

Reporting quality of clinical studies using mesenchymal stromal cell therapy for the prevention or treatment of bronchopulmonary dysplasia

Luke Moore

Ottawa Hospital Research Institute <https://orcid.org/0009-0001-4600-1928>

Celine Fawagreh

University of Ottawa <https://orcid.org/0009-0006-9587-6954>

Laurent Renesme

Ottawa Hospital <https://orcid.org/0000-0001-6848-3617>

Saad Khan

Boreal Biotherapeutics

Bernard Thebaud

Ottawa Hospital Research Institute <https://orcid.org/0000-0003-1844-7145>

Marc-Olivier Deguise

mdegu051@uottawa.ca

University of Ottawa <https://orcid.org/0000-0002-3802-1195>

Short Report

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TITLE: Reporting quality of clinical studies using mesenchymal stromal cell therapy for the prevention or treatment of bronchopulmonary dysplasia

AUTHORS: Luke Moore^{1,#}, Celine Fawagreh^{1,2,#}, Laurent Renesme^{2,3,4,5}, Saad Khan⁶, Bernard Thébaud^{1,2,3,4,5,7}, Marc-Olivier Deguise^{1,2,3,4,5,7}

#Co-first author

AFFILIATIONS:

¹Sinclair Centre for Regenerative Medicine, Ottawa Hospital Research Institute, Ottawa, Canada

²Faculty of Medicine, University of Ottawa, Ottawa, Canada

³Division of Neonatology, Children's Hospital of Eastern Ontario, Ottawa, Canada

⁴Department of Obstetrics, Gynecology and Newborn Care, University of Ottawa, Ottawa, Canada

⁵Children's Hospital of Eastern Ontario Research Institute, Ottawa, ON, Canada

⁶Boreal Biotherapeutics, Ottawa Hospital Research Institute, Ottawa, Canada

⁷Department of Cellular and Molecular Medicine, University of Ottawa, Ottawa, ON, Canada

Corresponding author: Marc-Olivier Deguise (mdegu051@uottawa.ca)

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Authors' contribution:

- Luke Moore: Investigation, formal analysis, data curation, Writing – original draft, Writing – review and editing
- Celine Fawagreh: Investigation, formal analysis, data curation, Writing – original draft, Writing – review and editing
- Laurent Renesme: Writing – review and editing
- Saad Khan: Writing – review and editing
- Bernard Thébaud: Conceptualization, Writing – review and editing, Supervision
- Marc-Olivier Deguise: Conceptualization, Methodology, investigation, Writing – original draft, Writing – review and editing, Visualization, Supervision, Project Administration.

ABSTRACT: Bronchopulmonary dysplasia (BPD) is a common complication of prematurity marked by altered lung development, which leads to lifelong sequelae. Mesenchymal stromal cells (MSC) earned robust biological therapeutic plausibility by targeting the complex pathogenesis of BPD in the experimental setting, with early phase clinical trials sprouting around the world. The quality of reporting of cell therapy products has been notoriously poor across all research fields. There have been recent efforts to improve the transparency of reporting to enhance reproducibility and scientific rigor of cell therapy studies. This led to a newly proposed MSC reporting guidance in 2025 established through a Delphi process. We retrospectively investigated whether clinical studies published using MSCs in the prevention or treatment of BPD, which all preceded the guidance, spontaneously reported key elements discussed in the latest MSC reporting guidance. Our primary intent is to establish the baseline status of the current existing evidence regarding best reporting practices and identify areas of improvement for future studies. We found that nearly all studies did not provide enough information to properly describe the cell product administered in patients, which can lead to poor reproducibility and interpretation while limiting the pooling of the results in future meta-analysis. Specifically, only 4 of 10 studies reported on 75% or more of the reporting items, while 4 of 10 studies reported on less than 40% of reporting items identified in the 2025 reporting guidance. Cell culture conditions were the least reported area. We encourage trialists using MSC therapies for BPD to report the recommended information as per the latest 2025 reporting guidance. This will ensure proper interpretation of the cell product and its therapeutic capacity via open science, ultimately improving MSC cell therapy optimization and translation.

INTRODUCTION:

Bronchopulmonary dysplasia (BPD) is the leading cause of morbidity and mortality for extremely low gestational age neonates¹. Although advancements in perinatal care have allowed extremely premature infants to survive, the incidence of BPD remains constant for decades². This is attributed to the heterogeneity of patients and the complex multifactorial pathogenesis of BPD³. Mesenchymal stromal cells (MSCs) have immunomodulatory, antioxidative and regenerative properties^{3,4}. Their multimodal mechanisms of action make them an attractive therapeutic candidate for multifactorial diseases such as BPD³. Experimental models of BPD have shown that umbilical cord-derived MSCs (UC-MSCs) have lung-protective effects including improved alveolarization, pulmonary hypertension, lung inflammation, fibrosis, angiogenesis, and apoptosis^{5,6}. UC-MSCs have been demonstrated as safe biological agents in non-human primates⁷. Early phase clinical trials have emerged in patients with the hope of translating the first effective therapy for infants at risk of BPD³.

Across all diseases, translation of MSC therapies has been disappointing. More than 55,000 published studies and 1,000 clinical trials using MSCs have been registered on clinicaltrials.gov^{4,8}. Drug discovery and development is known to be a long and costly process. In fact, nine out of ten drug candidates that enter clinical studies would fail during phase I, II, III clinical trials, and/or drug approval^{9,10}. Cell therapies are even more susceptible to failure. Unlike pharmaceuticals, the therapeutic potential of MSCs can be affected by the cell origin and identity, cell isolation methodology, manufacturing, storage, and delivery process¹¹. The International Society for Cell and Gene Therapy (ISCT) devised and updated minimal criteria to define mesenchymal stromal cells, defining what stemness means, and the important parameters required to maintain a shared understanding of the cell therapies used in studies. Yet, a recent scoping review shows that 318

preclinical and clinical studies had major inconsistencies in MSC characterization and culture conditions, with clinically relevant information about cell characterization and manufacturing identified as incompletely reported¹². This is a concerning finding as the “process is the product”^{4,12}. Thus, “The stem cell mess”, as described by others in the field¹³ continues to exist.

A recent study hopes to improve current reporting guidance through the Delphi research methodology¹⁴. Following a three-round modified Delphi process involving 87 international experts from 22 countries. Nine minimal criteria for (i) defining and characterizing MSCs and 33 reporting items for (ii) MSC clinical studies were established^{14,15}. The new reporting items from the Delphi reporting guidance study¹⁴ are contrasted to the 2006¹⁶ and 2019 ISCT¹⁷ reporting guidelines in Table 1.

Comparison of Minimal Criteria to Define and Characterize Mesenchymal Stromal Cells: 2006 vs 2019 vs 2025 Guidelines			
Category	2006 Mesenchymal Stromal Cell Guidelines (Dominici et al., <i>Cytotherapy</i> , 2006)	2019 ISCT Position/Guidance (ISCT Mesenchymal Stromal Cell Committee, 2019)	2025 Mesenchymal Stromal Cell Guidelines (Renesme et al., <i>Cytotherapy</i> , 2025)
 Tissue source	Not explicitly required.	Recommend supplementing "mesenchymal stromal cells" with tissue-source origin of the cells, which would highlight tissue-specific properties.	Describe tissue of origin.
 Morphology/ Adherence	Mesenchymal stromal cells must be plastic adherent under standard culture conditions.	Not explicitly updated in the 2019 guidelines.	Not required. Plastic adherence is not included as a defining criterion.
 Phenotype	Expression of specific surface markers by flow cytometry.	Not explicitly updated in the 2019 guidelines.	Phenotype by flow cytometry. • Report the pre-determined cut-off used. • Report the % positive/negative cell fraction for each marker.
 Positive markers	<ul style="list-style-type: none"> CD105 CD90 CD73 	Not explicitly updated in the 2019 guidelines.	<ul style="list-style-type: none"> CD105 CD90 CD73 Other tissue-relevant markers
 Negative markers	<ul style="list-style-type: none"> CD45 CD14 or CD11b CD79a or CD19 HLA-DR 	Not explicitly updated in the 2019 guidelines.	<ul style="list-style-type: none"> CD45 Other tissue-relevant markers
 Differentiation potential	Mesenchymal stromal cells must differentiate into osteoblasts, adipocytes, and chondrocytes <i>in vitro</i> .	Intended as mesenchymal stromal cells unless rigorous evidence for stemness exists that can be supported by both <i>in vitro</i> and <i>in vivo</i> data.	Not required as a defining criterion. Instead, demonstrate "stemness" if using "stem cell" nomenclature (e.g., self-renewal, clonogenicity, or other stemness assays).
 Functional/ Potency characterization	Not required.	Recommend a robust matrix of functional assays to demonstrate mesenchymal stromal cell properties, which are not generically defined but informed by the intended therapeutic mode of actions.	Demonstrate <i>in vitro</i> functionality. Functional assays appropriate to the intended clinical use (e.g., immunomodulation, angiogenesis, etc.).
 Clinical reporting guidelines	Not explicitly addressed.	Not explicitly updated in the 2019 guidelines.	Follow reporting guidelines for clinical studies including: 1. Mesenchymal stromal cell intervention & control: Dose, route, concentration, vehicle, infusion rate, etc. 2. Mesenchymal stromal cell characteristics: Provenance, donor characteristics, tissue source, cryopreservation, viability, functional assays, etc. 3. Mesenchymal stromal cell culture conditions: Culture method, oxygen, confluence, medium, serum, platelet lysate, etc.

Table 1. Comparison of minimal criteria for the definition and characterization of mesenchymal stromal cells (MSCs) between the 2006, 2019 and 2025 consensus reporting guidelines. The green font represents new items derived from the 2025 consensus guidance. The orange font represents items derived from the 2019 ISCT committee position statement on nomenclature. The red font represents items that have been dropped, significantly altered, or drastically changed. The color scheme is used to improve recognition of new items that now require reporting.

Here, we provide a first survey of the reporting quality of clinical trials in BPD that preceded the new 2025 reporting guidance ¹⁴ to identify current reporting practices and areas that will require the most improvement for future studies using MSC for BPD.

METHODS:

Identification of relevant studies

This narrative literature review builds the identification of studies in a stepwise fashion. First, we found initial records identified in the Cochrane systematic review in 2017¹⁸, no studies were included but an initial corpus of potential studies was assembled. A recent narrative review updated this corpus³. With the assumption that a paucity of studies exists, we did not perform a systematic review as we deemed the yield would be minimal. Rather, we identified studies and clinical trials under convenience sampling of all completed studies based on these two reports described above^{3,18}. We supplemented our study identification by a non-systematic PubMed search. We confirmed all completed studies using MSCs in BPD recorded on clinicaltrial.gov (Search date: 09/10/2026, Keywords: mesenchymal stromal cells; mesenchymal stem cells; MSCs; bronchopulmonary dysplasia; BPD used in varied combinations) were identified within our sample. As such, our search is not systematic and does not guarantee inclusion of non-indexed and potentially hidden studies or studies hosted on non-English websites.

Inclusion of studies

Study inclusion for reporting quality appraisal were as followed based on abstract and full-text retrieval:

1. Published clinical studies (independent of the study design)
2. Identifiable through major databases
3. Written in English
4. Use mesenchymal stromal cells or mesenchymal stem cells to treat patient at risk or with established BPD

Mapping of quality of reporting

The 2006¹⁶ and 2019¹⁷ ISCT criteria to define MSC are depicted in table 1. In short, the major contributions by the 2025 Delphi consensus¹⁴ was the removal of plastic adherence and requirement for differentiation, more stringent flow cytometry reporting inclusive of cut-off and the percentages positive/negative cell fractions and the addition of other tissue-relevant markers (specific to the experimental design). An important addition were the reporting guidelines for MSC clinical trials (intervention and control, cell provenance and characteristics, and cell culture conditions) (Table 1 and Figure 3). To map the new criteria for our study, we extracted the information directly from the 2025 Delphi study Table 6 & 7 to produce a data extraction sheet containing the suggested elements. We noted that the reporting items “tissue source” and “tissue source described” are each presented separately, although they are equivalent in what they describe. We chose not to alter the structure of reporting provided by Renesme & *al.* (2025)¹⁴. However, we appreciate it will inflate the reporting (+2 fields reported when the source is mentioned).

Some elements of the reporting scheme are not necessarily applicable to all studies. For example, case studies/series are not expected to have a control group by design. Furthermore, if studies explicitly report serum-free conditions, they will not report human platelet lysate use or amount separately. As such, these fields would be deemed non-applicable unless explicitly reported by the authors of the record. We also ensured that any culture techniques were not novel to the studies and that their emergence occurred prior to study publication (such as the use of human platelet lysate¹⁹). Lastly, the category determining stemness used the following rule: the item was designated as “reported” if the study used “mesenchymal stem cell” nomenclature with clear evidence of stemness illustrated via functional assay or if “mesenchymal stromal cell” (where no

evidence of stemness is required) was used. All studies that used “mesenchymal stem cell” without evidence supporting stemness were considered “not reported”.

Data extraction

Two reviewers (L.M. and C.F.) independently extracted data from clinicaltrials.gov, published articles and supplemental materials into separate datasets and subsequently cross-checked their extractions to ensure consistency and accuracy (Figure 1). A third author (MOD) resolved conflicts. Data extraction included general study characteristics (Figure 2), including study identification, trial design, population and scale, study timeline and status, clinical outcomes, and sponsorship and oversight. MSC minimal criteria, specific intervention, cell product, and manufacturing characteristics were also extracted (Figure 3) as proposed by Renesme et al.¹⁴.

AI use disclosure

Figures 1 to 4 were made with AI-assisted technology (ChatGPT). Their content was confirmed for veracity by the author who made them (C.F.). No other component of the manuscript used AI.

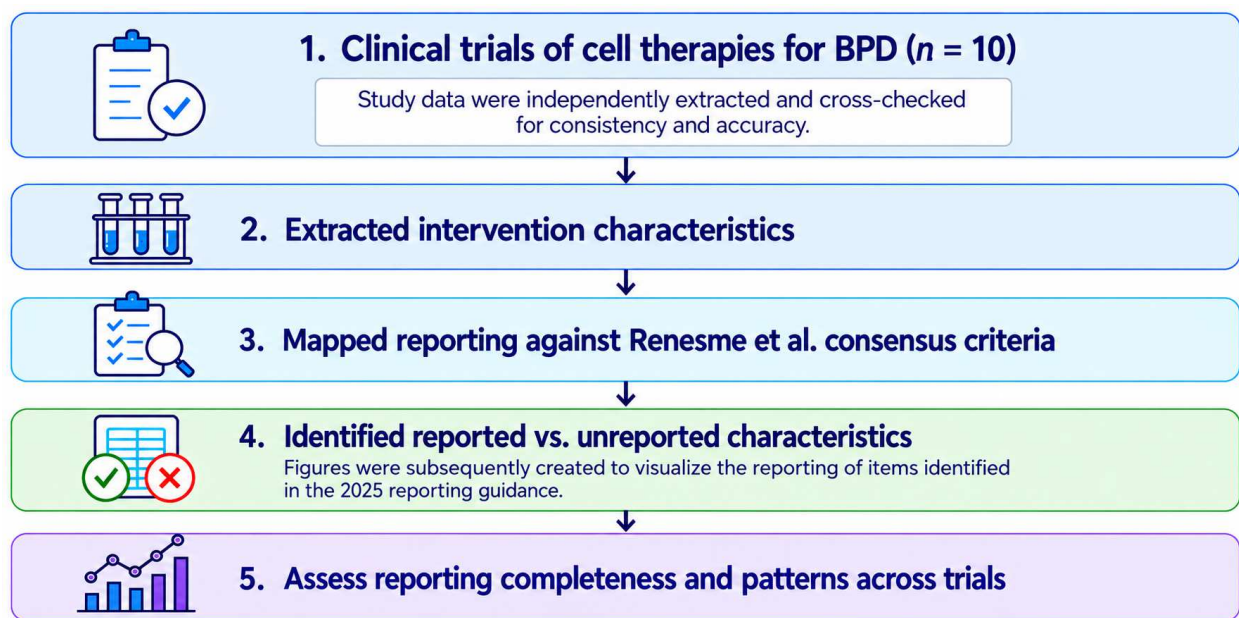


Figure 1. Study selection, data extraction, and assessment of mesenchymal stromal cell reporting. Overview of the study assessment workflow. L.M. and C.F. independently extracted study data into separate datasets and cross-checked their extractions for consistency and accuracy. Intervention characteristics were mapped against the Renesme et al. consensus reporting guidance¹⁴ to identify reported and unreported characteristics.

Clinical Trial and Study Characteristics Extracted



Figure 2. Clinical trial characteristics extracted from included studies. Overview of the study-level characteristics extracted from each included clinical study of cell-based therapies for bronchopulmonary dysplasia. Extracted variables were grouped into six domains: study identification, trial design, study population and scale, trial timeline and status, clinical outcomes, and sponsorship and oversight.

MSC Product Characteristics Extracted

According to the Renesme et al. Reporting Framework

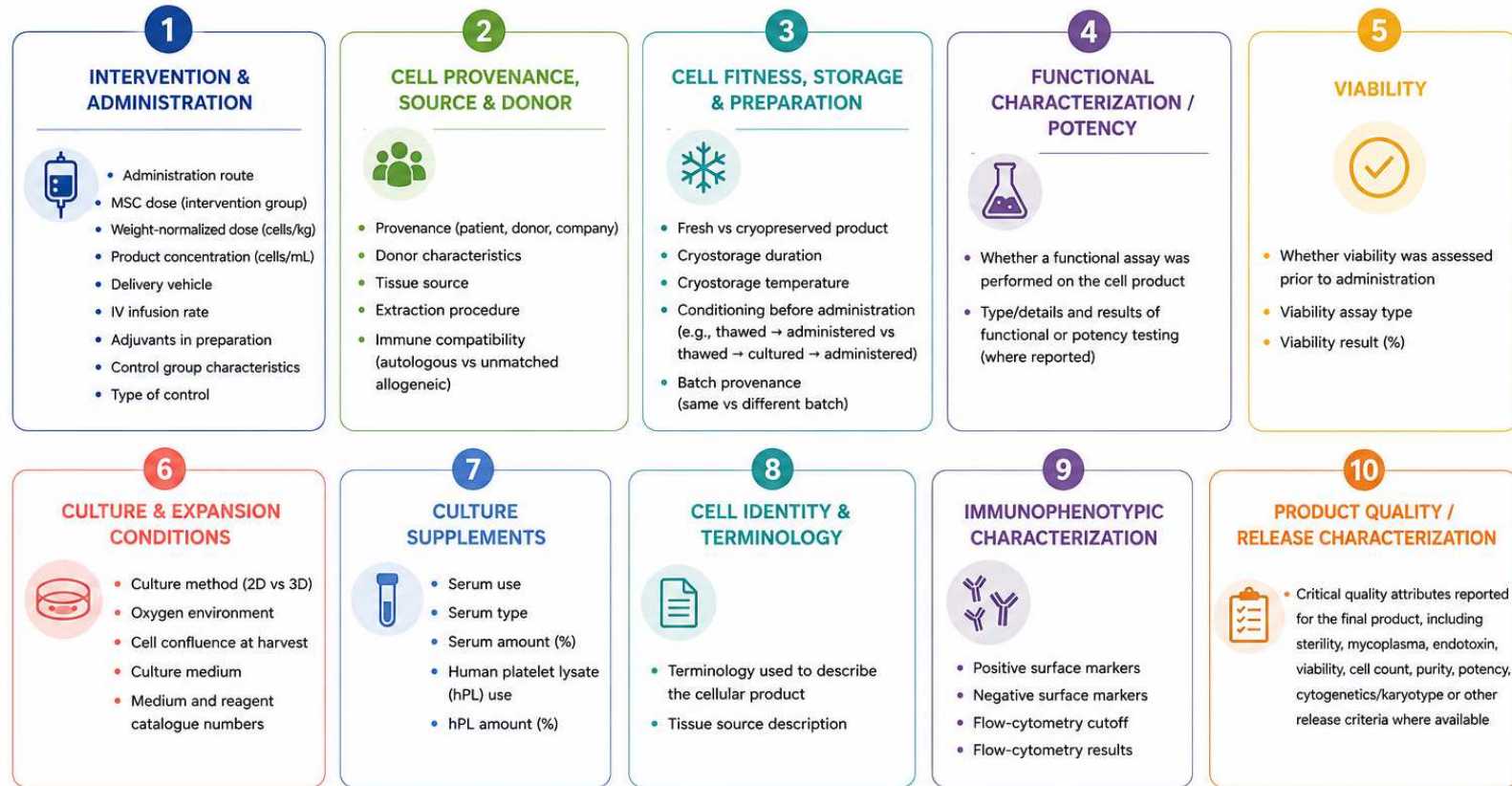


Figure 3. Cell product and intervention characteristics extracted as per the 2025 reporting guidance. Overview of the mesenchymal stromal cell-specific characteristics extracted from each study. The framework incorporates the 33 clinical reporting items proposed by Renesme et al. 2025¹⁴, encompassing intervention and administration, cell provenance and donor characteristics, cell storage and preparation, functional characterization, viability, and culture conditions. Additional variables related to cell identity and terminology, immunophenotypic characterization, and product quality and release characterization were also extracted according to the consensus on minimal criteria to define and characterize MSCs proposed by Renesme et al. 2025 reporting framework¹⁴.

Analysis and statistical methods

The results are displayed as reported/not reported/non-applicable for each field. The summary results are expressed in fractions of the total sample. The average reporting percentage and standard deviation (SD) for all studies was calculated as the unweighted mean of the individual study reporting percentages. Descriptive statistics (mean, SD, median, range) were calculated using GraphPad Prism 10 (11.0.1 (99)). The remainder of the analysis of this study is meant to be purely descriptive and provided in a narrative format.

RESULTS:

Studies’ characteristics

Ten clinical studies evaluating MSCs-based therapies for BPD were included, comprising three Phase I studies, one Phase I/II study, one Phase II study, two case reports, and three retrospective studies²⁰⁻²⁹ (Figure 4). Two studies^{24,28} did not report ethics approval. Three studies^{25,27,29} were funded by a pharmaceutical/biotechnology company while seven studies^{20-24,26,28} were supported by government, academic and/or other non-profit organizations funding.

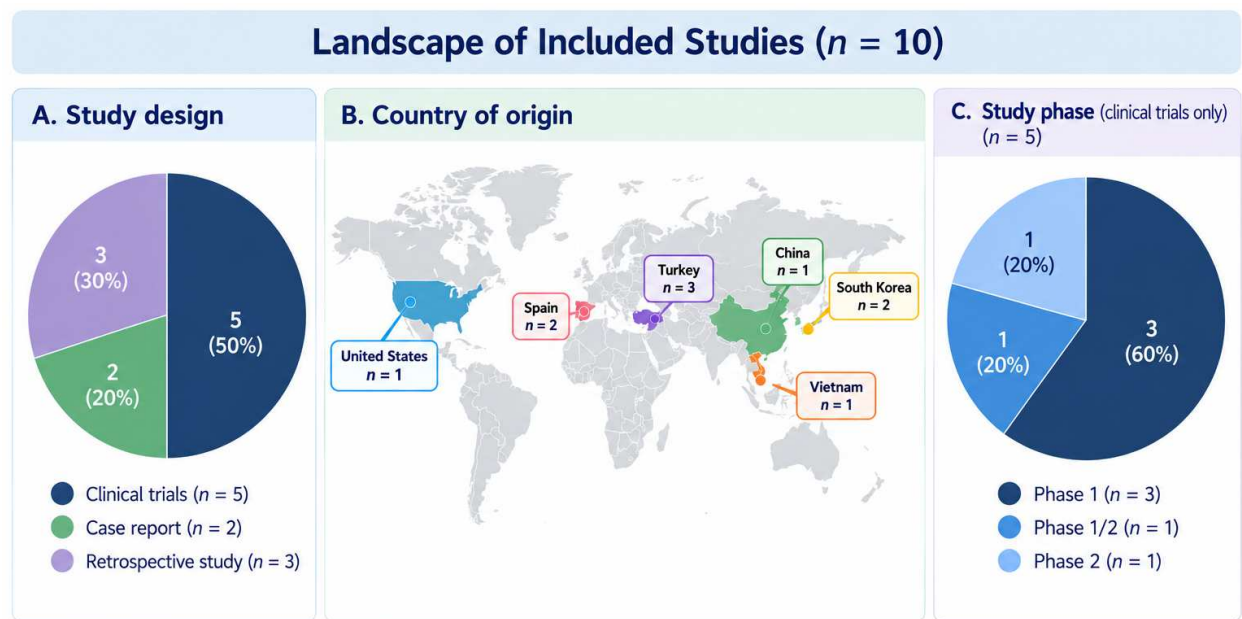


Figure 4. Landscape of included studies. (A) Distribution of study designs among the 10 included studies, comprising five clinical trials (50%), two case reports (20%), and three retrospective studies (30%). (B) Geographic distribution of the included studies across six countries: Türkiye (n = 3), Spain (n = 2), South Korea (n = 2), the United States (n = 1), China (n = 1), and Vietnam (n = 1). (C) Distribution of study phases among the five clinical trials, comprising three Phase I studies (60%), one Phase I/II study (20%), and one Phase II study (20%).

Complete Reporting Overview

Only three studies^{23,26,29} reported more than 75% ($\geq 30/40$) of the required 2025 guidance based on the study by Renesme 2025¹⁴. Four studies^{21,22,25,28} had particularly poor reporting coverage, with

less than 40% of data reported. Administration route, MSC dose, and weight normalized dose, along with tissue source and immune compatibility were reported across all studies. The duration of cryostorage was not reported in any studies. Similarly, the oxygen environment, the use of hPL and its amount were not reported in any studies where it was applicable.

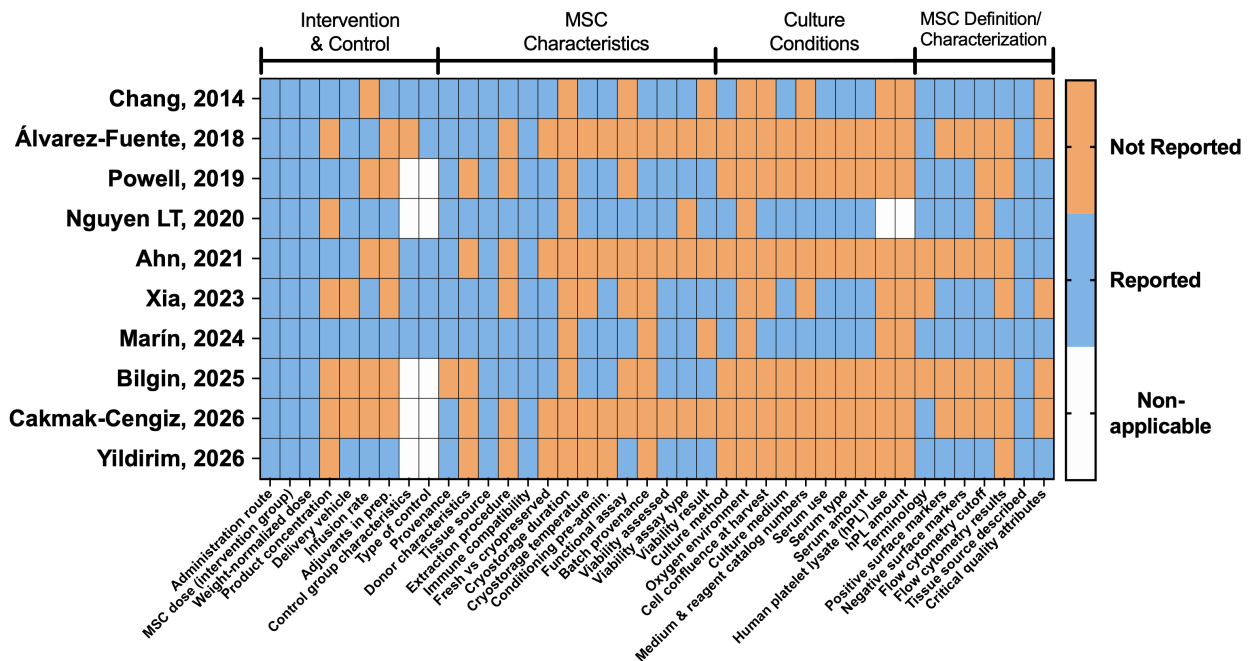


Figure 5: Complete reporting overview. Ten studies, organized chronologically, were assessed across 40 reporting items, and categorized either as not reported, reported, or non-applicable. All reporting items were derived from the 2025 Delphi study (Renesme 2025). The average reporting per study equaled 52.40% ± 23.78% (median 51.32%, range 21.05% - 86.11%).

The overall reporting across sub-categories delineated in Renesme & *al.* 2025 from best to worse, we find the intervention and control to be 66% complete (59/90 - 10 studies x 9 reporting items), the MSC definition and characterization to be 59% (41/70 - 10 studies x 7 reporting items), MSC characteristics is 56% (79/140 - 10 studies x 14 reporting items) and lastly culture conditions to only reach 24% (24/100 - 10 studies x 10 reporting items - Figure 6).

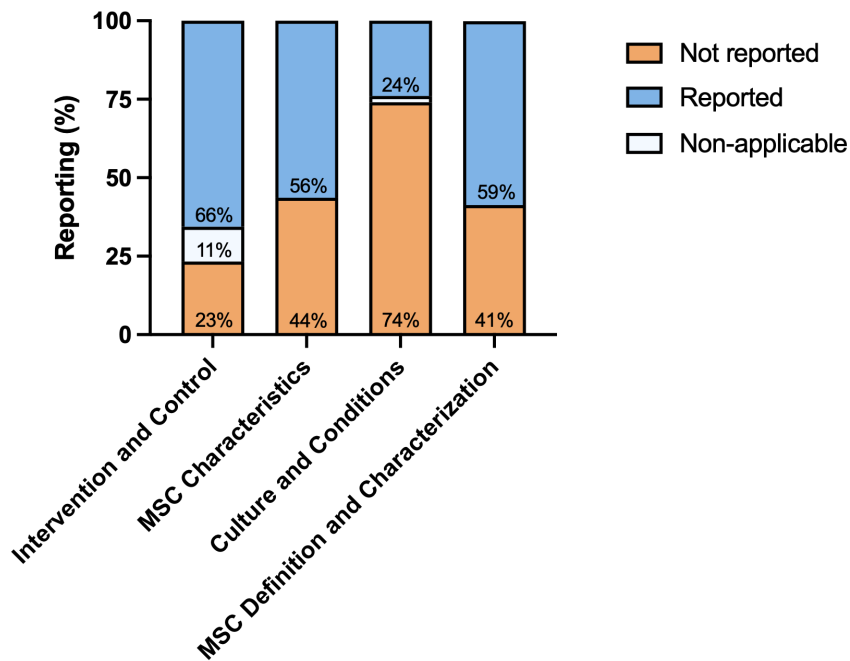


Figure 6: Sub-categorical comparisons between major Delphi groupings. All collected reporting items (n=40) were divided into four major groupings identified in the Delphi study¹⁴: Intervention and control, MSC Characteristics, Culture and Conditions, and MSC definition and characterization. Reporting percentage was highest in the intervention and control grouping (66%) and lowest in culture and conditions grouping (24%). Notably, 11% of data points in the intervention and control category were deemed non-applicable. Furthermore, 2% of

data points in the culture and conditions were deemed non-applicable and demarcated by the thin space between the reported and not reported values.

MSC intervention and control groups

MSC intervention and control group reporting were assessed via 9 items. Across all studies, administration routes were consistently reported with each of the ten studies reporting delivery as either intravenous (IV) (4/10 studies), intratracheal (IT) (4/10 studies) or a combination of both (2/10 studies) (Figure 7). MSC dosage for intervention groups was reported in all studies while product concentration (4/10 studies), and adjuvants in preparation (4/10 studies) were the least reported items. Five studies did not need to report control group characteristics, and type of control by design (displayed as non-applicable).

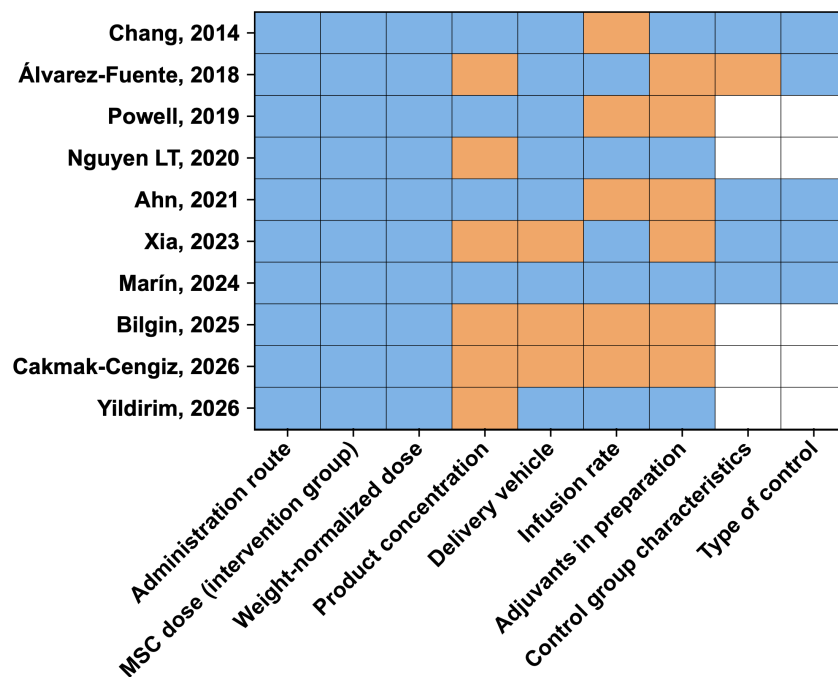


Figure 7: Reporting of MSC Intervention and Control Group Items. Nine reporting items were assessed. Reporting was highest and complete across all studies for the first three reporting items (administration route, MSC dose and weight-normalized dose), with a heterogeneous drop in reporting occurring across studies for the later reporting items. The lowest levels of reporting related to product concentration, and use of adjuvants in preparation. Multiple studies were deemed non-applicable for control group characteristics and type of control.

MSC characteristics

MSC characteristics reporting was assessed via 14 reporting items. The two most reported items were tissue source and immune compatibility, with all ten papers reporting both items (Figure 8). Furthermore, nine studies reported the provenance (Figure 8). The lowest levels of reporting stemmed from cryostorage duration (0/10 studies), followed by functional assay on products and batch provenance (3/10 studies) (Figure 8).

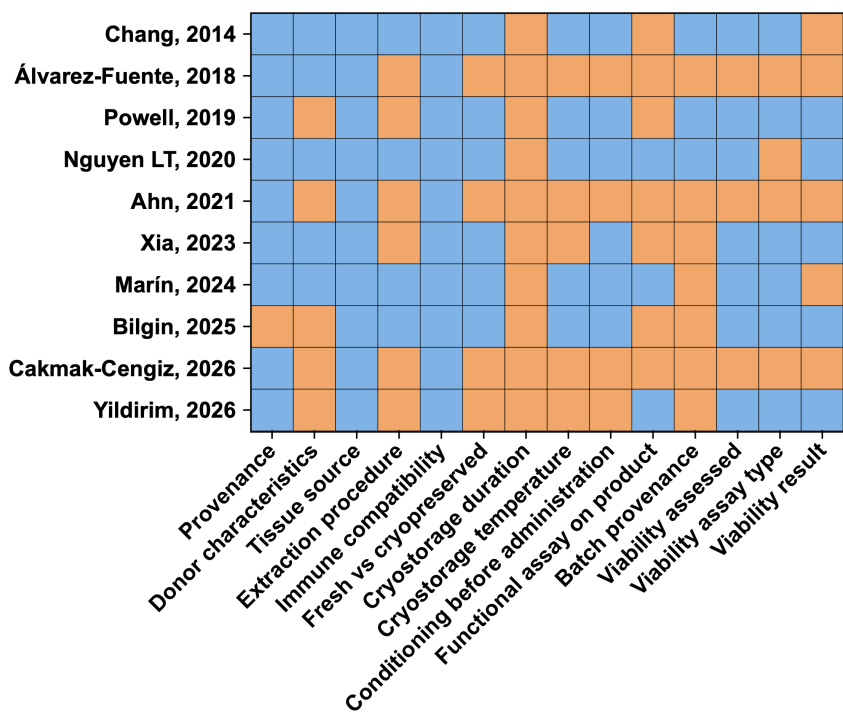
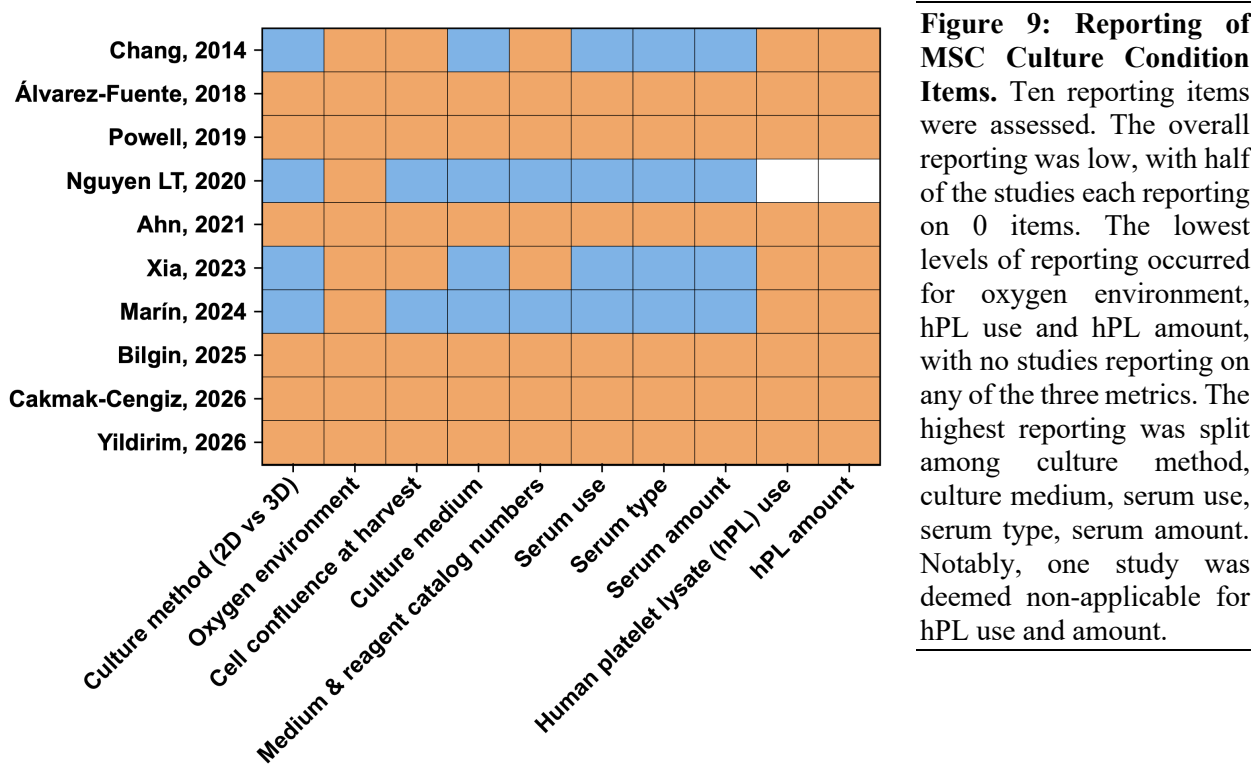


Figure 8: Reporting of MSC Characteristic Items. 14 reporting items were assessed. The highest levels of reporting occurred for provenance, tissue source, immune compatibility with whereby all studies consistently reported these items. The lowest reporting occurred for cryostorage duration and was not reported by any study.

MSC culture conditions

Reporting of MSC culture conditions was assessed across ten reporting items, ranging from broader characteristics such as culture methods to specifics such as catalog numbers for media and reagents (Figure 9). Overall, MSC culture conditions were vastly unreported across all studies. Specifically, no studies reported the oxygen environment, hPL use or hPL amount (Figure 9). One study was deemed non-applicable as it reported using serum-free conditions. The highest reported

items (culture method, culture medium, serum use, serum type and serum amount) were reported in only half (5/10 studies) of the studies.



MSC Definition/Characterization

Reporting of MSC definition and characterization was assessed through seven specific items, with a heavy emphasis on surface markers and flow cytometry testing (Figure 10). The level of reporting across all items was high, with the highest reporting stemming from tissue source description with all studies reporting their source (Figure 10). The lowest reported item was the actual flow cytometry results, with only three studies reporting distinct flow cytometry results (Figure 10). Stix studies tested for positive and negative flow cytometry markers but only four studies reported the cut off they used to establish the results and only three studies reported these results.

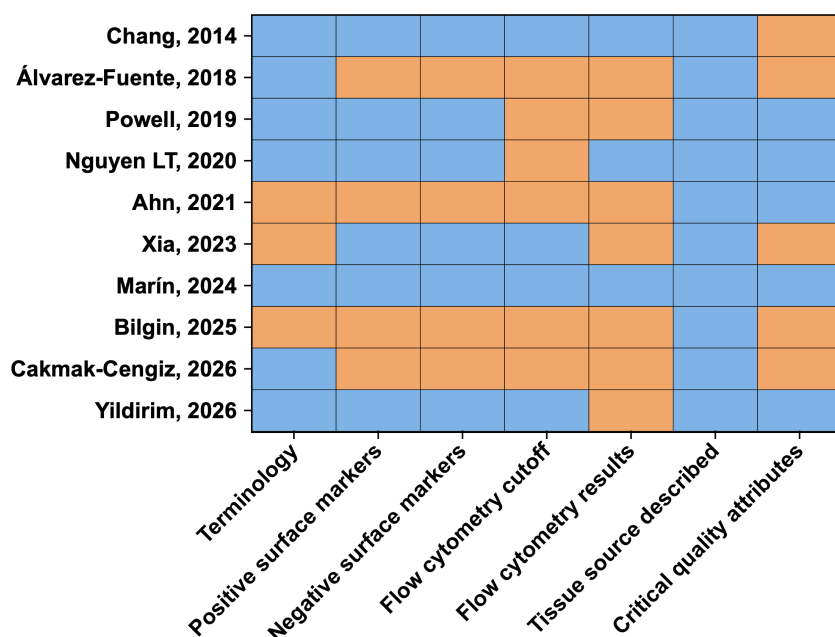


Figure 10: Reporting of MSC Definition/Characterization Items. Seven reporting items were assessed. The highest level of reporting stemmed from tissue source description, and the lowest from flow cytometry results.

DISCUSSION:

In this report, we retrospectively apply for the first time the new reporting guidance¹⁴ to a corpus of trials using MSC for the prevention or treatment of BPD published prior to the new reporting guidance. The goal of this evaluation was to establish the baseline status of the current existing evidence regarding best reporting practices and identify areas of improvement for future studies. We noted a disparity between the recommended reporting guidance and the reporting landscape from studies using MSC in BPD. It highlights an important gap between previous practices and the current rigor expected in information sharing of the manufacturing and delivery process. In fact, every step in the production of the cell product can have a significant impact on the resulting therapy⁴. This can ultimately contribute to the heterogeneity of cell therapy, difficulty of trial interpretation and their dismal translation despite promising preclinical studies.

Funding source and reporting

Proprietary information may alter reporting capacity. We identified one pharmaceutical/biotech company involved in the development of MSC for BPD. Three studies were supported by Medipost^{25,27,29}, while the others were supported through academic funding routes (governmental, charity, etc.). Trials supported by pharmaceutical companies should report as much information as possible to promote transparency and reproducibility, acknowledging information that cannot be disclosed due to knowledge protection.

Knowing the cell identity is central to the interpretation of therapeutic signal

Reporting the results of the assays these groups used and the associated thresholds are a recent addition from the Delphi study and were not necessarily expected in the set of studies included. However, poor reporting of flow cytometry markers is a significant issue. The lack of immunophenotypic characterization confirming the identity of the cell represents an important barrier to the clinical translation of cell therapies and a potential disregard to the patients receiving the treatment. Without a clear description that can ascertain the unique cell type with a known physiological action in the therapeutic agent, the attribution of findings (safety, efficacy, mechanisms, etc.) to a specific cell type is problematic. In the same way, the reader can't appropriately interpret the study results and systematic review with meta-analysis can't be properly conducted.

Preservation and conditions prior to MSC administration may affect therapeutic effect

One of the least reported fields included information about preservation. MSCs are commonly cryopreserved in a combination of 10% dimethyl sulfoxide (DMSO) and protein, such as fetal bovine serum (FBS). It is thought that these conditions conserve MSC viability and differentiation

capacity³⁰. The conservation medium and length of preservation are critical factors that may affect cell function. These are also important considerations in the logistical planning of MSC administration to patients. In large trials, current manufacturing processes are unable to provide large quantities of fresh cells upon request in a cost-effective manner. As such, there is heavy reliance on upfront cell production through cell banks and doses that are frozen down for later retrieval, thawing, and administration³¹. Galipeau et al. (2013) were among the first to propose that differences in cryopreservation protocols may be a culprit in the poor MSC translation observed to date³². Long-term MSC cryostorage may affect proteins/pathways involved in metabolism^{33,34}, oxidative stress³⁵, differentiation potential³⁶ and may lead to a defective cytoskeleton³⁷. Importantly, cryopreservation-associated impairments may be reversible. Culturing MSC after thawing the cells may allow to “refresh” them before administration, which may help mitigate the deleterious effects of cryopreservation to restore cellular function such as immunomodulatory effects³⁸. However, adding this specific step of 24 hour of culture prior to injection adds complexity and cost to the manufacturing process, distribution and administration protocol, that can impede trial feasibility.

The process of producing the cell product is the least reported category, yet it may have a major impact on the result of a trial

The culture conditions subcategory was by far the least reported by studies included in this report. The oxygen environment and hPL use were not reported in any studies. It will be the area that can gain the most improvement in reporting in future clinical studies. This can have important impact on MSC quality and function. For example, use of hPL has been demonstrated to improve UC-MSC differentiation capacity, proliferation, and limit senescence³⁹. This was associated with improved lung repair compared to FBS in a hyperoxia-induced lung injury model in rats³⁹. In

addition, a comprehensive review highlights the role of adjuvants used in cell preparation (such as pharmacological or chemical agents, trophic factors, cytokines or physical factors and materials) can have varying impacts on MSC functionality *in vitro* and *in vivo*⁴⁰. Furthermore, exposing MSCs to hypoxic culture conditions has been demonstrated to promote cell proliferation and migration, enhancing angiogenesis while inhibiting apoptosis and inflammation⁴¹. Another important item that was seldom reported is cell confluency. High confluency has been shown to increase gene expression in MSCs corresponding to chemotaxis, inflammation, and immune responses, indicating altered immunomodulatory functions⁴².

As such, understanding the culture protocol of the cell product is synonymous to understanding the synthetic steps to generate a small molecule or chemical compound. However, unlike synthesizing a specific compound which requires standardized workflow to reach the targeted molecule, the culturing conditions of cell therapies can be more flexible, and variation can still permit a viable product. However, this flexibility comes at the expense of varied therapeutic effects amongst different reports. As a research field, it must be appreciated that each step of cell manufacturing can potentially affect the cellular composition (i.e. sub-populations of MSC), their behavior, their secretome and ultimately their therapeutic capacity. While complete standardization of cell culture protocols may yet not be feasible, nor yet warranted, comprehensive reporting will enable studies to be stratified according to methodological differences, allowing their effects to be evaluated and informing the optimization of future MSC manufacturing processes.

Limitations of our study

Our reporting appraisal of MSC therapy in the field of BPD applies new reporting guidance (2025) to studies that predated said guidelines²³⁻²⁹ or were published simultaneously alongside or after the

newest guideline²⁰⁻²². Authors cannot be expected to follow a guideline that did not yet exist, or of which they had no knowledge of. Our primary intent is to establish the baseline status of the current existing evidence regarding best reporting practices. This enables readers to better understand results and base their interpretation according to what is known and unknown. As we update this study by including new reports in the future, we expect to see a greater alignment to the 2025 reporting guidance¹⁴. We hope that these results will encourage trialists to improve reporting of their studies and maintain the field at a higher standard of reporting practices. We also acknowledge that this study did not use state-of-the-art systematic review methodology to ensure completeness of the reporting quality appraisal. However, we felt that this type of methodology was not required to adequately address the description of the reporting in published clinical trials and open-label therapeutic studies. We anticipate that missing records from non-indexed sources may harbor even poorer reporting standards.

Future directions

As we deepen our analysis on the reporting quality appraisal, future endeavors will incorporate an ordinal grading appraisal system (adequately reported, unclear, not reported, not applicable). We will also consider extending our analysis to active studies with published protocols and clinical trial records (on clinicaltrials.gov) as these reporting items should be considered at the conception stage. We will also compare the reporting of each study to the ISCT 2006 and 2019 guidance. This will provide an estimate of the studies that adequately describe MSC for cell product ascertainment. Finally, we hope to extend this analysis to other neonatal diseases where MSC cell therapy is considered a potential treatment approach.

CONCLUSION:

Published BPD clinical studies display incomplete reporting, especially in manufacturing processes when benchmarked to the most recent 2025 MSC therapy reporting guidance. Poor reporting hinders clinical translation. We encourage future investigators to adhere to transparent and rigorous reporting beginning directly from the planification and conception of their studies. This will improve transparency, reproducibility, and comparability across studies, ultimately facilitating successful clinical translation of MSC-based therapies. With detailed reporting, the cell therapy community can proactively identify the sources of translational failure as they arise and devise innovative solutions to bridge the gap from the bench to the clinic.

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