Appendix D: The Importance of Sample Size

To conduct an effective and efficient study, it is important to calculate an appropriate sample size. Sample size determines resource requirements and the relevance of findings. If a sample is too large or too small, the results may be expensive or ambiguous. Sample size is only one element that researchers must consider in designing studies. Other factors that affect the quality of a study include definition of research questions, identification of measures, and selection of procedures for data collection.

Sample size calculations should be done by trained statisticians, as the calculations depend on several variables. How much confidence a researcher will have in study results depends in part on how much variability there is in the expected measure. A larger sample size requires greater resources, so the value of having a larger sample size must be balanced against requirements for funding and other resources.

To illustrate the importance of calculating sample size, consider this fictional example:

Before implementation of an e-prescribing system in an outpatient practice, the office manager believed they were making a large number of prescription errors, maybe as high as one in every four prescriptions, or 25 percent. Experience from other e-prescribing sites suggests that after implementation of the e-prescribing system, the rate would drop to 2.5 errors per 100 prescriptions. If you select 100 prescriptions at random for review both before and after implementation of e-prescribing, you might observe the following:

	Before	After
Number of Errors in 100 Sampled Prescriptions	27	3
Observed Error Rate	27%	3%

Given the large difference in both the percentage and the number of errors, you could be fairly confident that you were measuring some "real" effect, even though you measured only a small sample of prescriptions. On the other hand, if you observe the following data…

	Before	After
Number of Errors in 100 Sampled Prescriptions	5	3
Observed Error Rate	5%	3%

It would be inappropriate to conclude that the e-prescribing system had reduced prescribing errors. Statistics show that repeated samples of 100 would reveal slightly different rates. Since the number of observed events (prescription errors) is so small both before and after implementing the e-prescribing system, the errors may have shown up in the sampled prescriptions by chance. Random events might even result in one or two fewer errors before implementation, giving the impression that the system was causing errors rather than preventing them.

However, to illustrate the power of sample size, consider if you could afford to examine 100,000 prescriptions before and after implementation of the e-prescribing system. Even if the underlying probabilities did not change, you might observe:

	Before	After
Number of Errors in 100,000 Sampled Prescriptions	4,932	2,592
Observed Error Rate	4.9%	2.6%

Based on these data, would you feel more confident that the reduction in errors is real and not due to random chance? Most people would say "yes." Even if, by chance, the observed data are a few errors off from the "true" error rate, the overall rate would still not change in a significant way, and you still would conclude that the prescribing error rate was very different after implementation of e-prescribing.

For this example, the actual number of observations required to determine if there was a change in the number of errors with statistical certainty (i.e., the minimal sample size) falls somewhere between 100 and 100,000. To determine the exact number required, you need to conduct a "sample size calculation." A full discussion of sample size calculations is beyond the scope of this guide. Due to the need for expert advice to complete this work, it is preferable to consult with a statistician. The purpose of this discussion is to convey a rudimentary understanding of the importance of sample size in research design.

It is important to determine sample size before you embark on certain types of evaluation study designs such as pre-post designs. Doing so will help your team determine whether the required sample size is feasible within your evaluation budget and resources. If you find the required sample size is too large, you may need to reprioritize the measures you will include in your evaluation plan.