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CHOIS: Enabling grid technologies for obesity surveillance and control

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Abstract. CHOIS, the Child Health and Obesity Informatics System [2], is developed using open source portal technology with three-tiered Open Grid Services Architecture, an accepted standard for accessing Grid Computing and other services under Open Grid Collaborating Environments (OGCE). Its web application provides web based forms with 112 different fields to enter data ranging from demographic, height & weight for BMI, to genomic information. Automatic computation of BMI, BMI percentile and the risk of obesity alert are embedded into this system. After successful testing of the prototype, CHOIS is now ready to be used by the Illinois Department of Human Services School Health program (DHS) for obesity surveillance. This HIPAA & FERPA compliant secure system, integrating large databases in a high performance grid computing environment, enables school-nurse to collect data on school children and report statistical and surveillance information on BMI to identify those at-risk and obese for obesity prevention and intervention programs.

Keywords. Obesity, Body Mass Index (BMI), Portal technology, OGCE, wellness program, grid technology, mobile technology

Introduction

Obesity is from the Latin word *obesitas*, which means "stout, fat, or plump". In simple term, it can be defined as the excessive accumulation of fat in certain parts of the body to the extent that it may have an adverse affect on health, leading to reduced life expectancy. This metabolic disorder is often associated with an increased risk for developing a variety of serious health related conditions including social and emotional problems [1, 2]. Recent study has shown that the maternal obesity may even cause a serious congenital heart defect to the new-born baby [3]. The imbalance of energy intake and energy expenditure in the body is the underlying cause of obesity [4 and the references therein]. A 2006 review identified ten possible contributors to the recent increase of obesity [6]. It is the result of interplay between genetic and environmental

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[2] This has been developed with the financial support and sponsorships of Illinois Department of Human Services School Health Program (DHS), The University of Illinois at Urbana-Champaign (UIUC), the National Center for Supercomputing Applications (NCSA), and the National University Community Research Institute (NUCRI). Part of this development was presented at PRAGMA 18 [5].

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InSORS (now IOCOM) are available to us for video conference. These will be seamlessly embedded into this system for the clinicians, researchers and other users to communicate in a real-time.

Conclusion

Automatic computation of BMI, BMI percentile and the risk of obesity alert embedded into CHOIS have made this system very useful for the school-nurse and healthcare service providers in Illinois to collect data on children and report statistical and surveillance information on BMI with more than 99% accuracy to identify those at risk and obese students. Its web API has made it possible for SHCs uploading the data from Clinical Fusion™ directly into the system and, thus reduced the workload and data redundancy. Moreover, this system can be used for surveillance of other chronic diseases including Asthma.

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References

[1] D.W. Haslam, W.P. James, Obesity, *Lancet* **366** (2005), 1197–209.
[2] T.T. Huang, and T.A. Glass, Transforming research strategies for understanding and preventing obesity, *JAMA* **300** (2008), 1811 – 1813.
[3] J.L. Mills, J. Troendle, M.R. Conley, T. Carter, C.M. Druschel, Maternal obesity and congenital heart defects: a population-based study, Am J Clin Nutr. 2010 Apr 7 (Epub).
[4] E. Sazonov, S. Schuckers, The energetics of obesity: a review: monitoring energy intake and energy expenditure in humans, *IEEE Eng Med Biol Mag.* **29** (2010), 31-5.
[5] A.K. Datta, V. Jackson, R. Nandkumar, and W. Zhu, Cyberinfrastructure for CHOIS - a Global Health initiative for obesity surveillance and control, *Proceedings in the PRAGMA 18*, San Diego (CA), March 3 -4, 2010.
[6] T. Keith, Human Genome-Wide Association Studies Achieving Sufficient Power to Detect Disease Genes with the Quebec Founder Population, *Genetic Engineering and Biotechnology News*, **27** (2), Jan 15 2007.
[7] P. Poirier, T.D. Giles, G.A. Bray, Y. Hong, J.S. Stern, F.X. Pi-Sunyer, R.H. Eckel, Obesity and cardiovascular disease: pathophysiology, evaluation, and effect of weight loss, *Arterioscler. Thromb. Vasc. Biol*. **26** (2006), 968–76.
[8] J.C. Seidell, Dietary fat and obesity: an epidemiologic perspective, *Am J Clin Nutr.*, **67** (1998), 546S-550S.
[9] A. Drewnowski, C.D. Rehm, D. Solet, Disparities in obesity rates: analysis by ZIP code area, *Soc Sci Med.* **65** (2007), 2458-63.
[10] T.T. Huang, and T.A. Glass, Transforming research strategies for understanding and preventing obesity, *JAMA*, **300** (2008), 1811 – 1813.

[11] T.T. Huang, A. Drewnowski, S.K. Kumanyika, T.A. Glass, A systems-oriented multilevel framework for addressing obesity in the 21st century, *Prev. Chronic Dis*. **6** (2009). Retrieved on February 14, 2010 from http://www.cdc.gov/pcd/issues/2009/jul/09_0013.htm.
[12] T.T. Huang, M.N. Horlick, Trends in childhood obesity research: a brief analysis of NIH-supported efforts, *J Law Med Ethics* 35 (2007), 148-53.
[13] R.A. Hammond, Complex systems modeling for obesity research, *Prev Chronic Dis*. **6** (2009). Retrieved on February 14, 2010 from http://www.cdc.gov/pcd/issues/2009/jul/09_0017.htm.
[14] B. Caballero, The global epidemic of obesity: an overview, *Epidemiol Rev* **29** (2007), 1–5.
[15] K.M. Flegal, M.D. Carroll, C.L Ogden, C.L. Johnson, Prevalence and trends in overweight among US children and adolescents, 1999-2000. *JAMA* **288** (2002), 1723–1727.
[16] C.L. Ogden, M.D. Carroll, K.M. Flegal, High body mass index for age among US children and adolescents, 2003-2006. JAMA. **299** (2008), 2401-2405.
[17] P.R. Marantz, E. Bird, M.H. Alderman, A call for higher standards of evidence for dietary guidelines, *Am J Prev Med* **34** (2008), 234 – 40.
[18] R. Brychta, E. Wohlers, J. Moon, K. Chen, Energy expenditure: measurement of human metabolism, *IEEE Eng Med Biol Mag.* **29** (2010), 42-7.
[19] Y. Wang, M.A. Beydoun, L. Liang, B. Caballero, S.K. Kumanyika, Will all Americans become overweight or obese? Estimating the progression and cost of the US obesity epidemic, *Obesity*, **16** (2008), 2323-30.
[20] H.N. Sweeting, Measurement and definitions of obesity in childhood and adolescence: a field guide for the uninitiated, *Nutr J*. **6** (2007), 32.
[21] D.S. Gray, K. Fujioka, Use of relative weight and Body Mass Index for the determination of adiposity, *J Clin Epidemiol* **44** (1991), 545–50.
[22] I. Foster, C. Kesselman, J.M. Nick, S. Tuecke, *The Physiology of Grid*, Retrieved on Feb 14, 2010 from http://www.globus.org/alliance/publications/papers/ogsa.pdf
[23] I. Foster, K. Keahey, C. Kesselman, E. Laure, M. Livny, S. Martin, M. Rynge, G. Singh, Embedding Community-Specific Resource Managers in General-Purpose Grid Infrastructure, Preprint *ANL/MCS*-P1318-0106, January 2006.
[24] A.K. Datta, K. Hunt (moderator), R. Moye, and B. von Oehsen, Campus Champions –Bringing High Performance Computing to your Campus, *EDUCAUSE 2009 Annual Conference*, November 3–6, 2009, Denver, Colorado.
[25] A.K. Datta, P.P. Dey, R. Moore, K. Franklin, T. MacCalla, C-Grid: Enabling Grid Technology for Community Research. *Proceedings of Sixth National Conference on Convergence of Computer Science and Information Engineering*, keynote speech, Coimbatore, India, 22-23 Dec., 2006.
[26] A.K. Datta, Elys, V. Mitra., T. Maccalla, NU Community Grid: Enabling Grid Technology for Community Research, *Proceedings of the International Conference on Computer Science and its Applications*, p322, June 27-29, 2006, San Diego, CA.
[27] D. Lloyd, D. Kalra, EHR requirements, *Stud Health Technol Inform*. **96** (2003, 231-7.
[28] D. Kalra., Electronic health record standards, *Yearb Med Inform*, 2006, 136-144.
[29] B. Blobel, D. Kalra, M. Koehn, K. Lunn, P. Pharow, P. Ruotsalainen, S. Schulz, B. Smith, The role of ontologies for sustainable, semantically interoperable and trustworthy EHR solutions, *Stud Health Technol Inform.* **150** (2009, 953-7.
[30] B. Blobel, C. Chronaki, R. Stegwee, H. Grain, W.E. Hammond, C. Jaffe, D. Kalra, M. Koehn, F. Macary, S. Sabutsch, E. Sheetham, S. Schulz, M. Tan., HL7's comprehensive standards set and its international collaboration for enabling semantically interoperable eHealth and pHealth solutions, *Stud Health Technol Inform.* **150** (2009), 982-6.
[31] M. T. Dougherty, M. J. Folk, E. Zadok, H.J. Bernstein, F.C. Bernstein, K.W. Eliceiri, W. Benger, C. Best, Unifying Biological Image Formats with HDF5, *ACM Bioscience Computing*, Retrived from http://queue.acm.org/detail.cfm?id=1628215.
[32] I. N. Sarkar, Biomedical informatics and translational medicine, *J Transl Med*. 2010 Feb 26;8(1):22.
[33] L. Schmitt, T. Falck, F. Wartena, D. Simons, High Confidence Medical Devices, Software, and Systems and Medical Device Plug-and-Play Interoperability, 2007. HCMDSS-MDPnP. Joint Workshop, Boston (MA), 25-27 June 2007.p146-148. ISBN: 978-0-7695-3081-8
[34] The NIH National Center for Research Resources (2006). Electronic Health Records Overview. Retrieved from http://www.ncrr.nih.gov/publications/informatics/EHR.pdf
[35] M. McGilchrist, F. Sullivan, Kalra D., Assuring the confidentiality of shared electronic health records, *BMJ*. 2007 Dec 15;335(7632):1223-4.
[36] J. Klehr, J. Hafner, L.M. Spelz, S. Steen, K. Weaver, Implementation of standardized nomenclature in the electronic medical record, *Int J Nurs Terminol Classif.* 20 (2009), 169-80.