Interim Horizon Scanning Report: Identification of Paediatric Neurological Trauma Technologies

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Contents

Executive Summary

Scope

The NIHR Innovation Observatory has undertaken a horizon scan to identify innovative devices, digital and diagnostic health technologies (MedTech) developed for use for children or young people from age 28 days post-birth to 18-years-old with actual or suspected paediatric neurological traumatic injury.

Methods

Systematic searches were performed in February 2023 to identify registered clinical trials and funding awards published within the last five years (07/02/2018 onwards) and news articles within the last three years (07/02/2020 onwards). Search results were screened for relevance to a pre-specified scope, and key information on the included technologies was extracted and summarised.

Findings

Twenty nine technologies were identified of which 10 are commercially available with the majority developed in the UK or US. We identified 9 digital technologies, 8 diagnostic technologies of which 4 were delivered digitally, and 12 medical devices of which 3 incorporated digital components. The identified technologies covered hospital, community and home settings. The main indicated roles of the technologies were as follows: 14 technologies were designed for diagnostics or assessment either at the site of the accident, in the emergency department, and/or in other hospital setting; 12 were designed to be used in rehabilitation, either at home or in hospital; 3 were decision support algorithms; and 1 was for prevention.

Interim Conclusions

Results from this horizon scan show that development of paediatric neurological trauma devices, digital and diagnostic health technologies is currently limited, with only a small number of technologies being currently developed. Given the current limited development, we are now further asking stakeholders for their views on paediatric neurological trauma MedTech landscape. The combined results and final conclusions will be shared within a further publication.

Dissemination

This interim report has been prepared to enable timely sharing with the key stakeholders, including the NIHR Trauma Management MedTech Co-operative, the NIHR i4i programme and relevant professional organisations such as the British Academy of Childhood Disability and the Paediatric Neurorehabilitation Network, and to inform decision-making about innovation and research related to paediatric neurological trauma.

Introduction

Health technology innovations for children and young people lag to those for adults.[1,2] Children and young people make up a quarter of the UK population, and for them neurological trauma (e.g., traumatic brain injury, spinal cord injury) is one of the most common causes of death and disability. In England and Wales, approximately half a million under-15-years-olds attend emergency departments with a head injury each year, and roughly one fifth of them are admitted to hospital.[3]

New health technologies, including devices, digital and diagnostics, have the potential to improve short- and long-term outcomes for children and young people with suspected or actual neurological trauma. However, to actualise this potential, there is a need for targeted investment in paediatric technology development that takes into account the characteristics of paediatric patients - from their anatomical through to social features.[1,2] The Innovation Observatory is the national horizon scanning centre for emerging health technologies, and thus ideally placed to contribute intelligence to inform planning of future investment and innovation for children and young people.

Horizon scanning is an umbrella term for methods to systematically identify health technologies that are new or emerging, and that have the potential to affect health, health services or society by adoption into routine practice.[4] Intelligence from horizon scanning can also be used to identify persistent gaps, i.e., areas of unmet need or underserved populations where there are few emerging technologies within the healthcare ecosystem.

The present project was a horizon scan study to identify new or emerging devices, digital and diagnostic health technologies for children and young people with actual or suspected neurological trauma. A complementary follow-on survey was undertaken, to further explore gaps highlighted and potential barriers and facilitators to health technology adoption. Jointly, the findings can inform future planning and prioritisation of, and investment in, paediatric trauma innovations. The present interim report provides a summary of the horizon scanning findings, with the survey due to report later.

The present horizon scan project was designed collaboratively with the NIHR Trauma Management MedTech Co-operative, with input from a young person and clinician stakeholder representative and a paediatric allied health rehabilitation expert at key time points.

Methods

Scope

We outlined the scope for the search and inclusion/exclusion in terms of the population, health technologies and context. No limitations were set on the outcome.

Population: Children and young people (from 28 days post-birth up to and including 18 years old) with actual or suspected neurological trauma who have had an injury to the brain, spine or nervous system. These injuries could have occurred in diverse ways, for example, because of accidents involving vehicles, sports, drowning, falls, cardiac arrest, or through intentional acts. In relation to clinical manifestations, this definition included children and young people with traumatic brain injury, concussions, brain contusions, penetrating brain Injuries, anoxic brain injuries, diffuse axonal injuries and trauma after road traffic accidents, subdural haemorrhage, spinal injury, suspected non-accidental neurological trauma (i.e., shaking injury), and neurological injury following spontaneous haemorrhage (subarachnoid). We excluded those with congenital or birth trauma, and we excluded other non-neurological trauma (e.g., emotional trauma). We recognised that collectively the included population is diverse and their profile in terms of functioning, impairments and activity limitations overlap with other neurodisability populations such as children with cerebral palsy – however, for this scan, we used the more restricted focus on paediatric neurological trauma, as specified above.

Health technologies: Our focus was on any device, diagnostic or digital technology, as well as any combination of these, developed to diagnose, prognosticate, monitor, or solve a health problem or improve functioning or quality of life. The technology could target, or seek to influence, any biomedical, physical, cognitive or psychosocial mechanism.

Context: The relevant technologies may be used at any point of the care pathway from the scene of the trauma incident to initial diagnostics and management, to ambulatory care during transportation to a care facility, to emergency department including assessment, monitoring and management, to inpatient hospital care and acute rehabilitation, to community rehabilitation and ultimately community living with any remaining impairments and effects on functioning and quality of life.[5-13] The full scope is available in Appendix A.

Search Strategy

We used the horizon scanning methodologies developed by the Innovation Observatory to search a variety of information sources that could hold signals of research - initiated or underway – related to paediatric neurological trauma technologies in terms of devices, digital and diagnostics.

Data Sources: As primary sources of information directly from researchers and agencies, we searched ClinicalTrials.gov (a database of privately and publicly funded clinical studies conducted around the world) and the following funding portals: EuropePMC, UK Research and Innovation Grant Finder (UKRI GtR), NIHR Funding and Awards, National Science Foundation (NSF), CORDIS, and European Innovation Council (EIC). As secondary sources, we searched: MedTech news, Fierce Biotech, EurekaAlerts.

Search Terms: A comprehensive list of keywords and concepts were compiled by the Innovation Observatory's information specialists, based on key indicator reports provided by the Trauma

Management MedTech Co-operative. This list of terms was refined using scoping searches, testing, and analysis of the relevance of each concept. A search strategy was formulated, translated and performed within each data source. The search strategy combined key terms and synonyms, and where indexing allowed, MeSH terms. The funding source and news site search concepts focused on search string combinations of: 'child' or 'paediatric' or 'pediatric' AND 'head injury' or 'head trauma' or 'brain injury' or 'brain trauma' or 'neurological injury' or 'neurological trauma' or 'traumatic brain injury' or 'traumatic head injury'. Clinical trial searches utilised bibliographic key terms which mirrored these concepts.

Filters: The age filter field 'Child (birth–17)' provided by ClinicalTrials.gov was utilised to focus the search to the relevant population, and the recruitment stage filter to focus on trials registered as 'Completed' and 'Active, not recruiting'. Funding sources were restricted to 'active' projects and no filters were applied to the news sources. Clinical trial and funding award searches were restricted to collect only those published within the last five years (07/02/2018 onwards), and news sources within the last three years (07/02/2020 onwards). The full search strategy is available in Appendix B.

Systematic searches were performed in February 2023. All search results were then combined and deduplicated.

Screening

All search results were exported into a single document and screened against the following inclusion criteria: the technology can be used for children and/or young people with actual or suspected neurological trauma AND the technology is either a device, digital or diagnostic technology or a combination of these. During the initial screening, technologies were sifted based on the records title and brief summary. Any technologies that matched inclusion criteria, or where matching was uncertain, were taken forward to the next stage of screening.

At the second stage of screening, the developer and product webpages for each technology were searched to collect more detailed information about each technology and to ascertain if they met the inclusion criteria using the full information available. All technologies that met the inclusion criteria at this stage were taken forward to the data extraction.

Data extraction

The following information about included technologies was extracted:

- Record source type: (e.g., Funding, Clinical Trial, News)
- Developer, and Developer type: (e.g., academic institution, company, research institution, healthcare organisation, government, non-profit)
- Product name
- Product description (e.g., intended action and use, position on care pathway and target population)
- Product type: (e.g., diagnostic, device, digital or a combination)
- Care setting (e.g., acute, hospital, home, community)
- Country of development
- Regulatory approval status: (e.g., UK CA, EU-CE, US FDA, Health Canada, Australia-ARTG)

In addition, links to clinical trials, publications, and additional comments related to funding, investment, patent, awards, competition, collaboration, and license agreement were extracted.

As a general principle, the data extraction followed the health technology, meaning that where multiple technologies were identified in a single record, for example a clinical trial registration, all the relevant information pertinent to each of the identified technologies were extracted and stored within each individual record. Similarly, where a technology was identified across multiple sources (e.g., across several news and/or trials records) data about that technology were collated under a single data extraction record.

All the included technologies were classified according to their stage of development (stage 1-5). Stage 1 represents 'discovery' technologies that are at the earliest stage of development; stage 2 represents a technology being developed and tested to refine functionality; stage 3 represents technology being tested and validated in a controlled environment to ensure that it functions as intended; stage 4 represents testing in a clinical setting to determine safety and effectiveness; and stage 5, the final stage, represents technology that has been cleared by a regulatory authority for commercial distribution.

We anticipated that our search would identify technologies currently in development or testing for other populations (e.g., children with cerebral palsy) where the children and young people have overlapping characteristics – in terms of functioning, impairments or activity limitations – with children and young people experiencing neurological trauma. While we recognise the potential translation of these technologies for use in paediatric trauma, these technologies were outside the scope of the present project unless they explicitly mentioned paediatric neurological trauma. Where we came across such technologies, these were noted and added in a complementary dataset of 'excluded records of interest', to help capture information on the broader development landscape.

Results

The horizon scan identified a total of relevant twenty nine technologies that met the inclusion criteria. The characteristics of these have been summarised in Table 1, including the care setting, developer information, and who it was designed to be used by. The majority (16/29, 55%) of the included technologies were identified from clinical trial registries (Figure 1). Six (21%) and five (17%) technologies were identified from news sources and funding sources, respectively. Two (7%) technologies appeared on both the clinical trial registry search and the news search. While the intended user of the technology varied, in all identified cases the target of the technology was the patient.

The identified technologies were being developed for use across settings, including hospital, community or home settings, across the care pathway from the initial on-site assessment to acute care and rehabilitation to longer-term rehabilitation at home. Using broad categorisation, 17 (59%) of the technoplogies could be described as diagnostic tools to measure, make prognosis, monitor, or medically manage some aspects of the (potential) neurological trauma, 12 (41%) technologies could be described as designed for community or acute rehabilitation following neurological trauma, and 1 (3%) could be described as a preventative device. Overall, the development pipeline was evenly split amongst technologies considered to be device (37%), digital (34%), or diagnostic (29%) (Figure 2).

In terms of the global development landscape (Figure 3), the United States (14 technologies) and the United Kingdom (8 technologies) accounted for 76% of all technologies identified. Worldwide, companies, research institutes, academic institutions, and healthcare organisations play key roles in the development of innovative paediatric trauma interventions. In our scan we identified 29 developers worldwide with a higher number across North America and Europe. The key developers included Philip Healthcare, Q30 Innovations, EksoBionics, NHS Lothian, University of Cincinnati, and Boston Children's hospital.

Commercial distribution was the most common stage of development (Figure 4), with 10 (34%) of the identified technologies commercially available. Only 12 of the technologies had been specifically approved for use in neurological trauma (Table 1, Figure 5) – all 12 had been approved by the FDA for use in the United States, 2 had been approved for us in Australia and the European Union, and 1 for use in Canada and the UK. 17 technologies identified did not have regulatory approval by any agency. The true number of technologies approved for use by regulatory agencies specifically for paediatric neurological trauma is likely to be lower than 12 as our further analysis showed that the approvals for some of the technologies related to indicators such as dementia, with testing for other clinical indicators such as trauma only under way. Innovations developed by companies were found to be mostly at the commercial distribution stage while the technologies developed by healthcare organisations were found to be at the discovery, development and validation stage.

The trends in development status and intended care settings differed between the types of technologies. For the 13 technologies classified as a device, the intended context of use were mostly for home or community, and most (9/13, 69%) were either in late stage 4 development or had been commercially distributed. For the 12 digital technologies, the intended context of use was evenly distributed amongst hospital and home/community while their development appeared to be at a much earlier stage – only 5 (38%) were in stage 4 development or commercially distributed while 3

(23%) were at the earliest stage of discovery. For the 10 diagnostic technologies, almost all (9/10, 90%) were being developed for use in the home or community setting, with 3 being commercially distributed, 3 in the early stage of discovery, 2 in the development stage, and 1 each in the clinical evaluation and validation stages.

Table 1. Summary of the health technologies identified and their characteristics

Technology [ID] name	Developer	Purpose/Action	Technology description (developer ascribed)	Intended context of use	Intended user	Regulatory approvals in place
[T1] BIOFLEX DUO+ Photomodulation	ACT lasers	Rehabilitation	Use of light from a low intensity laser diode or an array of super luminous diodes to eliminate pain, accelerate healing and decrease inflammation for persistent post-concussion symptoms	Acute rehabilitation; community rehabilitation	HCP or patient	USA FDA
[T2] Brain+ Recover	Brain+	Rehabilitation	Cognitive capabilities assessment and a tailor-made program of neurogames and behavioural therapy and learning, also includes metacognitive therapy, mindfulness and other guided exercises	Community rehabilitation	Patient	No regulatory approval record by any agency
[T3] CANTAB	Cambridge Cognition; University of Cambridge	Assessment	Neuropsychological Test Automated Touchscreen Battery platform includes highly sensitive, precise, and objective measures of cognitive function	Initial trauma management (specifically at motorsport events)	HCP	EU CE; USA FDA
[T4] Cogmed	Cogmed	Rehabilitation	A professional coach tailors the program and guides the user through five weeks of cognitive exercises, accessed on a computer, tablet or phone	Community rehabilitation	Patient; HCP	No regulatory approval record by any agency
[T5] EksoGT	Eksobionics	Rehabilitation	EksoGT is a robotic exoskeleton used to improve motor function in gait training and rehabilitation for people with neurological conditions	Acute rehabilitation; community rehabilitation	Patient	USA FDA

Technology [ID] name	Developer	Purpose/Action	Technology description (developer ascribed)	Intended context of use	Intended user	Regulatory approvals in place
[T6] Eye-sync	SyncThink	Assessment	An AI-powered system used to analyse the results of a series of fast-paced eye-tracking assessments, in tandem with standard neurocognitive tests, patient records and reported symptoms, to determine the type and severity of cognitive dysfunction caused by a head injury. It outputs a report detailing the extent and type of cognitive dysfunction identified during the assessments. It is embedded into a VR headset and connected to tablet to work.	Initial trauma management	HCP	USA FDA
[T7] HEADON	NHS Lothian and The University of Edinburgh	Rehabilitation	Digital health program designed to support recovery after a concussion (post-concussion syndrome)	Community rehabilitation	Patient	No regulatory approval record by any agency
[T8] ImPACT paediatric	ImPACT Applications Inc	Assessment	A neurocognitive assessment administered online or using desktop software in a controlled environment.	Initial trauma management (specifically at motorsport events)	HCP	UK CA; EU CE; USA FDA; Health Canada; Australian-ARTG
[T9] InfraScanner 2000	InfraScan	Assessment	A portable screening device that uses Near-Infrared (NIR) technology to screen patients for intracranial bleeding	Initial trauma management; ambulatory care	HCP	USA FDA; Australian-ARTG

Technology [ID] name	Developer	Purpose/Action	Technology description (developer ascribed)	Intended context of use	Intended user	Regulatory approvals in place
[T10] I-PAS/Dx100	Neuro Kinetic	Assessment	Fully capable VNG system with a virtual 3D display built into the goggle Provide advanced tests useful in concussion, mTBI and neurologic populations	Initial trauma management; ambulatory care	HCP	USA FDA (ref K171884)
[T11] NeuroCap	Brain Scientific	Assessment	Pre-gelled EEG headset with 22 electrodes and 19 active channels with fixed electrode placement	Initial trauma management; ambulatory care	HCP	USA FDA
[T12] NeuroCatch Platform	HealthTech Connex Inc	Assessment	Measures the cognitive brain function Tracks subtle but significant changes in cognitive function by employing event-related potentials (ERPs)	Initial trauma management	HCP	USA FDA
[T13] Nurochek Headset	EO	Assessment	Portable brain assessment device which uses visual evoked potential (VEP) to measure aspects of the brains electrical activity using EEG.	Initial trauma management (sports events)	HCP	USA FDA
[T14] Phillips Actiwatch Spectrum Plus	Phillips	Rehabilitation	The Actiwatch family of devices is designed to help you better understand a subject's daily activity and sleep/wake patterns in response to drug or behavioural therapies. Use of rest-activity ratio as a measure of sleep-wake regulation in children with brain injury.	Acute rehabilitation	HCP	US federal law restricts these devices to sale by/on the order of a physician. e-doc SB 8/6/13 MCI 4105737

Technology [ID] name	Developer	Purpose/Action	Technology description (developer ascribed)	Intended context of use	Intended user	Regulatory approvals in place
[T15] Portable EyeBOX Model (EBX34)	Oculogica, Inc	Assessment	Non-invasive, non-baseline requiring concussion diagnostic	Initial trauma management; ambulatory care	HCP	No regulatory approval record by any agency
[T16] Q-Collar	Q-30 Innovations	Preventative	The Q-Collar is a non-invasive device that protects the brain from effects associated with repetitive sub-concussive head impacts.	Preventative (worn during sports activities)	Patient	USA FDA
[T17] SMART	Cincinnati Children's Hospital Medical Center & University of Cincinnati	Rehabilitation	SMART is a Web-Based Self-Monitoring Activity-Restriction and Relaxation Training Program	Community rehabilitation	Patient	No regulatory approval record by any agency
[T18] Teen online problem solving (TOPS) web-based programme	Royal Devon University Healthcare NHS Foundation Trust	Rehabilitation	A web-based problem-solving treatment to target common difficulties experienced by children and families following TBI	Community rehabilitation	Patient	No regulatory approval record by any agency
[T19] Unnamed	University of Cambridge	Monitoring	Analytical device that incorporates an integrated surface-enhanced Raman spectroscopy (SERS) microfluidic chip that is suitable for measuring continuous microlitre flow. Micro dialysis analysis of adult patients (16 or older) with a severe traumatic brain injury confirmed with cranial imaging	Hospital care including assessment, investigation, monitoring and/or management	HCP	No regulatory approval record by any agency

Technology [ID] name	Developer	Purpose/Action	Technology description (developer ascribed)	Intended context of use	Intended user	Regulatory approvals in place
[T20] Unnamed digital health intervention prototype	Northern Devon Healthcare NHS Trust	Rehabilitation	A repository of therapeutic speech apps for TBI patients, and iPad games for Brain injury patients	Community rehabilitation	Patient; Carer	No regulatory approval record by any agency
[T21] Unnamed machine learning algorithm to predict TBI at risk of the worst outcomes	University of Edinburgh	Decision support	PhD project to develop machine learning and informatics algorithms using clinical data of paediatric patients in critical care setting for brain trauma to inform about damage to brain and risk of poor clinical outcomes	Hospital care including assessment, investigation, monitoring and/or management	HCP	No regulatory approval record by any agency
[T22] Unnamed neuromuscular electrical stimulation	Children's Hospitals and Clinics of Minnesota	Management; Rehabilitation	Neuromuscular Electrical Stimulation will be applied by the therapist to infant's finger flexors and extensor for 15 min./day, 3x/week; Treatment of infants 7 months to 10 months with 14symmetric hand function due to cerebral palsy or hemiplegia as a result of brain injury, in a context of Infant Modified Constraint Induced Movement Therapy	Acute rehabilitation	HCP	No regulatory approval record by any agency
[T23] Unnamed non-invasive intracranial pressure probe	Crainio; Barts and The London NHS Trust; National Institute for Health Research;	Monitoring; Decision support	The proposed non-invasive ICP (nICP) monitor works by shining a harmless light into the brain through the skull. The developed sensor was attached to the skin of the forehead and recorded optical signals (known as photoplethysmography (PPG)) from the brain,	Hospital care including assessment, investigation, monitoring	HCP	No regulatory approval record by any agency

Technology [ID] name	Developer	Purpose/Action	Technology description (developer ascribed)	Intended context of use	Intended user	Regulatory approvals in place
	University of London City		which are related to changes in ICP. This pilot aims to build the first clinical database of nICP signals in intensive care patients. The acquisition of an extensive set of signals would allow the generation of advanced algorithms and Machine Learning (ML) models utilising optical signal feature extraction techniques. The resulting model will be implemented in translating the optical signals into absolute measurements of ICP.	and/or management		
[T24] Unnamed deep-learning radiology decision support tool	Boston Children's Hospital, GE Healthcare	Decision support	A decision support platform developed to help distinguish the large variability in brain MRI scans in paediatric population. The system will be preloaded with normative reference scans from young children of different ages, which physicians worldwide can use as a benchmark when reading scans of paediatric patients.	Hospital care including assessment, investigation, monitoring and/or management	HCP	No regulatory approval record by any agency
[T25] Unnamed specialised MRI diagnostic imaging	Academisch Ziekenhuis Leiden; The Leiden University Medical Center (LUMC)	Assessment	Develop new low-field MRI systems which will enable a role in medical screening in the developed world, as well as providing an affordable, sustainable and accessible platform for the developing world	Hospital care including assessment, investigation, monitoring and/or management	HCP	No regulatory approval record by any agency
[T26] Unnamed virtual reality	National Eye Institute	Assessment; Management	Virtual reality equipment used in the diagnosis and treatment of convergence insufficiency; an	Hospital care including	HCP	No regulatory approval

Technology [ID] name	Developer	Purpose/Action	Technology description (developer ascribed)	Intended context of use	Intended user	Regulatory approvals in place
			eye coordination disorder experienced by some concussion patients	assessment, investigation, monitoring and/or management		record by any agency
[T27] Unnamed virtual reality rehabilitation	University of Massachusetts	Rehabilitation	Windows 10-based virtual reality-based interactive cognitive training program designed for use in paediatric rehabilitation settings for children with impaired cognitive function particularly in core Executive Functions (EF)	Acute rehabilitation; community rehabilitation	HCP; Patient	No regulatory approval record by any agency
[T28] Unnamed virtual reality rehabilitation	Royal Free Hospital NHS Foundation Trust (Sponsor) Interreg Europe (collaborator)	Rehabilitation	Virtual Reality-based rehabilitation tools for children and young people with CP or TBI	Acute rehabilitation; community rehabilitation	HCP; Patient	No regulatory approval record by any agency
[T29] VIVE Pro Eye	Northeastern University (Sponsor) MaineHealth (Collaborator) Massachusetts General Hospital (Collaborator)	Assessment	Immersive, head-mounted, virtual reality visuo-motor skill assessment for patients with hemiplegia or CP aged 7 – 16 years	Hospital care including assessment, investigation, monitoring and/or management	HCP	No regulatory approval record by any agency

Figure 1. ***Sources used to identify technologies (n)***

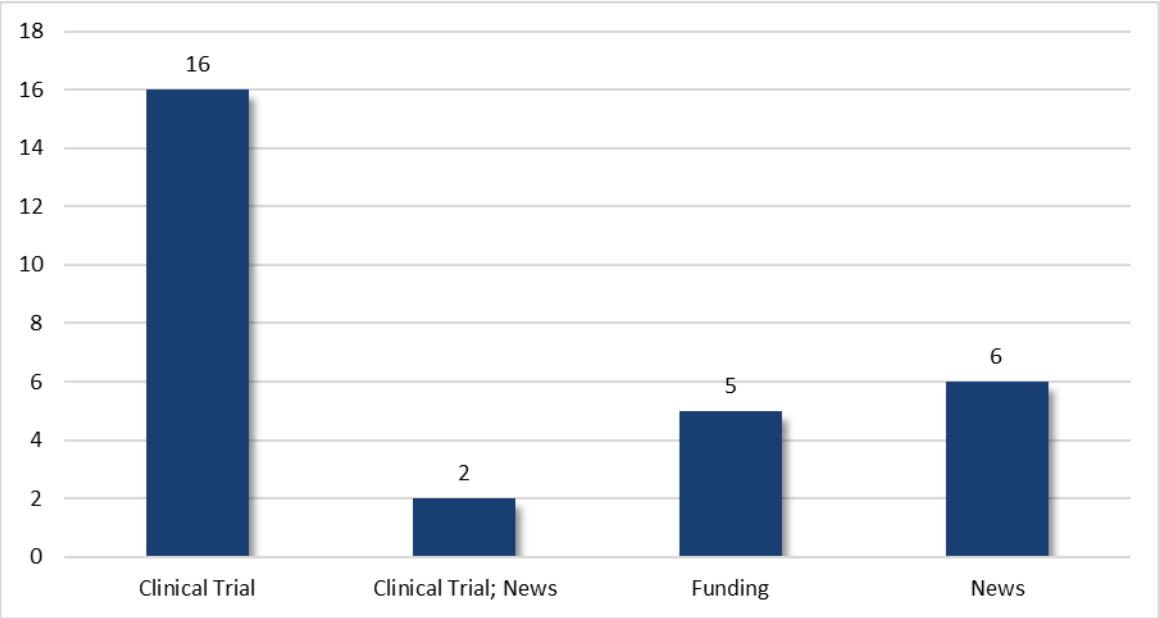
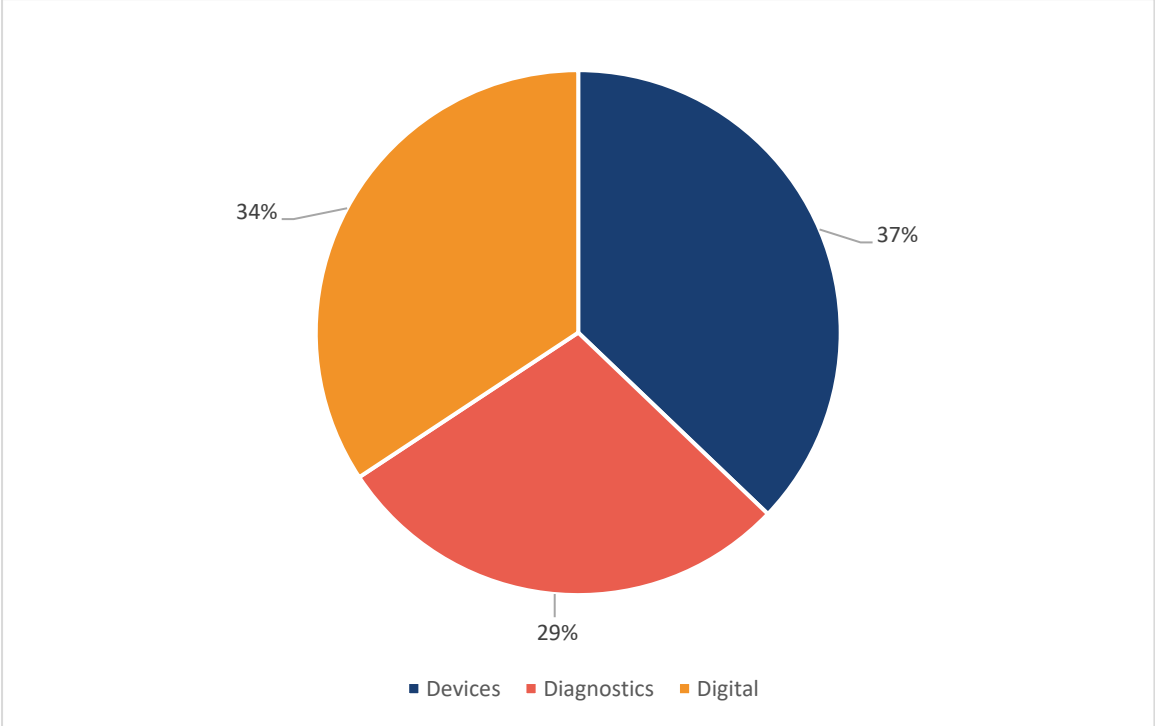


Figure 2. ***Type of technologies identified (n)***



Note: Some technologies were considered to be both diagnostic and digital, therefore the total count in Figures 2 and 5 exceed the number of technologies identified in the horizon scan.

Figure 3. ***Country of development overview (n, %)***

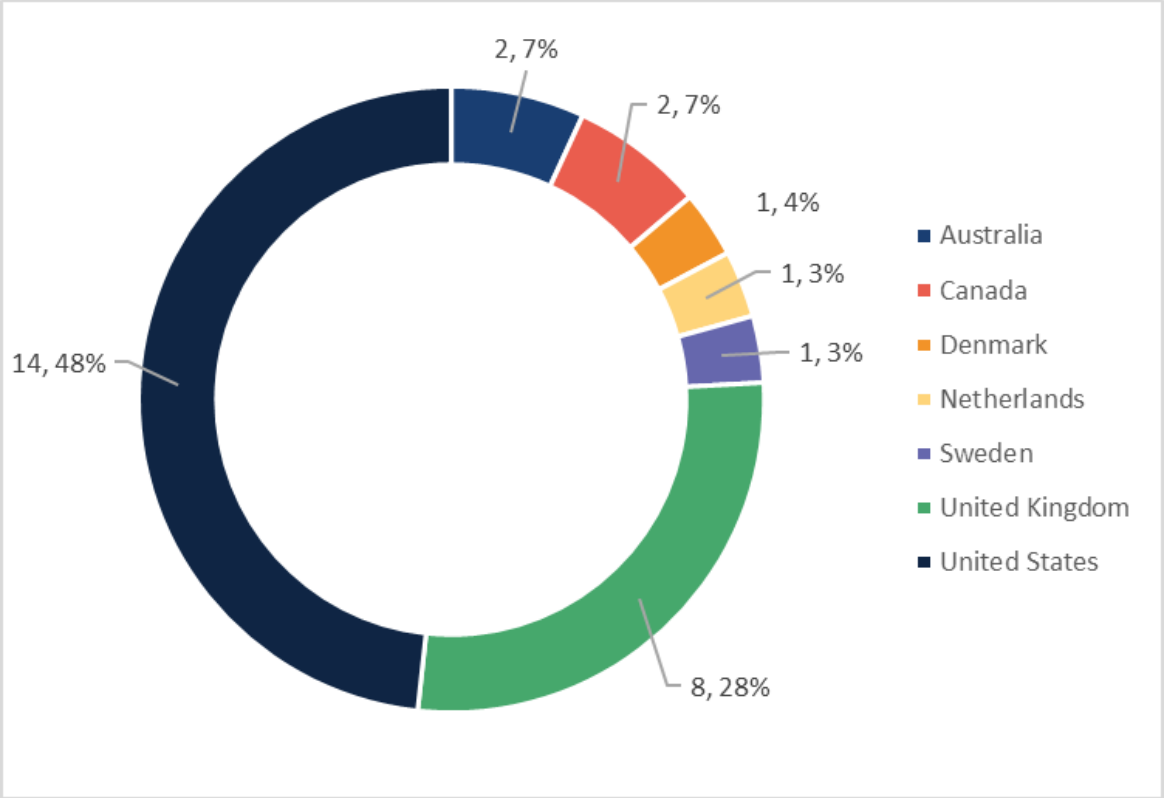


Figure 4. ***Stages of development overview (n)***

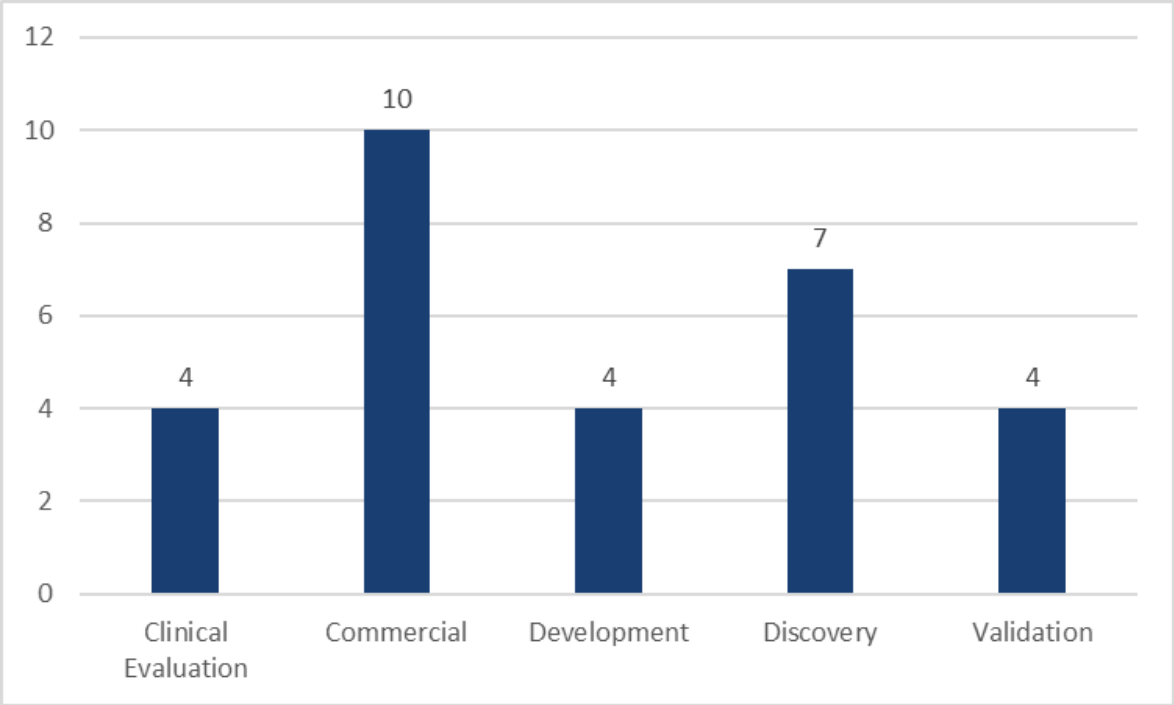
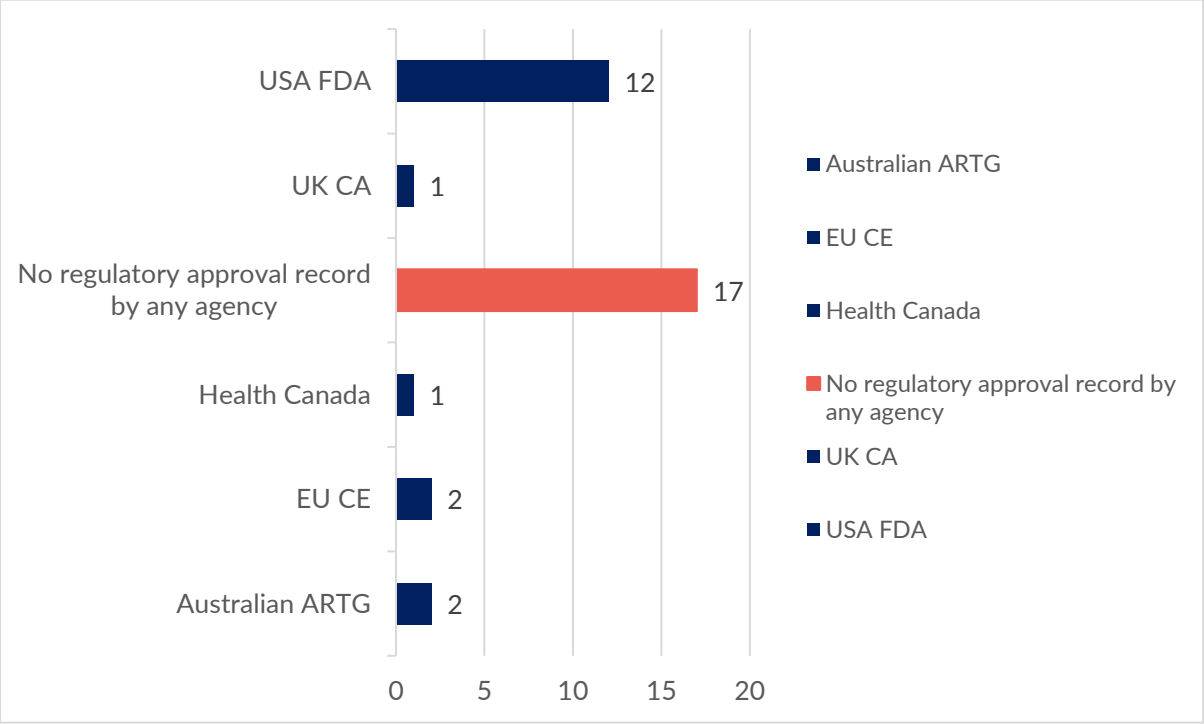


Figure 5. ***Regulatory status of technologies (n)***



Note: Some technologies have a mix of regulatory approval: In order to fully represent the spread of regulatory bodies against technologies, some technologies are seeking approval under multiple regulatory bodies therefore the total count in Figure 5 exceeds the number of technologies identified in the horizon scan. (1 of the technologies has USA FDA, Australian ARTG, EU CE, UK CA and Health Canada regulatory approvals, while another 1 technology has both USA FDA and Australian ARTG regulatory approvals and 1 other technology has both USA FDA and EU CE regulatory approvals).

Interim Conclusions and Dissemination

Results from this horizon scan show that development of paediatric neurological trauma technologies is currently limited, with only a small number of technologies being developed. Two main trends were identified. Firstly, tools to identify and assess the potential trauma severity and/or cognitive function early in the care pathway is a key focus of current development. Secondly, there is proportionally high focus on digital technologies being developed either to support at-home rehabilitation for patients or to improve the diagnostic accuracy of scans in out-of-hospital setting. Finally, as anticipated, we identified analogous populations (e.g. children with cerebral palsy) where there is development activity, and from which technologies could potentially be further translated for use in paediatric neurological trauma care.

Given the limitations in the emerging landscape of paediatric trauma technologies, we plan to survey key stakeholders for their reflections on areas of unmet need. The full, combined conclusions from the present horizon scan and the survey will be shared through a further publication.

This interim report has been prepared to enable early sharing with the key stakeholders, including the NIHR Trauma Management MedTech Co-operative, the NIHR i4i programme and relevant professional organisations such as the British Academy of Childhood Disability and the Paediatric Neurorehabilitation Network, and to inform decision-making about innovation and research related to paediatric neurological trauma.

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We wish to thank the young person representative and clinical advisors from Birmingham Children's Hospital for topic expertise in setting the scope for the scan and in interpreting the findings; and Rachel Keetley for expertise in contextualising the findings in relation to paediatric neurological trauma care pathway.

Appendix A: Scope

PICO

Population	Paediatric (28 days post-birth – up to and including 18 years) with a neurological trauma
Intervention	Devices, diagnostics, IVDs, digital med tech
Outcomes	Any health outcome. Reduction in mortality, morbidity, disability, neurodevelopment, confirming diagnosis, care process outcomes, avoiding hospitalisation, ventilator free days, school / educational outcomes including return to school, and support required, mental health.
Geographical reach	Worldwide
Horizon Scan Time Limitations	Clinical trial registries – 5 years Awarded funding – 5 years News – 3 years

Appendix B: Search strategy

Key Terms

Clinical Trial

Search string	Status	Eligibility criteria
Trauma, Brain	Active, not recruiting	child (birth-17)
	Completed	
Head Injury Trauma	Active, not recruiting	child (birth-17)
	Completed	
Neurological Injury	Active, not recruiting	child (birth-17)
	Completed	
Brain Injuries	Active, not recruiting	child (birth-17)
	Completed	
Head Injury	Active, not recruiting	child (birth-17)
	Completed	

Funding portals and news sites

child brain injury
child brain trauma
child head injury
child head trauma
child neurological injury
child neurological trauma
child traumatic brain injury
child traumatic head injury
paediatric brain injury
paediatric brain trauma
paediatric head injury
paediatric head trauma
paediatric neurological injury
paediatric neurological trauma
paediatric traumatic brain injury
paediatric traumatic head injury
pediatric brain injury
pediatric brain trauma
pediatric head injury
pediatric head trauma
pediatric neurological injury

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