Establishing scientific confidence in test methods: shipping studies to aid the transferability of methods using cell- and tissue-based test systems and reagents

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Background

- Scientific confidence in the use of a test method can be evaluated using a framework based on fitness for purpose, biological relevance, technical characterization, data integrity and transparency, and independent review.
- Technical characterization includes various components, such as the evaluation of accuracy, intra-laboratory reproducibility, and **transferability**.
- When assessing the transferability of methods that rely on cell- and tissue-based test systems and reagents, it is important to consider whether **shipping studies** may be needed, and what type(s) of shipping study will fit the needs of the test method.

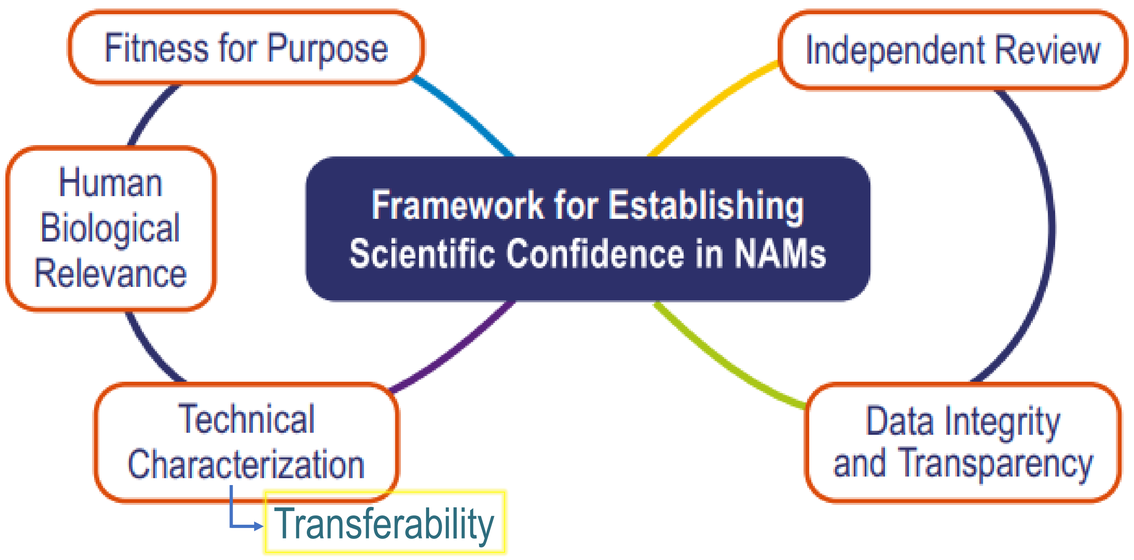

Figure 1: Shipping studies can comprise part of the technical characterization of a test method. Technical characterization is one of five essential elements outlined in van der Zalm et al. 2022.

Types of shipping studies

Depending on the goals, shipping studies can be conducted at different points:

- in early development
- prior to and after launching the test system
- during the validation of the test method that relies on the cell- or tissue-based test system or reagent

Shelf-life studies as mock shipping studies

- Without shipping, the vendor monitors the cell- or tissue-based test system or reagent in-house to establish plausible shipping conditions.
- Designed to develop and evaluate basic storage conditions for shipping (e.g., can the test system or reagent be maintained in a container with dry ice for 48 hours).
- Similar to stability studies.

Preliminary international documentation shipping studies

- Vendors ship one-way to end users to determine whether shipping documents and labeling are adequate for international recipients.
- Conducted in collaboration with prospective end users in specific markets to determine logistics and documentation for international shipments, such as international regulatory end user requirements and limitations, importation trade/tariff and customs documentation, and safety regulations.

Preliminary shipping performance studies

- Vendors ship one-way to a recipient and the recipient simply ships the package back to the vendor to conduct tests to determine whether the material can survive shipment.
- Results are used to establish packaging and shipping conditions.

Definitive shipping studies

- The end user receives cell- and tissue-based test systems and reagents from the vendor and conducts the same types of quality control evaluations as are conducted by the vendor on the same lot of materials.
- To evaluate the transferability of the test method that relies on the test system or reagent, the end user may also conduct and analyze the specific functional applications developed by the test method developer/vendor.

Select parameters to consider for shipping studies

Temperature

- Do the test systems and reagents need to remain frozen?
- If not, what temperature ranges are acceptable? Are monitors needed to assess temperature and/or air pressure during transit?

Packaging

- What packaging-specific considerations are required for extended storage and transport?
- Is the arrangement of components within the package important?
- Have handling instructions for the package receiver been included?

Stability

- For active test systems and reagents, are supplements or other amendments needed to maintain the support medium?
- Is there potential for events during shipping that could adversely impact the test systems or reagents, and are there ways to mitigate the adverse impact?
- Are the contents particularly sensitive, or the transit sufficiently lengthy, that maintenance of the materials is only possible with consistent surveillance?

Customs and travel

- Have the conditions been evaluated over longer-than-expected timeframes?
- Will the test system or reagent be shipped to local, regional, national, or global end users?
- What are the likely shipping routes/hubs/delivery networks?
- Have couriers/shipping providers been contacted directly to discuss the shipment?
- Have handling instructions for the customs and importation inspection authorities been included?

Cost

- What is the cost to ship the cell- and tissue-based test system and reagent, including packaging, shipping, and person-hours needed?

Conclusions

- Cell- and tissue-based test systems and reagents are increasingly being used due to their ability to reflect human biology. These test systems and reagents may be shipped long distances, including across international borders, from the vendor to the testing laboratory.
- To ensure confidence in the data obtained from testing involving these test systems and reagents, it is important to ensure that quality is maintained during the shipping process and that the materials can be used for their intended application (i.e., that the test method associated with the test system and/or reagent can be effectively transferred between laboratories).
- Emphasis is placed on the need for good communication between vendors, shipping agents, and end users to ensure efficient transferability of test methods.
- Various types of shipping studies might be conducted when transferring a method to a new laboratory and key considerations for their design that can help maintain the quality of the test systems and reagents during the shipment process.

References

- Raabe HA, van der Zalm AJ, Clippinger AJ, Costin GE. Organizing shipping studies to evaluate the transferability of cell- and tissue-based test systems and reagents: an end user perspective. *ALTEX*. 2025;42(3):556-560.
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