



ORIGINAL ARTICLE

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# Recommendations from the United Kingdom UNBIASED Study to Address Diabetes Technology Access Disparities for Children and Young People

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## Abstract

**Aims:** The UNBIASED UK study is the first national study that explores disparities in access to diabetes technology among children and young people (CYP) with type 1 diabetes (T1D) from ethnic minority and low socioeconomic backgrounds in the United Kingdom. Despite the National Institute for Health and Care Excellence guidance ensuring free universal access to diabetes technologies since 2023, significant inequities persist. This article outlines key barriers and provides recommendations to improve equitable access and engagement with diabetes technologies for CYP.

**Methods:** A multimethod participatory approach was used, including semi-structured triad interviews with parents and CYP of underrepresented groups living in low socioeconomic areas and minority ethnic groups. Health care professionals from the National Health Service were also interviewed to explore perceived and systemic barriers to technology adoption. Thematic analysis identified key challenges and potential solutions, and new recommendations were sought from codesigned workshops and public consultations were further developed.

**Results:** The UNBIASED study identified key themes from parents, children, and young people, including barriers to access, experiences with diabetes technology, inconsistent services and education, intersectional challenges, communication issues, and emotional support needs. Health care professionals highlighted financial limits, language barriers, regional service differences, unconscious bias, and low awareness as major factors contributing to disparities. Key strategies and new recommendations are made to improve fair access to diabetes technologies, including systemic reforms, better communication and support, and stronger community engagement.

**Conclusions:** This UK UNBIASED study highlights the urgent need for standardized policies, increased awareness campaigns, culturally tailored education, peer support initiatives, and improved health care provider training to ensure equitable access to diabetes technology for all CYP with T1D in the United Kingdom.

**Keywords:** type 1 diabetes, disparities, children, technology access.

## Introduction

Type 1 diabetes (T1D) is a lifelong condition requiring continuous monitoring and management. Advances in diabetes technology, such as continuous glucose monitoring

(CGM), insulin pumps, and hybrid closed-loop (HCL) systems, have significantly improved health outcomes, reducing the risk of complications and enhancing quality of life.<sup>1,2</sup> National and international organizations, including the National Institute for Health and Care Excellence

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(NICE), the International Society for Pediatric and Adolescent Diabetes, the American Diabetes Association, and the European Association for the Study of Diabetes, recommend the use of these technologies, especially in children and young people (CYP).<sup>3</sup> However, despite the National Health Service (NHS) policies for free access to all diabetes technology for CYP, disparities persist in the United Kingdom, particularly among CYP from ethnic minority and socioeconomically disadvantaged backgrounds.<sup>4–6</sup> Between 2019 and 2023, data from the National Pediatric Diabetes Audit (NPDA) showed that although insulin pump and CGM use increased across all levels of socioeconomic deprivation, the disparity in access between the most and least deprived CYP and in minority ethnic groups still persists. In 2022/2023, insulin pump usage in the most deprived quintile among CYP was 38.8%, whereas in the least deprived quintile it was 50.7%. The NPDA highlighted marked inequalities in technology use by ethnicity in Black children. The inequality gap increased from 8.6% in 2021/2022 to 14% in 2022/2023, with only 36.2% of Black CYP using real-time CGM compared with 50.2% of their White peers. Even with free universal CGM and insulin pump access, disparities were reported, disproportionately affecting Black, Asian, and other minority ethnic groups. Despite the expansion of access, Black children continue to have the lowest uptake, exacerbating existing health inequalities.<sup>7</sup>

Government-level health policies are essential for closing the digital divide. In the United Kingdom, the importance of universal health policies aimed at reducing health inequalities is well recognized, and a similar strategy is now being applied to improve access to health technologies. NICE guidance (NG18, 2022) mandates that all CYP up to age 18 years with T1D be offered CGM. The NICE Technology Appraisal TA943<sup>8</sup> also mandates equitable access to HCL systems for all CYP. NHS England developed a 5-year implementation strategy for HCL systems starting from April 2024. The aim is to ensure eligible people get access to HCL technologies in a phased but fair manner. The UNBIASED study is the first UK study aimed to identify the key challenges in equitable access to diabetes technology and propose evidence-based recommendations to bridge these gaps. The NPDA data presented reflect the period during which the UNBIASED study was designed and conducted, at a time when substantial disparities in access to diabetes technologies by ethnicity and socioeconomic deprivation were well documented. Since then, significant national policy developments have occurred, including NICE Technology Appraisal TA943<sup>8</sup> and the NHS England phased implementation plan for HCL systems, which aim to address inequities in access. While these represent major and welcome advances, their real-world implementation will take time, and early experience suggests that structural, social, and service-level barriers may continue to influence equitable uptake. The UNBIASED findings therefore provide important contextual insight into the baseline challenges these policies seek to address and highlight areas requiring continued focus during implementation. Note that in the United Kingdom, “deprivation” refers to socioeconomic disadvantage and is measured using the Index of Multiple Deprivation. This composite index considers several factors, including income, employment, education, housing, health, and access to services, rather than insurance coverage (as health care is universally provided through the NHS). In

the NPDA, CYP are grouped into deprivation quintiles based on their residential postcode, with Quintile 1 representing the most deprived areas and Quintile 5 the least deprived. Therefore, when discussing deprivation-related inequalities in diabetes technology access, this reflects broader socioeconomic and structural barriers—such as lower household income, reduced digital literacy, and limited health care engagement—rather than differences in insurance or direct health care costs.

Research from the United States, Canada, and New Zealand has highlighted the complex interplay between ethnicity, socioeconomic status, and health outcomes, although social, political, and health care contexts differ compared with the United Kingdom.<sup>9–11</sup> These studies demonstrate that individuals from marginalized ethnic minority groups and those living in socioeconomically disadvantaged circumstances often encounter significant barriers to accessing and effectively using health technologies. These challenges are often rooted in a deep history of social, economic, and systemic inequality. Ethnicity and deprivation frequently intersect, compounding difficulties in accessing technological resources. For example, certain racial and ethnic minority groups in the United States are disproportionately affected by poverty and often lack access to educational tools such as structured education and access to virtual training that support technology use.<sup>11,12</sup> In areas with limited internet access or digital literacy, families may struggle to benefit from these remote support systems, leading to delayed feedback, less effective data-driven care, and potentially poorer glycemic outcomes. In addition, evidence suggests that implicit bias among health care professionals (HCPs) can lead to under recommendation of diabetes technologies for underrepresented groups, sometimes influenced by perceptions of race and ethnicity or limitations in health insurance coverage.<sup>9</sup> Implicit bias among HCPs refers to unconscious attitudes or stereotypes that can influence clinical decisions and interactions with patients, often without deliberate intent. In diabetes care, research has shown that such biases can contribute to disparities in technology access and outcomes.<sup>11</sup> For instance, studies have found that health care professionals may hold subconscious assumptions about a family’s ability to manage complex technologies such as insulin pumps or CGMs based on factors such as ethnicity, socioeconomic status, language proficiency, or perceived health literacy. This can result in lower rates of technology recommendations for children from minority ethnic or more deprived backgrounds, even when they meet clinical criteria.<sup>9</sup>

Such systemic issues create a ripple effect, where individuals in deprived settings are less likely to afford or effectively use advanced devices and reliable internet services. These findings highlight the importance of understanding health disparities through the broader lens of social determinants of health. Likewise, the digital divide cannot be adequately addressed without considering the cultural and societal influences that shape technology access and use. Systemic barriers continue to restrict equitable distribution and implementation. In response to these challenges, the UNBIASED study aims to explore the multifaceted barriers contributing to these disparities, focusing on the perspectives of health care professionals, CYP, and their families. The United Kingdom now provides free and full universal access to diabetes technologies, including autoamted insulin delivery (AIDs), to all

children, and to date, the study is also the first study in the United Kingdom looking at health inequalities related to diabetes technology in children with Type 1 diabetes. The goals of this article were to outline key barriers to diabetes technology and provide new recommendations to improve equitable access for CYP in the United Kingdom.

## Methods

By drawing together evidence from recent qualitative studies, this work aims to provide an in-depth understanding of the inequities in access to diabetes technologies in the United Kingdom and to propose sustainable strategies and recommendations to reduce these disparities. Findings from the two qualitative studies,<sup>13–15</sup> from UNBIASED conducted in the United Kingdom, have been previously reported, each qualitative study using semi-structured interviews to explore the perceptions and experiences of health care professionals, CYP, and their families regarding access to diabetes technologies.

Tonga et al.<sup>15</sup> conducted online semi-structured interviews with parents and caregivers of CYP (2–17 years) with type 1 diabetes mellitus (T1D) and young people (14–17 years) from ethnic minority groups and/or living in low socioeconomic areas (i.e., all participants came from ethnic minority backgrounds, 80% of participants met both the criteria of ethnic minority and low socioeconomic group, while 20% met the criteria of ethnic minority group but not the low socioeconomic group). Recruitment occurred via social media and parent/carer groups, diabetes charities, clinical site referrals, and community outreach. All participants were either CYP with T1D or their caregivers; no separate group of participants without diabetes was recruited.

Participants were recruited via purposive sampling, and data were analyzed using thematic reflexive analysis. A qualitative, exploratory design was used, incorporating semi-structured triad interviews with 32 participants (parents, CYP, and young people-led discussions), codesign animation workshops to explore lived experiences and identify solutions, and public involvement consultations with CYP and parents. Participants included families from diverse ethnic backgrounds, with the majority identifying as Black African (67%) and residing in urban and lower income areas. Participants were specifically asked about their strategies, experiences, and recommendations during the interviews. Their suggestions were not inferred by the research team; they were explicitly provided by CYP and parents/carers in response to direct interview questions and further expanded during the coproduction workshops.

Interviews were also conducted with health care professionals from 15 sites in England, and data were analyzed thematically to provide insight into technology barriers (18).

Dlugatch et al.<sup>13,14</sup> explored health care professionals' perceptions of factors underlying inequities in technology access. They interviewed 29 health care professionals (consultants, diabetes specialist nurses, dietitians) working in pediatric diabetes in England between October 2023 and April 2024. The range of HCPs involved in diabetes care included pediatric diabetologists, diabetes specialist nurses, and dietitians, many of whom were directly responsible for technology prescribing decisions and were representative of staffing units across the whole spectrum due to the NHS national best practice tariffs, mandating minimum staffing levels. Semi-structured

interviews informed by a topic guide took place on MS Teams or telephone, lasted between 1 and 2 h, and were digitally recorded and transcribed in full. All health care professionals were purposively selected from diabetes center sites based on NPDA data, focusing on those with notably high or low uptake of diabetes technologies among disadvantaged populations. In addition, sites with a higher-than-average proportion of CYP from low-income and/or minority ethnic backgrounds were selected. Data were analyzed thematically and have been previously published.

## Ethics

UNBIASED was approved by the UK Research Ethics Committee and the Health Research Authority (REC 23/WS/0095).

## Results

The study by Tonga et al.<sup>15</sup> found that despite NICE guidelines ensuring free universal access to diabetes technology for CYP, many families were unaware of their entitlements, leading to delays in uptake. Financial concerns, misinformation, language barriers, and geographic challenges compounded these inequities. Parents and CYP often assumed that costs applied to diabetes devices prevented them from seeking the support available to them. CYP and parents found diabetes technology terminology complex and difficult to understand and highlighted the need for national awareness campaigns designed with the input of ethnic minority and low-income communities, alongside the development of multilingual educational resources tailored to diverse populations.<sup>15</sup> Acronyms such as “CGM” (continuous glucose monitoring systems), “HCL” (hybrid closed loop), and smart pens were often unclear, creating barriers to engagement. Many expressed confusion when introduced to new technologies, particularly in environments where structured educational support was lacking.<sup>15</sup> Participants included families from a range of ethnic minority backgrounds. Although religious beliefs were not consistently raised as explicit barriers, cultural and linguistic factors such as language discordance, differing health beliefs, and lack of culturally relevant education were frequently reported. These findings highlight the importance of culturally competent training and policy approaches that recognize diversity in family contexts without assuming religion-specific barriers.

The study by Dlugatch et al.<sup>13,14</sup> reported on the complex factors contributing to inequities in access to diabetes technologies among CYP with T1D in the United Kingdom. Health care professionals cited staffing constraints as a major limitation in supporting more CYP to adopt and use technology. Staffing shortfalls were perceived to disproportionately affect those CYP requiring more support, such as those from ethnic minority groups or deprived backgrounds (e.g., individuals with low literacy/numeracy skills, non-native English speakers, and those with additional learning needs). Interviewees highlighted geographical variability in commissioning, which contributed to the “postcode lottery” effect. Echoing the accounts given by parents and CYP, health care professionals also identified socioeconomic barriers affecting technology uptake. These included lack of access to smartphones required to use diabetes technology, difficulty traveling to clinic due to cost and/or time constraints (leading to

# How do we improve access to diabetes technology?

The Unbiased Study, a diabetes UK funded project interviewed 32 young people and parents across England to discover the barriers to accessing diabetes technology.

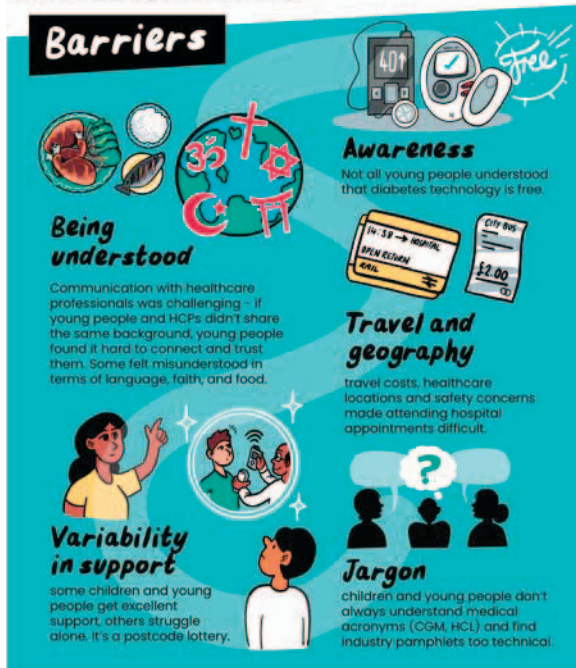


FIG. 1. Infographic—How do we improve access to diabetes technology?<sup>15</sup>

less engagement with services and fewer opportunities to learn about technology), and/or low literacy/numeracy. While many CGMs and insulin pumps can be used independently of smartphones or internet access, in the case of children using HCL systems, a smartphone is typically required as an additional device. This allows the child's parent or caregiver to remotely monitor glucose data, review trends, and receive alerts, making smartphone access an important factor for safe and effective use of these advanced technologies.

The “commissioning process” in the NHS refers to how services and treatments are planned, funded, and provided by regional integrated care boards (ICBs) in the United Kingdom. Commissioners in the ICBs decide which technologies or therapies are funded locally, how eligibility criteria are applied, and which providers can deliver them. A “postcode lottery” arises when these local decisions result in unequal access to health care based on geographic location. For diabetes technologies, this means that a child in one region may be offered an insulin pump or CGM according to NICE guidance, while a child with the same clinical profile in a different area may not be offered, simply because the local commissioning policies are more restrictive or slower to implement new technologies. This variation contributes to inequities in access and outcomes across the country, reinforcing disparities linked to deprivation or ethnicity.

## Infographic and animation

Using a systematic community-based participatory codesign approach, we actively engaged young people with diabetes in

the development of an infographic (Fig. 1) animation that genuinely represents their lived experiences. The animation was developed through coproduction workshops involving CYP with T1D and their parents/carers. The workshops were conducted with members of the similar population group as the interview participants. This collaborative process ensured that the resource was highly relevant and aligned with the principles of generative codesign in health care innovation, which prioritizes active involvement of end users. The animation codesigned is an example of a powerful tool for raising awareness, enhancing education, and fostering stronger support networks.<sup>15</sup>

The animation is intended as a knowledge-mobilization tool to support awareness of technology entitlement, reduce misconceptions, and facilitate discussion within clinics, schools, and community settings.<sup>16</sup> Dissemination is planned through NHS diabetes services, diabetes charities, community organizations, and online platforms. While not an outcome measure, the animation represents a codesigned output aligned with the study's equity and engagement aims.

## Recommendations from UNBIASED

Across both UNBIASED studies, CYP, their families and health care professionals proposed various strategies and recommendations to improve equitable access to diabetes technologies. These strategies encompass systemic reforms, improved communication and support, and community engagement. To mitigate these disparities, the

following key recommendations to address technology access disparities are discussed.

#### A. Systemic and Policy Reforms

- *Culturally Tailored and Standardized Education:* Participants emphasized the need for codevelopment of culturally tailored and standardized education programs embedded within routine diabetes education and supported by protected staff time. These programs should address linguistic and cultural barriers, ensuring that all CYP and their families receive the necessary information and support to effectively use diabetes technologies and developing educationally appropriate materials and support systems that are culturally and linguistically appropriate to meet the diverse needs of CYP and their families. This approach can enhance understanding and acceptance of diabetes technologies.
- *Policy and Practice Reforms:* Implementing policies that ensure equitable resource distribution and standardized care protocols across different regions to eliminate the “postcode lottery” effect. This includes investing in training for health care professionals to deliver culturally competent care. This includes enacting large-scale government and health policies aimed at fostering socioeconomic, ethnic, and cultural equality to create a more equitable health care landscape.
- *Equitable Resource Distribution and Geographical Variability (postcode lottery):* Ensuring equitable distribution of resources is crucial to address systemic inequities. This includes adequate funding for diabetes services, particularly in deprived areas, and addressing staffing shortfalls to support increased technology uptake. Encourage the use of population health data such as the NPDA to identify regions and communities with the lowest uptake of diabetes technologies and implement targeted interventions to link commissioning decisions and workforce investment to demonstrable inequities in access.
- *Streamlined Commissioning Processes:* Reforming commissioning processes to reduce variability and ensure more equitable access to diabetes technologies across different regions is essential. National mandates, such as the NICE TA943, are a positive step, but effective implementation and monitoring are crucial.
- *Resource Allocation:* Allocating sufficient resources to ensure that all CYP receive the necessary support and training to utilize diabetes technologies safely and effectively.
- *Financial Assistance and Subsidy:* Programs with a need for smartphones advocate for government- and charity-funded programs to provide free or subsidized smartphones for low-income families.

#### B. Improved Communication and Support

- *Enhanced Health Care Professional Training:* Health care professionals need training to improve communication, address unconscious bias, and provide culturally sensitive care. This training should focus on understanding the social, cultural, and economic factors that influence technology access and use. HCPs noted that underrepresented groups might require

more personalized training and support, necessitating additional staff time and resources.

- *Increased Staffing and Support Roles:* Expanding diabetes teams to include nonclinical staff, such as administrators, diabetes care technicians, and youth support workers, can help improve efficiency, free up clinical staff time, and provide additional support to CYP and their families who need the most support moving onto diabetes technology. These roles can support tasks such as device ordering, training organization, and engagement with CYP, particularly those from disadvantaged backgrounds.
  - *Promotion of Peer Support and Community Outreach:* Facilitating peer support and community outreach initiatives can provide valuable support networks for CYP and their families. This can include connecting families with similar backgrounds or experiences, and utilizing community ambassadors to reach underserved populations. Establish peer mentoring programs where individuals from similar backgrounds share their experiences using diabetes technologies. Provide funding and training to empower peer mentors to lead local support groups.
  - *Community Engagement:* Engaging with community leaders and organizations to build trust and disseminate information effectively within ethnic minority and deprived communities. Such collaborations can facilitate better understanding and uptake of diabetes technologies.
- #### C. Addressing Unconscious Bias
- *Awareness and Training:* While health care professionals suggested that unconscious bias has become less prominent, continued efforts are needed to raise awareness and provide training to address potential biases in technology recommendations. This should include strategies to ensure that all CYP, regardless of their background, are offered and supported to use diabetes technologies.
  - *Targeted Interventions:* Implementing strategies specifically designed to support CYP from deprived and ethnic minority backgrounds in accessing and effectively using diabetes technologies. Concerns about the safe and effective use of these technologies can lead to reluctance in offering them, perpetuating access inequities.
- #### D. Technological Considerations
- *Device Design and Accessibility:* Considerations around device design to improve access and acceptability across diverse groups should be addressed. This may include devices that do not rely on smartphones or are more discreet.
  - *Tailored Digital Resources:* Develop apps or online platforms that provide educational content in multiple languages and formats.

## Discussion

Implementing these strategies requires a coordinated, integrated approach with closer collaboration and resource-sharing within and across sites. Sustainable, long-term funding is essential, with a significant portion dedicated to increasing staffing capacity to support the practical implementation of

these strategies. The UNBIASED study underscores the urgent need for systemic reforms to ensure equitable access to diabetes technology.<sup>5</sup> Despite significant policy advancements such as NICE TA943, implementation challenges persist, with financial barriers, digital literacy gaps, and health care inequalities contributing to ongoing disparities. It is important to note that participants were not asked by the NHS to self-fund diabetes technologies. Instead, some families assumed that payment would be required, reflecting gaps in awareness and communication about entitlement. This misconception was particularly evident among families with language barriers, lower health literacy, or limited prior engagement with diabetes services and underscores the need for clearer, culturally appropriate communication regarding free access.

Findings from multiple studies<sup>17–19</sup> highlight the intersectional nature of these challenges. The perspectives of health care professionals further illuminate the need for additional staffing resources to ensure adequate support for CYP from disadvantaged backgrounds. Many health care teams lack the capacity to deliver the necessary training and guidance for diabetes technology, leading to inconsistencies in service provision across NHS trusts. Addressing workforce shortages and expanding diabetes specialist training for HCPs will be essential in ensuring a more uniform and equitable approach to diabetes technology access.<sup>19</sup> The UNBIASED study highlights that CYP from ethnic minority groups and deprived backgrounds face significant challenges in accessing diabetes technologies. These challenges are often compounded by cultural differences, language barriers, and varying levels of health literacy, which can impede effective communication between health care professionals and patients.<sup>15</sup>

In addition, cultural and linguistic barriers continue to play a significant role in limiting access to diabetes technology.<sup>20</sup> The importance of culturally competent care cannot be overstated, with research highlighting that many CYP and their families struggle to navigate complex health care systems due to language barriers and lack of culturally appropriate materials.<sup>21</sup> Targeted interventions, including multilingual resources, dedicated patient advocates, and structured peer support initiatives, are necessary to foster trust and engagement within underserved communities.<sup>9,11</sup> Data-driven solutions are also critical in tracking and addressing disparities. A national registry for diabetes technology access would provide transparency in identifying gaps and informing policy decisions. Regular audits comparing uptake across NHS sites would help ensure that interventions are targeted effectively and that funding is allocated to the areas with the greatest need.<sup>13,14</sup>

By implementing these recommendations, health care systems can take meaningful steps toward reducing health inequalities and ensuring that all CYP with T1D receive equitable access to the life-changing benefits of diabetes technology. Inequities in access to diabetes technologies among CYP with T1DM in the United Kingdom are a persistent and complex issue. These inequities are driven by a combination of financial constraints, linguistic and cultural barriers, systemic health care inequities, and health care-related factors. Addressing these disparities requires multifaceted interventions that include systemic reforms, improved communication and support, community engagement, and a focus on sustainability. By implementing these strategies, it is possible to move toward more equitable access to diabetes technologies

and improve the health and well-being of all CYP with T1DM.

A key limitation was the lack of funding to address digital poverty and exclusion. Many CYP may not have access to personal devices needed to communicate with services or participate in sessions and research activities, often relying solely on school-provided resources. This limited both their ability to engage and our ability to reach them. Notably, some CYP expressed a preference for meeting face to face, which further highlighted these access barriers. Another limitation is reliance on published and unpublished qualitative data, potential gaps in generalizability, and the fact that new recommendations are derived from a synthesis rather than primary data collection. A further limitation is that recruitment via social media and parent/carer networks may have introduced selection bias and may have underrepresented the most digitally excluded families. To mitigate this, recruitment also included referrals via clinical sites, diabetes charities, and community outreach centers. This limitation highlights a key finding of the study, which is lack of access to digital infrastructure not only impedes technology uptake but may also limit engagement with services and research.

The UNBIASED study offers critical insights into the specific challenges faced by ethnic minority and socioeconomically deprived populations in accessing diabetes technologies. By identifying both systemic and individual-level barriers, the study provides a foundation for developing targeted strategies to promote equity in diabetes care. Implementing the recommended interventions can help bridge the digital divide, ensuring that all CYP with T1D have equitable access to the benefits of technological advancements in diabetes management.

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### Authors' Contributions

S.M.N.: conceived the UNBIASED study (Grant reference number: 22/0006434) and is the lead investigator. S.M.N., N.D., E.T., J.L., R.D., D.R., M.E., and N.O.: reviewed, edited and approved the final version.

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