



## Nature-based solutions and restoration are intertwined but not identical: Highlighting implications for societies and ecosystems

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### ABSTRACT

Nature-Based Solutions (NbS) and ecosystem restoration are often conflated, but cannot be assumed to be identical. Understanding and choosing between these different framings is important. It affects our ambitions for reinvigorating natural systems, the range of actors and resources that can be drawn on to achieve them, and every part of how interventions are planned, delivered and appraised.

To explore the differences and relationships between NbS and restoration we focus on freshwater catchment management initiatives, but our points are relevant to initiatives in other settings or framed in other terms. We firstly identify the potential differences by analysing accepted definitions of restoration and Nature-Based Solutions; and we then illustrate these with examples of catchment management in UK and Ireland, with which we are familiar from our own work and collaborations.

These real-world cases demonstrate that the framings of restoration and NbS can lead to different priorities for how ecosystems and natural processes are managed; and who is involved and how projects develop. The cases also show that interventions may be somewhere on a continuum somewhere in between the two concepts, and potentially shift over time. There is often a lack of clarity over why these terms are used, causing sometimes unacknowledged confusion and potentially missed opportunities to improve catchment management.

Different stakeholder groups involved in catchment management could benefit from more opportunity to explicitly reflect on preferred goals, and the implications for how to achieve this. We need more explicit reflection on the purpose of an intervention, and then different actors from site-managers to policy and other enabling groups can plan to achieve that vision. Given the time lags between interventions and outcomes, it is particularly important to use these insights in adaptive approaches to understand the changing drivers shaping current and future action.

### Introduction

In this perspective piece we identify differences between the concepts of Nature-Based Solutions (NbS) and ecosystem restoration. In the last decade we have observed NbS become an increasingly popular term, often linked or equated with many pre-existing projects, terms and practices, especially ecological restoration. For example, in July 2022, an event at a UN Climate and SDGs Synergy Conference discussed “ecosystem restoration as a nature-based solution” [1].

Ecological restoration will indeed be integral to addressing global sustainable development challenges. However, it should not be assumed as synonymous with NbS. Understanding potential differences, we

believe, has important implications for purpose, plans and practices that shape societies and ecosystems.

Below we explain and highlight the need to consider carefully the differences. In doing so we build on our own interdisciplinary research experiences, ranging from hydrological and hydraulic modelling of natural flood and drought management (e.g. [2]), through to social scientific analyses of catchment management processes (e.g. [3]). Over the last decade our work has been increasingly framed in terms of NbS, reflected in outputs relating NbS to river restoration [4] and mapping relations with other concepts [5].

In this perspective article we thus focus on river, floodplain and catchment-related practices, which are critical for shaping landscapes,

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biodiversity and human societies [6] but the distinction between restoration and NbS is also relevant to other domains and settings.

### Defining and distinguishing restoration and nature-based solutions

Definitions of both restoration and nature-based solutions vary (e.g. [5,7]) but here we build on some well-accepted definitions, to highlight the similarities and differences between restoration and nature-based solutions.

We define Restoration as “assisting in the recovery of ecosystems that have been degraded or destroyed, as well as conserving the ecosystems that are still intact” [8]. In the context of river restoration, there is perhaps more attention to physical interventions as a “form of indirect and direct river engineering, undertaken to improve hydrologic, geomorphic and/or ecological processes within a river system” [9,10]. Restoration initiatives vary in their attention to returning to past reference states, but all forms have a strong focus on reinvigorating natural processes to achieve ‘resilient and self-sustaining’ ecosystems, as discussed by the Society for Ecological Restoration & IUCN Commission on Ecosystem Management [11].

We define Nature-Based Solutions (NbS) as per the IUCN [12] as “actions to protect, sustainably manage, and restore natural and modified ecosystems that address societal challenges effectively and adaptively, simultaneously benefiting people and nature”. This definition is also aligned with that endorsed by the UN [13]. NbS incorporates or is an alternative label for approaches that focus on working with nature to tackle societal problems, such as Green Infrastructure [14], Engineering with Nature [15], with types of catchment-specific NbS also called Natural Flood Management or Natural Water Retention Measures (e.g. [16]). This ‘rise’ in NbS may partially be a rhetorical response to shifting priorities and terminology by funders of research and practice; nevertheless NbS initiatives reflect a genuine commitment to achieving societal benefit, and start with specifying specific problems to be tackled [7].

NbS is a more recent term than restoration, but currently both are very prominent in recent international and intergovernmental processes and policies. In particular, the United Nations has declared 2021–2030 the decade for the Restoration of Ecosystems, whilst the European Union (EU) is currently debating a new Nature Restoration Law and commits to restoration within its 2030 Biodiversity Strategy. NbS is not the sole focus of any specific policy either globally [17] or internationally [18]. However, the UN Environment Programme has endorsed NBS<sup>1</sup> and the EU is commissioning a large programme of action-oriented research<sup>2</sup>. NbS is noted to support the strategic responses by the Intergovernmental Platform on Biodiversity and Ecosystem Services [19] and the current international global targets for biodiversity (Kunming-Montreal Global Biodiversity Framework 2022) recommends the use of nature-based solutions in target 11.

In these endorsements – and in more specific plans and projects – support for one concept is often linked with the other.

The two concepts are similar and can be mutually supportive. However, the starting point of restoration is to repair nature itself; whereas the starting point of NbS is societal needs and goals. Restoration’s focus of healthy ecosystems will also tend to benefit society [20] but this cannot be assumed. For example, Shyamsundar et al. [21] show that fair outcomes for people require specific planning and cannot be assumed to emerge from projects focused on conserving or restoring nature. Principles established to guide restoration do note the importance of providing societal benefits [11]. However, the primary focus of restoration practices typically remains ecology in its own right. A recent

review by Basak et al. [22] found societal benefits and public involvement weakly addressed in river restoration studies. Whilst Ecological Restoration can provide societal benefits, these are co-, not core, benefits from the interventions; whereas they should be the focal point of NbS.

### Identifying potential implications for societies and ecosystems

Discussing terminology can be seen as an esoteric exercise with little relevance for those focussed on the pressing requirements to improve how ecosystems are protected, maintained or repaired. However, precision in language is always important for science. Moreover, good practice for catchment management, at least in the global North, includes the importance of a clear and agreed problem framing and goal for work [23]. Therefore, having observed that the concepts of restoration and NbS signal quite different starting points, we explore here how these framings can affect every part of the planning, delivery and appraisal of work. In Table 1 we present ideal types of these two concepts, as a starting point to think through some of the differences we have encountered in our work.

Although Table 1 focuses on differences, we do not claim that the consequences of one concept or the other are always wildly different, although they can be so. For example, Souliotis and Voulvoulis [24] describe in this journal a constructed wetland by a recycling Centre in Norfolk, UK, which does not restore or replicate any pre-existing habitat but provides a very useful societal function: this is clearly NbS and not restoration. But in other cases, including some we describe below, the differences are less clear. It may be helpful to see restoration and NbS as ends of a continuum: at any point in time a particular idea or initiative may be somewhere in between these concepts. Furthermore, most projects accrete and evolve based on previous initiatives (e.g. [25]), so they may move in this position over time.

### Illustrating the ideas

We illustrate the differences and relationship between the concepts by reference to interventions in three cases with which we are familiar: Belford catchment in England; Logie Burn in Scotland; and the Ballygow catchment in Ireland. This article has its origins in our reflections on these cases and the evolution of these projects.

Firstly, the case of the Belford, a 6 km<sup>2</sup> upland catchment (55.5992945, –1.8288350) in northeast England. Key sources of further information, including maps, are Hewett et al. [26]; Nicholson et al. [27]. A mix of interventions have been used that fit very well with the idea of NbS – often been labelled in terms of Natural Flood Management and catchment systems engineering [26] – but less so with restoration. The main activities have been installing ‘leaky barriers’, creating offline storage ponds, making in-field bunds, riparian planting and sediment traps, with over 40 interventions in total. In Belford, this work has primarily aimed to attenuate runoff [28] so reducing flood risks [29] and also providing some benefits for water quality [30]. The practical interventions aim to ‘disconnect’ flow pathways, such as diversion structures in ditches to spill and store high flows or large woody debris structures within channels [31]. In other words, the work has focused on tackling societal challenges, not ecological restoration. Restoration would imply greater focus on recreating the original channel morphology and activities such as creating bankside habitats, improving the upland grassland habitat and potentially reinvigorating natural processes and biodiversity across the catchment e.g. through regenerative farming. Some of the existing interventions *may* offer ecological benefits – indeed, [32] found more newts in wetlands – but this cannot be assumed, as it is neither the primary focus of management nor monitoring. Indeed, in the face of countervailing societal and economic drivers on land use and nature [26], some ecological functions may be declining, as land management across the catchment is still heavily oriented to farming. So far, funding for this work has mainly derived from research and public sector funding related to flood risk reduction

<sup>1</sup> <https://www.unep.org/unga/our-position/unep-and-nature-based-solution>

<sup>2</sup> [https://research-and-innovation.ec.europa.eu/research-area/environment/nature-based-solutions\\_en](https://research-and-innovation.ec.europa.eu/research-area/environment/nature-based-solutions_en)

**Table 1**

Key distinctions and overlaps between Restoration and Nature-Based Solutions, illustrated in terms of catchment management and structured by questions about different stages in project development and implementation.

	Restoration	Nature-based Solutions
<b>What are the goals?</b>	To restore ecosystem function, which entails removing or mitigating significant human impacts. Biodiversity and habitat conservation are usually prioritised. Defining the ideal natural state may be challenging, especially given climate and other human-induced changes.	To support sustainable development by responding to major societal challenges. These range from climate change mitigation and adaptation, through to human health, food security and water security. Each intervention must define its own priorities.
<b>What is the geographical scale and remit of work?</b>	Interventions aim to restore functional ecosystem units, this could be whole catchments, though in practice restoration activities have often been confined to reach-scale initiatives and small rural sub-catchments.	Interventions are planned according to the scale of benefits required; this may entail working at catchment scales – or connecting work across catchments – but specific goals may also be achieved by targeting smaller scales.
<b>How is work conceived and planned?</b>	Usually a small group of partners with strong conservation interests.	Requires input from all the relevant stakeholder groups beyond conservation.
<b>Who is involved?</b>	Mainly public sector (environmental statutory agencies), fisheries and related interest groups & eNGOs (environmental Non-Governmental Organisations). The expertise used focusses on ecosystem function and, especially for physical habitat restoration, hydromorphology.	Many groups from across sectors: includes public sector, not solely relating to environmental interests but also, for example, planning; also ranging from for-profit businesses through to community organisations). Expertise used includes ecosystem function and hydromorphology but extends to include expertise in wider economic and social issues.
<b>What type of interventions and activities are involved?</b>	Encompasses both passive interventions e.g. waiting for natural regeneration, and more proactive interventions e.g. engineering works to reconnect floodplains to river channels.	Potentially encompasses both passive and proactive interventions but may tend to emphasise more proactive designed interventions to ensure societal benefits will be delivered.
<b>How are projects typically funded?</b>	Public sector grants, as well as ‘in kind’ resources such as staff time from eNGOs, fisheries interest groups and public sector. eNGO resources are in turn provided by members and/or donations.	Fixing societal problems helps unlock more types of funding than for restoration; additional resources provided by other stakeholder groups who are motivated to support & resource the work – ranging from crowd-funding, community volunteers, to public infrastructure funding and corporate investments.
<b>How is the project monitored?</b>	Monitoring, when it occurs, is often focused on assessing ecological, biophysical and hydrological parameters. This information should be used in adaptive management.	Monitoring should focus on achieving the societal goals; and intermediate steps, and project processes. All of this information should be used in adaptive management.

[29], but in future there could be scope to seek resourcing from insurers or other private sector actors.

Secondly, the case of the Logie Burn, a 31 km<sup>2</sup> catchment (57.097720, –2.918000) in northeast Scotland. A key source of information, including maps, is Addy and Wilkinson [33]. This has often been

labelled in terms of restoration but may actually align more with NbS, as so far societal benefits are more evident than ecological ones. In this case, a Logie Restoration Project reconnected a straightened sand-gravel bed stream to its floodplain. There were two main activities; river reconnection for remeandering, and riparian planting. A major funder was The Water Environment Fund of the Scottish Environment Protection Agency (SEPA), which was created to improve the ecological status of water bodies<sup>3</sup>. Three years of monitoring this work shows that the physical habitats have not so far strongly benefited, but it has significantly enhanced ecosystem functions in terms of retaining nutrients and fine sediment [33], which are key ecosystem services in relation to pollution management. The project design also included recreational access to increase local connection to the river and deliver stronger societal benefits. Those planning and monitoring the work have reported an effect on morphology [33] and expect downstream flood risks to be alleviated by the intervention.

Thirdly, the case of the Ballygow catchment, a 2.5 km<sup>2</sup> (52.2110715, –6.8660661) in County Wexford, Southeast Ireland. A key source of information, including maps, is the website of the ‘SloWaters’ project <https://slowaters.eu/> This case illustrates how the evolving goals and scope interventions can shift from restoration towards NbS. The catchment is part of an intensively farmed landscape, with the water-related problems associated with diffuse pollution and localised flooding. The Ballygow drains into Bannow Bay, which is designated at the European-level for both its rare species and habitats. Historically the work in these catchments has been focused on tackling these problems in isolation, especially water quality problems linked to nitrogen from intensive agriculture [34]. However more recently a multifunctional approach has been used. The SloWaters project has been working within the Ballygow catchment to enhance the water retained in aquifers, soil, aquatic and water dependent ecosystems. Its measures are expected to slow and store floodwaters in an ungauged, ‘flashy’ catchment, thereby reducing downstream flood risks, and supporting ecological goals. There have been five main interventions; reconnecting floodplain, installing a ‘leaky’ dam, making a bund, creating a sediment trap pond, and placing large tree trunks. Aspirations for future work are further evolving to increasingly emphasise both water quality and quantity issues, framing these in terms of ecological and flood risk related benefits. Accordingly, the work has been described in the past in terms of Natural Water Retention Measures (NWRM), Natural Flood Management (NFM) and even building with nature, but is increasingly explicitly framed in terms of Nature-Based Solutions<sup>4</sup>.

#### *Not identical but intertwined*

We use these three examples to show how NbS and restoration are different but intertwined concepts, with no case representing a perfect archetype of NbS, or restoration. For example, most work in Belford has focused on flood-related NbS, but some ecological benefits have been recorded. Meanwhile, the Logie Burn demonstrates societal benefits, although much of its funding was justified on ecological restoration grounds. Finally, the Wexford case is quite explicitly starting to plan for societal benefits, even without (or before) using the NbS label.

We expect the differences that we have encountered will also be relevant to other settings in which NbS and restoration concepts are used, ranging from terrestrial ecology through to marine management (e.g. [35]). For example, it affects how forests are managed [36]. Forest restoration likely focuses on (re)creating and replanting native woodlands and enhancing its unique or endangered biodiversity; whilst forest-based NbS may focus more enhancing recreation opportunities and health benefits, safeguarding regulating services (e.g. carbon sequestration, flood prevention) and even, perhaps, some production of

<sup>3</sup> <https://www.sepa.org.uk/environment/water/water-environment-fund/>.

<sup>4</sup> <https://slowaters.eu/nwrm/>.

timber and wood. Indeed, distinctions between NbS and restoration may be even more apparent looking beyond our catchment-based examples. For example, nature conservation efforts have often focused on managing sites designated for endangered species and habitats [37] often in relatively rural areas or where there is little human presence; whereas much of the NbS literature has focused on urban settings [38] potentially building on distinct expertises and processes related to spatial planning. It is also relevant to related terminology and concepts – for example, rewilding is a branch of restoration that emphasises maximising the self-sufficiency and autonomy of natural processes [39] – this may indeed provide or underpin some societal benefits but cannot be assumed identical to an intervention planned as NbS.

The differences offer insights as to how to further enable and develop interventions: we expand more on such implications in the next section.

### Implications for managing nature

In our experience, differences in labels can reflect anything from disciplinary differences, funder priorities, as well as shifts over time in underlying ideas and aspirations. It will be worthwhile to reflect on what motivates the choices regarding the headline labels used by projects, and the underlying concepts and goals held by a restoration team; as this can be useful for revealing unacknowledged differences and also potential. For example, widening the scope of interventions that use the restoration label, to include some societal objectives, has been observed by Smith et al. [40]; also Fernández-Manjarrés et al. [41], who pointed out this could entail additional hurdles in reconciling different objectives. If these consequences are not expected, it could risk disillusionment and even derail implementation.

More explicit reflection on framing can help to identify potential consequences for who, how and what activities are involved in an intervention. Such reflection can be relevant for a variety of groups who seek to inform and improve the management of natural systems, ranging from project managers, through to funders and other enabling actors, and researchers.

#### *Implications for practitioners and project managers*

Purposeful reflection on goals – and re-evaluation of these in light of changing context and progress – has long been relatively neglected by environmental initiatives [42]. Reflecting and setting clear goals is essential (e.g. as discussed for restoration by [43]). There is often a lack of resources and mandate for doing so, but frameworks and resources are available to help in this process (e.g. [44]). Sources such as Hobbs and Harris [43] discuss the importance of goal setting in restoration; additionally there is a growing body of guidance, notably for the IUCN global standard [45] and other support in this journal (e.g. [46]). Terminology should be agreed that makes sense to those involved in the initiative, but the choice of labels can be a useful signal – both internally and externally – as to the agreed framing and remit of the project [47].

When a (re)framing towards NbS is agreed to be preferred, there may be challenges entailed. For example, its stronger focus on societal involvement entails more time, skills to engage meaningfully; and a broadening of the set of stakeholder groups who must agree and get involved in the work [48]. Additionally, institutional conservatism [49] may combine with resistance to any perceived weakening of pre-existing approaches to managing biodiversity [50]. However, deliberation over the merits of different framings, and then articulating choices, can eventually pay dividends in helping to plan and deliver actions. For example, NbS projects planning to deliver ecosystem services may identify a range of stakeholders benefiting from those services. Carefully engaging more of these stakeholders may improve acceptability and support for NbS [51], and some may be able and willing to pay to support delivery of those same services [52].

### *Implications for policy and enabling actors*

A wide range of actors may indirectly or directly shape nature's management, including catchment management. However, state or public sector actors are nearly always formally responsible for developing policy, designing regulations and allocating resources (e.g. [53]).

At present, activities for restoration are often resourced by public sector environmental policies and institutions that are allocated to safeguard designated habitats and endangered species. Funding for designated species and sites is not always perfectly aligned with a goal of ecosystem restoration [54]. Additionally, what resources there are – often deriving from climate adaptation, biodiversity and/or water environment policies – are often thought to be insufficient (e.g. [55]) This contrasts with institutional structures and resources focused on supporting intensive agricultural production or engineering approaches (e.g. [56]). For freshwater biodiversity, the global research and management community has thus called for reforming policy, investments and resources [57]. In Europe, the limitations of existing institutional support and policies [58] partially explain ongoing efforts for a new Nature Restoration Law. Indeed, analysis of the proposed Nature Restoration Law suggests that attention to implementation and resources will be crucial to success [59]. In summary, although there are generally some funds from the public sector that can be used to support restoration – often linked to biodiversity and nature policies – those who control resource allocation may wish to consider changes as outlined by Harper et al. [57]; Hering et al. [59].

NbS can also be funded using public sector support, as it is centred on the needs of society, such as flood risk management. NbS may be relevant to more funders, both within and beyond the public sector – since many actors and sectors should be motivated by the benefits it delivers. The integrative promise of NbS [60] is thus an opportunity to diversify funding. As a result, even when the label of restoration is still used, some have observed a broadening of objectives to include societal benefits, in order to bridge perceived funding gaps [41,61]. However, navigating all these potential-funders is not necessarily straightforward. It is well known that funders' silos and disconnections tend to impede more holistic approaches such as integrated catchment management (e.g. [62–64]) so this is also likely to challenge Nature-Based Solutions. As there is no primary policy that mandates NbS, either in Europe [18] or globally [17], there is no specific mandate, lead agency or primary funder of NbS. A global NbS policy tracker report [17] has argued for specific policies to support NbS and there are a number of roadmaps to mainstream NbS implementation such as policy approaches [65] and supporting R&D requirements [38]. In the interim, those who seek to balance ecosystem services and deliver to multiple societal goals must incur transaction costs to navigate and 'blend' multiple sources of private and public sector influence and funding [66,67]. Those who wish to enable NbS should therefore recognise and resource these efforts e.g. by site and catchment managers. They should also reflect if their own institutional structures and mandates may assist in overcoming silos between policies and between sectors.

We note there are currently some steps already happening to incorporate NbS into the strategic planning and implementation of existing policies. For example, Ireland's River Basin Management Plans – which identify 'pressures' and corresponding a 5-year programme of 'measures' to tackle these – mention "nature-based" 63 times in its current 3rd version (in draft), but not all in the previous 2nd cycle plan<sup>5</sup>. It will be valuable to track such efforts and their consequences, in order to understand appropriate policy mixes and approaches.

Regardless of whether restoration or NbS is preferred, those who enable interventions such as catchment management should encourage – and even oblige – the planning and reflection mandated above. This will enhance planning and support adaptive (co)management [68] and

<sup>5</sup> <https://www.watersoflife.ie/river-basin-management-plan/>.

so improve the chances of creating sustainable landscapes.

### Implications for research

Academic studies of interventions need precision and clarity, since the objectives used to frame research will shape everything from the outcomes of specific project appraisals, through to the balance of research linked to a subject area. For example, framing research around NbS entails attention to societal processes and relationships with nature; yet research on catchment management have traditionally been dominated by individuals trained in the natural sciences not the social sciences [69].

We have proposed that restoration and NbS are distinct but overlapping concepts on a spectrum of approaches from nature-centric to human-centric. It is possible that more subtle and nuanced distinctions exist, so future attention to developing and theorising these and other concepts may be productive. Such reflection should learn from rapidly evolving practices and cases [70], especially seeking to learn from the Global South (Chausson, 2020), where contexts, ideas, practices may offer distinct innovations and insights.

### Conclusion

In this Perspective article we have sought to stimulate debate on the potential differences between restoration and NbS. We have been illustrated this through some examples of catchment management that have inspired our own reflections on this subject. Additionally, our experiences primarily derive from Western Europe, and are conditioned by these political, ecological and social contexts: we are curious to know if and how our reflections resonate with others working in other domains and across the world.

We do not propose that one concept should be preferred over the other. Most natural systems are hugely dominated and degraded by societies [71]: to balance this, it is perhaps reasonable and necessary that some sites and landscapes reflect more ecocentric visions, as per restoration. In other settings, due to the ethical need to sustain human rights and needs from Earth's natural systems [72], nature's management must be appraised and motivated in more anthropocentric terms, as per NbS.

As a result, we expect that many readers will identify with both concepts, as indeed we do ourselves. However, NbS may be the concept which is better able to catalyse transformative nature and landscape management at scale. Although both restoration and NbS projects are expected to offer some societal benefits [73], because NbS focuses on societal benefits – such as flood risk management – it should be better able to motivate the involvement of a wide range of actors and resources. In the European Union, the difficult passage of Europe's Nature Restoration Law [74] highlights how nature restoration is perceived by some as opposing economic interests; so the framing of NbS may galvanise greater support [59]. However, if the term NbS is used merely to relabel another concept without any additional value, its distinctive contribution may be lost, ultimately risking disillusionment with this term. Cycles of hype and disillusionment have already been observed with other terms [75]. It is vital this does not happen to NbS.

We strongly advocate careful and explicit reflection on the implications of using specific terms and concepts. This is needed by all those connected with governing catchment and nature: from those tasked with developing and implementing specific projects, through to those enabling and influencing those practices, and those who analyse and theorise how nature can and should be managed. The implications for how we manage nature will sometimes be significant and other times more subtle. Discussing the intention and motivations to engage in an intervention supports teamwork and underpins adaptive governance and management. The resultant clarity will not erase all contention and conflict, but will provide a useful starting point for building trans-disciplinary coalitions to implement much-needed action with and for

nature.

### NbS impacts and implications

- Ecological restoration is similar but not always identical to Nature-Based Solutions (NbS) – the former places more emphasis on environmental concerns and the latter places more emphasis on achieving societal benefits and working with society.
- Case studies from UK and Ireland catchment management illustrate differences and relationships between the concepts.
- Those involved in nature and environmental management must identify their framing to help ensure desired goals for ecology and society are achieved.
- NbS' stronger link with economic and social concerns may help leverage resources and support for intervening in nature.

### CRedit authorship contribution statement

**Kerry A Waylen:** Conceptualization, Writing – original draft, Writing – review & editing. **Mark E. Wilkinson:** Conceptualization, Writing – original draft, Writing – review & editing. **Kirsty L. Blackstock:** Conceptualization, Writing – original draft, Writing – review & editing. **Mary Bourke:** Writing – original draft, Writing – review & editing.

### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Data availability

No data was used for the research described in the article.

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