HEALTH BASICS

Sensitivity analysis

Sensitivity analysis tests whether a health study's conclusions change under reasonable alternative assumptions.

WHAT IT IS
A repeat analysis that tests reasonable assumptions

WHERE IT COMES UP
Research reports, risk estimates, and healthcare funding decisions

WHY IT MATTERS
Shows how strongly evidence supports a health conclusion

WHAT IT IS NOT
Not a disease, diagnosis, or medical test

WHO TO ASK
Clinician, study author, or health evidence service

HOW IT IS CHECKED
Repeating calculations with reasonable alternative assumptions

Overview

Sensitivity analysis is a way to test how reliable a calculation or research conclusion is. Researchers repeat an analysis after changing uncertain assumptions, data choices, or methods. They then look at whether the main result stays similar.

For example, some people may leave a clinical trial before it ends. Researchers do not know exactly what their missing results would have been. A sensitivity analysis can test several reasonable ways of handling those missing results. If each approach leads to a similar conclusion, confidence in the finding may increase.

If the conclusion changes greatly, the result is described as sensitive to that assumption. This does not automatically make the research wrong. It means the uncertainty matters and should be considered when interpreting the result.

Sensitivity analysis is not a disease, diagnosis, treatment, or type of symptom. It is also different from the sensitivity of a medical test . Test sensitivity describes how often a test correctly identifies people who have a particular condition.

You may see sensitivity analyses in clinical trials, reviews of several studies, public health forecasts, risk calculators, and assessments of whether a treatment offers good value for a

health system.

How it works

Most health research involves choices or assumptions. Researchers may need to decide which people to include, how to define an outcome, how to handle missing information, or which statistical model to use.

The researchers first perform a main analysis , sometimes called the primary or base-case analysis. This uses the methods planned for the study.

They then repeat the calculation using reasonable alternatives. Depending on the question, they might:

A simple sensitivity analysis may change one assumption at a time. This helps show which input has the greatest effect.

A probabilistic sensitivity analysis , often used in health economic models, changes many uncertain inputs across plausible ranges. The model is run repeatedly to show how often different conclusions occur. This is more complex, but the basic question remains the same: does uncertainty change the decision?

Sometimes researchers perform a tipping-point analysis . They ask how extreme the missing or uncertain information would need to be before the conclusion changed. This can help readers judge whether that alternative seems realistic.

The alternatives should have a reasonable basis. Trying many unlikely scenarios until one produces a preferred result is not a sound sensitivity analysis. Good reports explain what was changed, why it was changed, and what happened.

- include or exclude studies at higher risk of bias
- use different reasonable definitions of an outcome
- change assumptions about missing results
- compare statistical models
- test different estimates for treatment costs or benefits
- examine whether an unusually large study drives the overall result

Why it matters for your health

Health decisions are rarely based on one number alone. An estimate such as a treatment

benefit, side-effect risk, or cost may be affected by incomplete data and research choices.

A sensitivity analysis helps show whether the conclusion is robust , meaning it remains broadly stable when reasonable assumptions change. A robust result may offer more reassurance than one that depends heavily on a single uncertain choice.

If the result changes substantially, the evidence may still be useful. However, you may need to interpret the exact estimate more cautiously. For example, the evidence might suggest that a treatment helps, while leaving uncertainty about how large the benefit is.

Sensitivity analyses can also affect healthcare policy. Agencies may use them when deciding whether a medicine, screening programme, or other service provides enough benefit for its cost. The analysis can show which uncertain facts have the greatest effect on that decision.

A sensitivity analysis does not tell you whether a treatment is right for you personally. Research findings describe groups of people. Your own choices may also involve your diagnosis, other health conditions, treatment goals, possible harms, and preferences.

What can go wrong

Sensitivity analysis is especially relevant when research involves missing data, uncertain measurements, different statistical methods, or assumptions about future events.

Missing data can arise when participants leave a trial or do not complete follow-up. If the people with missing results differ from those who remain, the study estimate may be distorted. Sensitivity analyses can explore possible effects, but they cannot reveal the missing information with certainty.

Selection bias occurs when the people or studies included are systematically different from those left out. Removing studies at higher risk of bias may show whether they strongly influence a review. However, repeating the calculation cannot fully repair poor study selection.

Measurement error means that an exposure, diagnosis, treatment, or outcome was measured inaccurately. Alternative assumptions can estimate the possible effect, but they do not replace accurate measurement.

Confounding occurs when another factor is linked to both the exposure and the outcome. This is a particular issue in observational research, where treatments are not assigned at random. Sensitivity analysis may estimate how strong an unmeasured confounder would need to be to explain a result. It cannot prove that no confounding exists.

Model uncertainty arises when results depend on how researchers represent a complex situation mathematically. This is common in long-term forecasts and cost-effectiveness

studies. A model can be carefully tested while still being limited by weak input data.

Selective reporting is another concern. A report may describe only analyses that support a preferred conclusion. Look for a clear primary analysis, an explanation of the alternatives tested, and results from all important scenarios.

What you can do

You usually do not need to perform a sensitivity analysis yourself. If a study or health assessment may affect your decision, you can ask:

Keep the report, patient information sheet, or link to the evidence you are discussing. Note the outcome that matters to you, such as pain, daily function, hospital admission, or side effects. This can help a clinician explain whether the study measured something relevant to your situation.

Sensitivity analysis itself never creates an urgent medical problem. Questions about research findings can usually wait for a routine appointment or discussion with a pharmacist, clinician, or evidence information service.

Do not delay urgent care while trying to interpret a study. If you have severe or rapidly worsening symptoms, signs of stroke, serious trouble breathing, or signs of a severe allergic reaction, use the emergency service available where you live. The need for urgent care is based on your condition and symptoms, not on whether a research paper included a sensitivity analysis.

- Did reasonable alternative analyses reach a similar conclusion?
- Which assumption had the greatest effect on the result?
- Did the analysis address missing data and studies at higher risk of bias?
- Did the conclusion change, or only the estimated size of the effect?
- Were the sensitivity analyses planned before the results were known?

Common questions

Does a sensitivity analysis prove that a result is correct?

No. It shows what happens under the alternatives that were tested. Other problems, such as poor study design or unknown bias, may remain.

Is a result unreliable if it changes?

Not necessarily. A change tells you that a particular uncertainty matters. The result may still guide decisions, but its limits should be stated clearly.

Is this the same as a test being highly sensitive?

No. A highly sensitive medical test correctly identifies a high proportion of people who have the condition being tested for. Sensitivity analysis is a statistical method for testing assumptions.

Can researchers choose any alternative they want?

Alternatives should be plausible and relevant to the study question. Researchers should explain why each one was chosen. Preplanned analyses are generally easier to interpret than analyses selected after the results are known.

Should every study include one?

Not every research question needs the same analysis. Sensitivity analysis is most useful when uncertain assumptions or methodological choices could reasonably affect the conclusion.

Sources

- Cochrane, Cochrane Handbook for Systematic Reviews of Interventions , version 6.5, Chapter 10: Analysing data and undertaking meta-analyses, 2024
- International Council for Harmonisation, ICH E9(R1): Addendum on Estimands and Sensitivity Analysis in Clinical Trials , 2019
- National Research Council, The Prevention and Treatment of Missing Data in Clinical Trials , National Academies Press, 2010
- European Medicines Agency, Guideline on Missing Data in Confirmatory Clinical Trials , EMA/CPMP/EWP/1776/99 Rev. 1, 2010
- National Institute for Health and Care Excellence, NICE Health Technology Evaluations: The Manual , process and methods PMG36, 2022
- Briggs AH, Weinstein MC, Fenwick EAL, Karnon J, Sculpher MJ and Paltiel AD, "Model Parameter Estimation and Uncertainty Analysis," Medical Decision Making , 2012;32(5):722-732