underserved minority youth.

There are two specific aims of the study. The first aim is to evaluate the effectiveness of web-based training with and without computerized clinical decision support on provider's process and outcome behaviors related to implementing the current guidelines for prevention of obesity and related conditions. Process variables include provider knowledge, attitudes and barriers to guideline implementation, parent perception of the interpersonal process of care (i.e., provider communication, collaborative decision making, and interpersonal style) and parents' perception of provider support for their child's healthy eating and exercise. Behavior outcomes include the following: Provider self-reported behaviors of identification and assessment of overweight, counseling on nutrition and physical activity, use of behavioral interventions, referrals, and cultural competency. Outcomes also include documentation variables assessed through a chart review of the following: 1) body mass index (BMI) percentile for age and sex for patients 5-12 years old seen for well-care or sports physical visits, 2) appropriate diagnosis when BMI $\geq$ 85th percentile, 3) blood pressure (BP) percentile for age, height, and sex for all patients 5-12 years of age seen for well-care or sports physical visits, and 4) ordering appropriate laboratory tests when BMI $\geq$ 85%. The second aim is to explore the role of HIT in the processes of system change for implementation of the guidelines for prevention of obesity and related conditions. The study examines facilitators and barriers to change across the adopter and non-adopter of the clinical guidelines.

The Chronic Care Model for Childhood Obesity, adapted from the Care Model for Child Health, [34] includes practice changes to provide the patient/family with *self-management support* using relationship-focused methods such as Motivational Interviewing (MI); provider *decision support*, evidence-based care; *delivery-system redesign* to promote better care and follow up; and *clinical information systems* (CIS) to provide data to evaluate the progress the practice is making in meeting its goals**.** A mixed methods design combining (a) a prospective, cluster-randomized controlled trial of web-based training with and without HIT decision support for introducing evidence-based guidelines into practice in SBHCs, (b) focus groups to explore the system change processes including facilitators and barriers for adopting technology to improve adherence to recommendations for prevention of obesity and related conditions, and (c) descriptive survey (Chronic Care Model Elements Survey). SBHCs are randomly assigned to one of two intervention groups: (1) web-based training on the guidelines using the adapted Chronic Care Model and regular interaction with a virtual learning collaborative; or (2) the web-based training with virtual learning collaborative plus the CDSS tool (HeartSmartKids™) with tailored recommendations. A growth mixture model (Mplus) [35-37] will specifically address the research question; does web-based training on evidence-based recommendations plus CDSS with tailored recommendations improve care for prevention of obesity-related chronic conditions more than web-based training alone?

HeartSmartKids ™ Decision Support Tool

HeartSmartKids™ (HSK) is a web-based CDSS focused on childhood cardiovascular risk. The HSK system compares lifestyle information - gathered prior to the encounter by a bilingual kiosk - to clinical practice guidelines. Standard growth charts, including BMI percentile, are automatically generated and plotted, promoting greater understanding of the child's growth pattern by parents and providers. Relevant health risks are highlighted in the HeartPrint, a summary of the child's cardiovascular risk factors. "The system can be used to increase perception of risks and provide suggestions regarding evidence-based behavior change strategies."[38 (p. 75)] In addition, this cardiovascular risk assessment clusters risk factors for provider convenience in identifying the risk of metabolic syndrome. "Tailored recommendations give the provider and the family a starting point for discussions of behavior change." [38 (p. 75)] The family is given the cardiovascular risk assessment to take home. The risk assessment also facilitates communication among other care providers. The HSK system contains two web-based applications: a bilingual lifestyle interview and a webpage for data entry of measurements and also the output of the HeartPrint risk summaries. Standard web browsers on internet-connected computers facilitate these functions. The patient/parent completes the interview using a touch-screen monitor, which allows for intuitive use by those who lack basic computer skills. The standard interview covers family history of cardiovascular disease, eating habits, smoke exposure, and activity levels, including sedentary.

The HSK applications use the free Adobe Flash Player to present and gather information. This software works with all major web browsers. The kiosk computers and touch screens are provided to study sites. Local computer support vendors install the kiosk computers. These computers are configured with software that allows for full-screen display and prevents undesired use. Web browsers on the office computers are configured with the relevant bookmarks and shortcuts as part of the installation. The requirements for the office are high- or medium-speed internet connection (not dial-up) and an existing internet-connected office computer and printer for creating the summaries. The touch-screen computers are placed in the clinic waiting room or in the back office, depending on practice site and patient flow. Patients are directed to the HeartSmartKids ™ kiosk either at check-in (for kiosks

located in the waiting room) or during measurement and screening (for kiosks located in the back office). Patients are asked to complete the standard interview. Once the interview is complete, patients continue in the waiting room or continue to the exam room. Office staff obtain height, weight, and blood pressure and enter them into the CDSS at any office computer. In less than 30 seconds, patient cardiovascular risk summaries and tailored recommendations are generated and ready to be printed and given to the provider. This occurs prior to the patient encounter so that the tailored recommendations can be used to increase the patient/families' understanding of risks and provide the patient specific recommendations for collaborative goal setting and care planning. Upon completion of the visit, a copy of the HeartPrint is sent home with the patient and a copy is added to the patient's chart. Patients who complete the interview in Spanish receive their HeartPrint summaries in Spanish, including lifestyle recommendations.

Conclusion

This paper presents a summary of the existing evidence to support the use of CDSS tools to impact clinician performance and ultimately patient outcomes. This funded comparative effectiveness study of CDSS used by providers in school-based health centers is in progress and serves as an example of an interdisciplinary research team (nursing, engineering and informatics) investigating the use of information technologies to address the global epidemic of obesity. A more detailed presentation of the study protocol and results will be presented at the congress.

References

1. World Health Organization (nd). Controlling the global obesity epidemic. http://www.who.int/nutrition/topics/obesity/en/
2. Finucane MM, Stevens GA, Cowan MJ, Danaei G, Lin JK, Paciorek CJ, et al. National, regional, and global trends in body-mass index since 1980: systematic analysis of health examination surveys and epidemiological studies with 960 country-years and 9.1 million participants. *Lancet* 2011; 377: 557–67
3. Ogden CL, Troiano RP, Briefel RR, Kuczmarski RJ, Flegal KM, Johnson CL. Prevalence of overweight among preschool children in the United States, 1971 through 1994. *Pediatrics*. 1997;99:E1.
4. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999-2004. *JAMA*. 2006;295:1549-1555.
5. Ogden CL, Carroll MD, Flegal KM. High body mass index for age among US children and adolescents, 2003-2006. JAMA. 2008;299:2401-2405.
6. Reaven GM. Banting Lecture 1988. The role of insulin resistance in human disease. *Diabetes*. 1988;37:1595-1607.
7. Cook S, Weitzman M, Auinger P, Nguyen M, & Dietz WH. Prevalence of a metabolic syndrome phenotype in adolescents findings from the third national health and nutrition examination survey, 1988-1994. *Arch Pediatr Adolesc Med*. 2003;157:821-827
8. Morrison JA, Friedman LA, & Gray-McGuire C. Metabolic syndrome in childhood predicts adult cardiovascular disease 25 years later: The Princeton lipid research clinics follow-up study. *Pediatrics*. 2007;120:340-345.
9. Freedman DS, Khan LK, Serdula MK, Ogden CL, Dietz WH. Racial and ethnic differences in secular trends for childhood BMI, weight, and height. *Obesity (Silver Spring)*. 2006;14:301-308.
10. Jago R, Harrell JS, McMurray RG, Edelstein S, El Ghormli L, Bassin S. Prevalence of abnormal lipid and blood pressure values among an ethnically diverse population of eighth-grade adolescents and screening implications. *Pediatrics*. 2006;117:2065-2073.
11. Lee JM, Okumura MJ, Davis MM, Herman WH, Gurney JG. Prevalence and determinants of insulin resistance among US adolescents. *Diabetes Care*. 2006;29:2427-2432.
12. Tortolero SR, Goff DC,Jr, Nichaman MZ, Labarthe DR, Grunbaum JA, Hanis CL. Cardiovascular risk factors in Mexican American and non-Hispanic white children: The Corpus Christi child heart study. *Circulation*. 1997;96:418-423.
13. Barlow, S.E., The Expert Committee. Expert committee recommendations on the prevention, assessment, and treatment of child and adolescent overweight obesity summary report. *Pediatrics*. 2007;120S:S164-192.
14. Barlow SE, Dietz WH. Obesity evaluation and treatment: Expert committee recommendations. The maternal and child health bureau, health resources and services administration and the department of health and human services. *Pediatrics*. 1998;102:E29.
15. National Association of Pediatric Nurse Practitioners. Healthy eating and activity together clinical practice guidelines: Identifying and preventing overweight in childhood. *JPHC*. 2006;20:S1-S63.

16. Mabry IR, Clark SJ, Kemper A, Fraser K, Kileny S, Cabana MD. Variation in establishing a diagnosis of obesity in children. *Clin Pediatr (Phila)*. 2005;44:221-227
17. Cook S. Screening and counseling associated with obesity diagnosis in a national survey of ambulatory pediatric visits. *Pediatrics*. 2005;116:112-116.
18. O'Brien SH, Holubkov R, Reis EC. Identification, evaluation, and management of obesity in an academic primary care center. *Pediatrics*. 2004;114:e154-9.
19. Barlow SE, Dietz WH, Klish WJ, Trowbridge FL. Medical evaluation of overweight children and adolescents: Reports from pediatricians, pediatric nurse practitioners, and registered dietitians. *Pediatrics*. 2002;110:222
20. Lomas J, Anderson GM, Donmick-Pierre K, Vayda E, Enkin MW, Hannah WJ. Do practice guidelines guide practice? the effect of a consensus statement on the practice of providers. *The New England Journal of Medicine*. 1989;321:1306-1311
21. Bauer MS. A review of quantitative studies of adherence to mental health clinical practice guidelines. *Harvard Review of Psychiatry*. 2002;10:138-153.
22. Hayward RSA. Clinical practice guidelines on trial. *Canadian Medical Association Journal*. 1997;156:1725-1727
23. Cabana MD, Rand CS, Powe NR, et al. Why don't physicians follow clinical practice guidelines? A framework for improvement. *JAMA*. 1999;282:1458-1465.
24. Institute of Medicine. *Crossing the Quality Chasm: A New Health System for the 21st Century.* New York: National Academy of Sciences; 2001.
25. Garg AX, Adhikari NKJ, McDonald H, Rosas-Arellano MP, Devereaux PJ, Beyene J, Sam J, Haynes B: Effects of Computerized Clinical Decision Support Systems on practitioner performance and patient outcomes. JAMA 2005, 293:1223-1238.
26. Bordowitz R, Morland K, Reich D. The use of an electronic medical record to improve documentation and treatment of obesity. *Fam Med*. 2007;39:274-279.
27. Goldberg HI, Neighbor WE, Cheadle AD, Ramsey SD, Diehr P, Gore E. A controlled time-series trial of clinical reminders: Using computerized firm systems to make quality improvement research a routine part of mainstream practice. *Health Serv Res*. 2000;34:1519-1534
28. Kawamoto K, Houlihan CA, Balas EA, Lobach DF: Improving clinical practice using clinical decision support systems: a systematic review of trials to identify features critical to success. BMJ 2005, 330:765-773.
29. Randell R. Mitchell N, Dowding D, Cullum N & Thompson C. Effects of computerized decision support systems on nursing performance and patient outcomes: a systematic review, J Health Serv Res Policy 2007;12:242-251
30. Jaspers MWM, Smeulers M, Vermeulen H, & Peute LW. Effects of clinical decision-support systems on practitioner performance and patients outcomes: A synthesis of high-quality systematic review findings. J Am Med Inform Assoc 2011;18:327e334.
31. Shea BJ, Grimshaw JM, Wells GA, et al. Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews. BMC Med Res Methodol 2007;7:10.
32. Heselmans A, Van de Velde S, Donceel P, Aertgeerts B & Ramaekers D. Effectiveness of electronic guideline-based implementation systems in ambulatory care settings - a systematic review**.** *Implementation Science* 2009; 4:82. http://www.implementationscience.com/content/4/1/82
33. Damiani G, Pinnarelli L, Colosimo SC, Almiento R, et al. The effectiveness of computerized clinical guidelines in the process of care: a systematic review. BMC Health Ser Res 2010; 10:2
34. National Initiative on Child Health Quality. Child Care Model. 2006. http://www.nichq.org.
35. Murray DM, Blitstein JL, Hannan PJ, Baker WL, Lytle LA. Sizing a trial to alter the trajectory of health behaviours: Methods, parameter estimates, and their application. Stat Med. 2007;26:2297-2316.
36. Murray DM, Hannan PJ, Pals SP, McCowen RG, Baker WL, Blitstein JL. A comparison of permutation and mixed-model regression methods for the analysis of simulated data in the context of a group-randomized trial. Stat Med. 2006;25:375-388.
37. Muthen LK, Muthen BO. MPLUS User's Guide. 5th ed. Los Angeles, CA: Muthen & Muthen; 1998-2007.
38. Gance-Cleveland B, Gilbert L, Kopanos T, Gilbert K. Evaluation of technology to identify and assess overweight children and adolescents. J for Spec in Ped Nrsg. 2010;15:72-83.