

Supplemental Figures 1-3 for:

Lanoue M, Mills G, Cunningham A, Sharbaugh A. Concept mapping as a method to engage patients in clinical quality improvement. *Ann Fam Med.* 2016;14(4):370-376.

Appendix – Additional Information & Resources

The Group Concept Mapping (GCM) methodology we present here was developed by the social scientist William Trochim in the 1980's. It appears that the first usage of the term 'concept mapping' is a 1986 publication where Trochim describes the development and application of a process of 'structured conceptualization' and makes reference to the ongoing development of software to process the results.¹ That paper details the development of the method and the statistical techniques on which it is based and is available in full text on the internet.² The GCM method is now viewed as a unique and valid social research method.³ Trochim's work in this area led to the establishment of the for-profit company Concept Systems™, which sells the Concept System™ Software (Ithaca, NY). Thus, the method and the software are to some degree inextricably linked.

The manual detailing the method and use of the software, titled *Concept Mapping for Planning and Evaluation*⁴, is partially available for free online via the publisher⁴. The manual presents the CM method and provides detailed examples of its application in program planning and evaluation. Some of the content was initially published in a special edition of the journal *Evaluation and Program Planning* in 1989⁵, including technical articles on the method and a CM example of nurse's conceptualization of the concept of "caring." Additional internet resources are available, including a bibliography of Trochim's papers,⁶ with many full text links. A particularly useful treatment is the 2005 paper *Concept Mapping: an Introduction to Structured Conceptualization in Healthcare*.⁷

Group Concept Mapping brings together several techniques that are not new: qualitative methods of brainstorming and idea or theme sorting and quantitative techniques of multidimensional scaling (MDS) and cluster analysis (CA). Statistical details, including programming language for SAS, appear in Trochim & Kane (2005),⁷ and also in the 1986 Trochim paper referenced above¹. In short, MDS is a statistical method that uses aggregated similarity ratings derived in the sorting task in order to generate a visual representation of the data - called a point map - where each point is an idea from brainstorming and the distances between the points index their relatedness. Cluster analysis is applied to the MDS results to produce clusters of these points, which minimize the distances of the points in each cluster from one another. Cluster analysis is similar to factor analysis and has a degree of subjective judgment, in that the clusters can be reconfigured so that they make sense conceptually.

It is possible to undertake the individual steps of GCM in isolation and without the CM™ software. An organization could convene groups to brainstorm, and brainstormed ideas could be manually transferred to

cards for sorting, and transferred to lists for rating. Average ratings per idea could easily be calculated via a spreadsheet program, and statistical comparisons of stakeholder ratings of the ideas would be easy to achieve without the analytic step of map production. Further, using the programming references presented here, a proficient SAS or SPSS user could conduct the multidimensional scaling and cluster analyses required to produce the maps. Nevertheless, we judge the overall utility of the CM™ software to be worth its price: \$1700 for a single project or \$3200 for an annual unlimited use license at the time of writing. The easy-to-use software facilitates and streamlines a GCM project from start to finish: emailing participants directly from within the program, conducting remote brainstorming sorting and rating tasks via the internet, data storage and organization, the analytic steps, the production of high quality maps and other rating visualization data, and the functionality of comparisons of cluster ratings across groups, creation of Go-Zone diagrams, and pattern matching.

References

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2. Trochim Publications. <http://www.socialresearchmethods.net/research/research.htm>. Accessed July 3, 2012.
3. Rosas SR. The utility of concept mapping for actualizing participatory research. 2012;12(2):7-24.
4. Kane M, Trochim W. *Concept Mapping for Planning and Evaluation*. Thousand Oaks, CA: Sage Publications; 2007.
5. Trochim, William M.K. K. E. A Special Issue of Evaluation and Program Planning on Concept Mapping for Planning and Evaluation. *Eval Program Plann.* 1989;12.
6. Trochim Publications. <http://www.socialresearchmethods.net/research/research.htm>.
7. Trochim WMKK, Kane M. Concept Mapping: An Introduction to Structured Conceptualization in Healthcare. *Int J Qual Heal Care.* 2005;17(3):187-191.