MSQC 3.0 Case Sampling Methodology

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Complex medical record abstraction is vital to the Michigan Surgical Quality Collaborative (MSQC) mission to improve patient safety and care. The collaborative targets general surgery, vascular, and hysterectomy operations from 306 different CPT Codes arranged into 14 broadly defined procedure groups. Given the scope of this targeted population, abstraction for all cases would be impractical and is, in fact, unnecessary given alternatives offered by statistical sampling.

While MSQC has always utilized a case sampling approach, the implementation of MSQC 3.0[1] includes an improved case sampling methodology to enhance statistical validity and generalizability of results to hospital populations. In order to support direct generalization to the hospital population, a probability sample must be drawn such that each element in the population has a known, nonzero chance of being included in the sample. Under the previous MSQC 2.0 methodology, hospitals were asked to sort their population of MSQC eligible cases by date, time, and operating room number for a given cycle. Then, the first 25 cases in order were selected for the MSQC sample. Using this approach, the total number of MSQC eligible cases at a hospital was unknown, as the ordering and selecting of cases ceased after the initial 25 cases were identified. Therefore, this was not a true probability sample, as some elements of the population had zero chance of being included in the sample.

An additional concern was selection bias. Selection bias may occur when there is a systematic tendency to over-represent or under-represent some portion of the population. Under the MSQC 2.0 methodology, there was risk for introducing selection bias into the sample. Also, while the MSQC 2.0 sampled cases should reflect the actual hospital prevalence of the procedures, it may well deviate from this prevalence substantially, even by chance alone. This may affect having adequate sample size for comparison purposes, especially for those situations when the sampled frequencies are very low for a particular procedure. Therefore, the new MSQC 3.0 sampling methodology utilizes an equal allocation stratified sampling procedure to address this issue as well.

The new MSQC 3.0 sampling methodology begins with a complete sampling frame of all MSQC eligible cases, based on the MSQC 3.0 CPT Code inclusion criteria. Identifying all eligible cases is the first step to ensuring each and every case has a nonzero probability of selection. Next, cases are stratified by procedure group, and a simple random sampling procedure is employed within each stratum. Thus each case within a stratum has an equal probability of being sampled. (This probability is also known as the sampling fraction.) This sampling fraction is calculated as n/N, where n = number of cases selected from the stratum, and N = total number of cases in stratum. The sampling weight is the reciprocal of the sampling fraction, or N/n, and provides the missing link between the sample and the hospital population.

[1] Beginning with operations performed October 8, 2015

The goal of the new MSQC sampling is equal allocation of the sample across strata. However, considering the workflow criteria of 22 cases sampled for abstraction each cycle, it is not always possible to select an equal, whole number of cases for each of the (up to) 14 procedure group strata each cycle. Perfect equal allocation of 22 cases per cycle would require n = 1.57 cases per strata selected each cycle (22 ÷ 14 = 1.57). Thus, the sampling algorithm was built to accommodate the desire for both equal allocation and 22 cases per cycle by using a rounding algorithm.

The rounding algorithm keeps a running total of sampled cases by procedure group strata across all cycles. In order to obtain 22 sampled cases in a given cycle (assuming the total 14 eligible procedure group strata exist on the sampling frame), 8 of the procedure group strata need to round up to select 2 cases, and 6 of the strata need to round down to select 1 case. Initially, whether a stratum selection number, n, will round up or down will be determined randomly, using a random number generator within the algorithm. After that, priority for rounding up will first be given to the strata with the lowest total cases in the sample, and ties will be broken randomly. The rounding algorithm continues in this manner each cycle to select 22 cases per cycle, and the number selected for each stratum is adjusted every cycle to approach equal allocation by strata across the entire sample.

As further clarification, this is a rounding algorithm only. The rounding algorithm will not allocate additional or extra cases to a procedure stratum based on a past deficiency in sampling. It will only round the number of cases up or down to the nearest whole number in order to preserve the equal allocation stratified sampling design with the desired 22 sampled cases per cycle. Ultimately, while equal allocation in the overall sample is a goal, it is also dependent upon hospital volume and procedure mix. At a minimum, this algorithm will result in larger sample size for some procedures that were previously too small to analyze meaningfully.

In Summary, employing the equal allocation stratified sampling methodology to MSQC 3.0 will increase the statistical validity of the MSQC data abstracted and will allow for direct generalization to the hospital population and meaningful analysis of previously low volume procedures. The sampling algorithm was written to account for both the statistical foundation of the equal allocation stratified sampling process and the workflow constraint of 22 cases sampled for abstraction each cycle. As a result, this improvement to the sampling methodology will greatly increase the quality of the MSQC sample and strengthen the merit of MSQC program overall.

References

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