Use of a Quality Improvement Tool, the Prioritization Matrix, to Identify and Prioritize Triage Software Algorithm Enhancement
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Abstract
Complex decision support software can require significant effort in maintenance and enhancement. A quality improvement tool, the prioritization matrix, was successfully used to guide software enhancement of algorithms in a symptom assessment call center.

Introduction
Clinical decision support software which contains triage algorithms can be very complex. Ask Mayo Clinic is a call center which handles symptom assessment calls from a subscriber population of over 900,000. Expert RN, the triage software at Ask Mayo Clinic, has 39 separate symptom assessment algorithms, the largest having over 400 decision nodes. The multiple algorithms involved and amount of performance data for each algorithm necessitate a structured approach to algorithm maintenance and enhancement. We used a prioritization matrix to rank the separate symptom assessment algorithms for logic enhancement. This is a well known quality improvement matrix tool which has columns consisting of criteria with corresponding weights and rows consisting of entities to be ranked.

Methods
Ask Mayo Clinic call center records from 2006 were used. Experienced triage nurses at Ask Mayo Clinic used the Expert RN system to lead patients through branching logic that resulted in an algorithm suggested recommendation. Concordance of the algorithm recommendation with triage nurse recommendation was captured in real time for 36,059 unique algorithm traversals. The concordance data along with other data captured from each traversal was used to construct several possible criteria for the prioritization matrix. A panel of physicians and nurses selected the criteria and agreed on criteria weights which were used for the matrix columns. Pairwise correlation of the selected criteria was evaluated.

Results
Five criteria were selected for inclusion into the prioritization matrix. Two criteria reflected the triage nurses’ agreement/disagreement with the algorithms on each of the 36,059 traversals. The kappa agreement statistic was selected to represent the level of nurse agreement with each algorithm. Nurses’ disagreements with algorithms were often asymmetric (more triage downgrades than upgrades). This asymmetry of disagreement was not captured by kappa and a binominal p value was selected as a criterion to reflect this asymmetry. The medical importance of each algorithm was determined by the proportion of patients recommended for emergency evaluation. The remaining two criteria selected were algorithm frequency of use and average traversal length for each algorithm. A prioritization matrix was constructed consisting of 39 rows of algorithms to be prioritized and columns consisting of the five algorithm criteria and their corresponding weights. Pairwise correlation of the five criteria showed only 2 out of 10 possible pairs of criteria were significantly correlated, (R²=0.51 for asymmetry p values and algorithm use, R²=0.35 for asymmetry p values and proportion recommended for emergency evaluation). Where there was correlation between the criteria, the physician panel considered that in the criterion weights. The result of the prioritization matrix was a single number for each algorithm. This number represented the weighted input from all five criteria.

Discussion
A prioritization matrix can be a useful tool to aid decision making about maintenance of complex triage software involving multiple algorithms. Real time capture of nurse agreements and disagreements with the algorithm logic allows for differentiation of algorithms with agreement statistics such as kappa and asymmetry of disagreement p values. The prioritization matrix allows these and other criteria such as use, traversal length, and relative recommendation importance to be integrated into a single number for each algorithm. The single prioritization number for each algorithm can then be used by management for appropriate effort distribution in algorithm maintenance and enhancement.

Conclusion
A prioritization matrix can incorporate many aspects of triage algorithm data into a framework to help prioritize software maintenance resources. This tool potentially has applicability in the quality maintenance of similar clinical decision support software.