

1 **Developmental outcome measures in neonatal physiotherapy services of the United**
2 **Kingdom: a survey of current use, and facilitators and barriers to their implementation**

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8

9 **Abstract**

10 **Background and purpose:** Current guidelines recognise the need for neonatal
11 physiotherapists to provide surveillance assessments to neonates, from birth onwards. This
12 study explored the current use, barriers and facilitators to using developmental outcomes
13 measures in neonatal units, in the United Kingdom.

14

15 **Method:** A cross-sectional, web-based survey with 32 items was piloted and distributed to
16 members of the Association of Paediatric Chartered Physiotherapists and advertised on
17 social media and professional discussion forums. Responses from the group of therapists
18 who reported using outcome measures, were compared with those who reported not using
19 them, using Mann-Whitney U tests for non-parametric data. Other findings were presented
20 descriptively.

21

22 **Results:** Forty-three completed surveys were analysed. Most respondents (91%) had a
23 positive attitude towards the use of developmental outcome measures, and many (79%)
24 used them in their neonatal practice. These included the General Movement Assessment
25 (n=18/34), Hammersmith Neonatal Neurological Examination (n=16/34), and Lacey
26 Assessment of Preterm Infants (n=15/34). The high cost of acquiring certain measures was
27 a perceived barrier (86%). The presence of a neonatal-specialist physiotherapist (p=0.023),
28 active engagement in continuous professional development (0.011) and support from fellow
29 physiotherapists (p<0.001) significantly influenced outcome measure utilisation.

30

31 **Conclusion:** Outcome measures were commonly used in the analysed units. Perceived
32 utility and positive attitudes towards outcome measure use are in-line with current
33 recommendations. This must be weighed up against the high acquisition cost of some
34 measures. Further research is required to define tailored strategies for promoting best
35 practice in the utilisation of specific developmental outcomes in neonatal care.

36

37 **Introduction**

38 Approximately 60,000 babies are born prematurely (earlier than 37 weeks gestation), in the
39 United Kingdom (UK) every year (Office of National Statistics, 2016). There has been
40 continued improvement in the delivery of neonatal care that has enabled an increase in
41 survival of infants born extremely prematurely between both 1995 and 2006, and still further
42 between 2008 and 2014 (Santhakumaran et al, 2017). However, infants who survive a
43 premature birth are at greater risk of developmental delay with associated long-term
44 consequences, such as cerebral palsy (Moore et al, 2012). Physiotherapists play a vital role
45 in the treatment of neonates in the UK, particularly those who are at increased risk of
46 developmental delay. Input from a physiotherapist may include baseline assessment,
47 parental education and working within the multi-disciplinary team to ensure that the complex
48 needs of the family are being met. Guidelines published by the National Institute for Health
49 and Care Excellence (NICE) on the developmental follow-up of children and young people
50 born prematurely, recommended that premature babies are monitored for the first two years
51 of their lives (NICE, 2017). Physiotherapists are well placed to contribute to this monitoring
52 process.

53 The physiotherapy assessment of neonates can provide an important baseline of
54 information. This can then be used to monitor developmental evolution, identify
55 abnormalities and predict developmental disabilities (Majnemer and Mazer, 1998).
56 Therefore, the use of a valid, reliable, standardised tool has the potential to highlight those
57 patients requiring early intervention, aid in decision-making processes regarding the
58 management of the baby, and ensure optimal quality of care (CSP, 2012). However, the
59 purpose of outcome measures in neonates varies widely, encompassing neurological,
60 neurobehavioural and motor performance assessments. They also have different functions.
61 These include predictive value (the ability to predict the likely future course of development),
62 evaluation (change as a result of a specific intervention) and discriminative function (the
63 ability to discriminate between the presence or absence of a certain impairment at a single

64 time-point). For these reasons, the utilisation of developmental outcome measures is likely to
65 vary substantially between hospitals. This could be problematic when the infant is
66 transferred between neonatal units, as 10% of hospitalised infants were in 2015 (RCPCH,
67 2016).

68 To date, no studies have investigated the current use of, or facilitators and barriers to, using
69 outcome measures in neonatal care. A previous cross-sectional survey found that 89.1%
70 from a sample of 97 physiotherapists used a standardised assessment tool during their
71 neurodevelopmental follow-up programmes of neonates (Harniess and Nikopoulou-Smyrni,
72 2015). The inclusion criteria for this particular work specified that 'lead' neonatal
73 physiotherapists would be recruited, therefore it remains unknown whether 'non-lead'
74 physiotherapists have a similar approach to the use of outcome measures. Furthermore, the
75 study concentrated on follow-up assessment, leaving the broader use of outcome measures
76 unknown.

77 Although barriers to using outcome measures have been identified in some specialties of
78 physiotherapy (Swinkels et al, 2011), the unique environment of neonatal care means that
79 some of the challenges are likely to be specific to the assessment of neonates. It is vital that
80 the use of outcome measures in the UK is quantified, to measure the extent to which best
81 practice is currently being adhered to. Barriers should be identified so that strategies can be
82 implemented to address them. 'Facilitators' (factors that enable or support therapists to
83 utilise outcome measures), will provide researchers and clinicians with an understanding of
84 how best to encourage others to utilise outcomes. Therefore, the aims of the study were
85 threefold. Firstly, to capture a snapshot of current use of developmental outcome measures
86 in neonatal care in the UK. Secondly, to identify any facilitators or barriers that supported or
87 impeded their implementation. Thirdly, to describe differences in neonatal unit, or in attitudes
88 and approaches between those therapists who used outcome measures, and those do did
89 not.

90 **Method**

91 Ethical approval was granted by the Chair of the UCL Research Ethics Committee on 6th
92 June 2017 (REC reference 11151/001). UCL Data Protection and Risk Assessment
93 registration was obtained on 26th May 2017 (reference no. Z6364106/2017/05/124). To
94 prevent the occurrence of duplicate responses from the same hospital, participants were
95 requested to provide demographic details of their units, which were coded to maintain
96 anonymity in accordance with the Data Protection Act 1998.

97 A survey was selected as the most appropriate method for meeting the aims of the study. It
98 comprised of 32 items divided into three domains: the use of developmental outcome
99 measures; barriers and facilitators to their implementation; neonatal physiotherapy service
100 provision and training (Appendix 1). Inclusion criteria for completing the survey were
101 physiotherapists working in neonatal care in the UK, with only one response permitted per
102 hospital site.

103 The survey included closed-ended multiple-choice questions, with additional free-text space
104 for respondents to clarify their responses or add any options that were not listed (Polgar and
105 Thomas, 2013). Perceived facilitators and barriers to implementation of outcome measures
106 were gathered using a 5-point Likert scale, with responses ranging from 'strongly disagree'
107 (1 point) to 'strongly agree' (5 points) in response to a range of statements. These
108 statements were based on previous studies into the implementation of guidelines and
109 outcome measures for general practitioners, midwives and physiotherapists (Peters et al.,
110 2003, Van der Wees et al., 2013, Van Peppen et al., 2008). The final section of the survey
111 was adapted from a validated questionnaire published in 2012, the aim of which was to
112 establish a benchmark for the overall provision of neonatal physiotherapy services in the UK
113 (Ronan and Barron, 2012). With permission from the principal author, eight questions from
114 that questionnaire were utilised in the current study, in order to gather data regarding
115 neonatal units, levels of expertise and training.

116 The questionnaire was piloted among two specialist neonatal physiotherapists who were
117 independent of the study, and three members of UCL academic staff. This helped to identify

118 ambiguous questions, and any perceived biased or leading questions. The participants of
119 the pilot study were also asked to email their comments regarding the time taken to
120 complete the survey and the clarity, relevance and completeness of the survey in order to
121 evaluate its face and content validity (Polgar and Thomas, 2013). Three items were added
122 (items 14, 18 and 19, see Appendix 1) and details within the survey, in particular the order of
123 the domains and the phrasing of the questions were modified. One specific point raised by
124 all reviewers related to the frequent use of 'negative sentences' such as, 'the use of the
125 developmental outcome measures is not too time-consuming.' Although reverse worded
126 items have been shown to reduce response bias, recent evidence suggests that they are
127 more likely to result in confusion (Sonderen et al, 2013). The reviewers also had differing
128 opinions over how to respond to such questions. Therefore, for clarity, these were re-
129 phrased to provide consistently positively-worded items.

130 The finalised electronic survey was distributed along with an invitation to all members of the
131 APCP. Respondents were also sought using social media (Twitter and Facebook) and via
132 on-line professional discussion forums (i-CSP) in order to reach other neonatal
133 physiotherapists who were not members of the APCP. Data collection was conducted using
134 the UCL Opinio web-based survey tool, and all responses were anonymised at source. Data
135 were transferred from the Opinio software into an Excel spreadsheet for storage, which
136 allowed data transfer into Statistical Package for the Social Sciences (SPSS) software for
137 statistical analysis. Descriptive statistics were used to report the findings. Furthermore,
138 responses from the group of therapists who reported using outcome measures, were
139 compared with those who reported not using them, using Mann-Whitney U tests for non-
140 parametric data and presented as U and p-values. This was important, since one aim of the
141 survey was to compare differences between users and non-users in their attitudes and
142 approaches towards outcome measures. Where questions were binary (requiring a 'yes' or
143 'no' response), responses were compared using Fisher's exact test after dividing the

144 respondents into those who reported using outcome measures and those who reported not
145 using them.

146 **Results**

147 A total of 91 responses were received, from which 43 were included in this study.
148 Respondents of the 47 remaining questionnaires did not press the final 'submit' button, and
149 their surveys were often substantially incomplete, so these were excluded. One other
150 completed survey was excluded as the participant was not working in the UK. Each
151 response came from a different hospital, so no hospital-specific focus of practice was over-
152 represented. Of the included surveys, 79.1% (n=34) of respondents reported using
153 developmental outcome measures on their units (Table 1).

154 Respondents were predominantly Band 7 physiotherapists (86%, n=37), working in units
155 which had multiple bands of physiotherapy staff. All the units (100%, n=6) that included a
156 Band 8 physiotherapist in their skill mix, used outcomes measures. This compares with 78%
157 (n=29) of units where the highest level of experience was Band 7. Most of the respondents
158 (44%) worked in units providing level 3 neonatal care, although 18 physiotherapists worked
159 across more than one level of care. 90% of physiotherapists who worked on a unit that
160 included level 3 care, used outcome measures. This compares with 67% of those whose
161 highest level of care was level 2. Neither band of physiotherapists present on units nor level
162 of care significantly influenced the use of outcome measures on the unit (U=132.5, p=0.513
163 and U=110.5, p=0.177 respectively).

164 Of the 43 units included in the study, 58.1% (n=25) had input from a neonatal-specialist
165 physiotherapist. 'Neonatal-specialist' was a self-reported term to differentiate from
166 physiotherapists who would normally work with either paediatrics or adult patients. Where a
167 neonatal-specialist physiotherapist was involved on the neonatal unit, 92% (n=23/25) of the
168 respondents reported using outcome measures (Table 1). The presence of a neonatal-

169 specialist on the unit was significantly related to the use of outcome measures (Fisher's
170 exact test: $p=0.023$).

171 Nearly all the respondents ($n=40/43$) participated in continuing professional development
172 related to neonatal care. This included self-directed learning (90.7%) and peer learning and
173 support within each NHS trust (81.4%) as part of their specialist training. 53% of
174 physiotherapists also took part in postgraduate education with a neonatal component. The
175 number of continuing professional development opportunities, training and support sources
176 accessed by physiotherapists was significantly higher in the group who reported using
177 outcome measures ($U=71.5$, $p=0.011$).

178 Current use of outcome measures

179 The most frequently utilised outcome measures were the Hammersmith Neonatal/Infant
180 Neurological Examination (HNNE/HINE), the Lacey Assessment of Preterm Infants (LAPI)
181 and the Prechtl's Method of Qualitative Assessment of General Movements (GMs) (Table 2).
182 Physiotherapists with greater years of experience in the use of developmental outcome
183 measures, or who received specific training in their use were significantly more likely to
184 utilise a measure on their unit (Table 1).

185 Facilitators to using developmental outcome measures

186 The majority of respondents ($n=39/43$, 91%) had a positive attitude towards the use of
187 outcome measures in clinical practice (item 8, 'I feel that I have a positive attitude towards
188 the use of developmental outcome measures'). The same number of respondents
189 recognised the utility of outcome measures in providing insight for parents into their child's
190 physical functioning (item 21) (Table 3). Indeed, four physiotherapists specified in the
191 'comments' section that the use of outcome measures gave them the opportunity to have a
192 discussion with the parents about different aspects of infant development, developmental
193 support and the function of follow up clinics.

194

195 Barriers to using developmental outcome measures

196 Finding the opportune moment for completing a developmental assessment (item 18) was
197 challenging for most of the physiotherapists (81.4%). Funding issues were reported by six
198 respondents and were confirmed by 86.1% (n=37/43) of physiotherapists who considered
199 the costs related to outcome measure acquisition (such as courses and materials) (item 16)
200 an obstacle to using them, indicating the main barrier to their implementation (Table 3).

201

202 Differences in perceived barriers and facilitators between respondents using, and not using,
203 developmental outcome measures on units

204 There were some significant differences between those respondents who used outcome
205 measures and those who did not. There were significantly different responses to the
206 statements 'the use of a developmental outcome measure fits into my way of working at my
207 unit' (item 9) (U=18.5, p<0.001), and 'I regard the use of a developmental outcome measure
208 to be a good starting point for my physiotherapy interventions and for further referrals' (item
209 10) (U=46, p<0.001). Those who used outcome measures tended to agree with these
210 statements (with the exception of one respondent), whereas those who didn't tended to
211 disagree or be neutral (Table 3).

212 Regarding the outcome measures' adaptability to the individual needs of infants (item 20),
213 there was a significant difference between the two groups (U=79.5, p=0.016) and although
214 73.5% of the physiotherapists who utilised outcome measures agreed with the statement
215 (n=25/34), one reported the difficulty of using non-completed data when transferring patients
216 between units and for longitudinal data collection.

217 With regards to the environment, physiotherapists who had support from fellow
218 physiotherapists (item 22) and other professionals (item 23) were significantly more likely to
219 utilise outcome measures than those who did not (with U=34, p<0.001 and U=70, p=0.005
220 respectively) (Table 3).

221 **Discussion**

222 Existing guidelines recognise the need for neonatal physiotherapists to provide surveillance
223 assessments and developmental support to neonates, from birth to age of two years (NICE,
224 2017; CSP, 2017). From the results gained, it is encouraging that developmental outcome
225 measures were utilised by 79% of the 43 respondents to the survey, facilitating the majority
226 of the surveyed physiotherapists to provide a good-quality physiotherapy service and
227 appropriate follow-up (Grol and Grimshaw, 2003; King et al., 2011). The most frequently
228 used outcome measures were HNNE/HINE, GMs and LAPI. This study found that the
229 presence of a band 8 clinical specialist physiotherapist and/or input from a neonatal
230 specialist physiotherapist on the unit, were significant indicators for the use of developmental
231 outcome measures. Those physiotherapists who engaged with a variety of continuing
232 professional developmental opportunities from a number of different sources were also more
233 likely to use outcome measures in clinical practice.

234 The most representative neonatal service care was level 3 (44%). Although there was no
235 significant relationship between the level of care and the use of outcome measures, most
236 physiotherapists working on a unit that included level 3 care used outcome measures
237 (89.5%). This suggests that outcome measures hold particular clinical importance for infants
238 with more complex conditions, who require closer monitoring and tend to have longer length
239 of stay; thus, greater priority may be given to using outcome measures to monitor these
240 infants.

241 The band of physiotherapy staff most present on units was Band 7 (86%), which is aligned
242 with the previous findings (72.8% n=43/59, without missing data), (Ronan and Barron, 2012).
243 Again, despite no significant relationship being found between the band of physiotherapists
244 present on the unit and outcome measures utilisation, all units that included a Band 8
245 physiotherapist used outcome measures. This, combined with the findings regarding the use
246 of outcome measures and involvement of a neonatal-specialist physiotherapist on the

247 neonatal unit (Fisher exact test: $p=0.023$), suggests that the presence of a clinical specialist
248 results in close monitoring of neonates.

249 Level and amount of training and support sources had a significant influence in outcome
250 measure utilisation (higher levels of training and multiple training sources being related to
251 outcome measure usage). These findings are in keeping with previous studies (Jette et al.,
252 2009; Wedge et al., 2012). However, previous studies also argue that physiotherapists with
253 greater clinical expertise tended to use informal outcome measures, relying on their own
254 judgement and experience, whilst newly graduated physiotherapists were more familiar with
255 integrating standardised outcome measures into their practice (King et al., 2011; Wedge et
256 al., 2012). In contrast to these findings, in the current study, the neonatal physiotherapy role
257 is an advanced clinical sub-speciality that requires a relevant postgraduate education and an
258 appropriate professional experience (Brady and Smith, 2015), and physiotherapists with
259 greater years of experience of using the tools, were more likely to implement standardised
260 outcome measures on their neonatal unit. In addition, there is a difference between using a
261 developmental outcome measure to track or anticipate changes over time, and using a
262 short-term outcome measure to evaluate the effectiveness of a single treatment or course of
263 treatments. As a result, the use of 'informal outcomes' by expert practitioners in other non-
264 neonatal specialties may reflect the use of the outcome tools for a different purpose. In
265 neonatal care, the tracking of development over a longer period may demand a more
266 standardised approach.

267 The most frequently used outcome measures were HNNE/HINE, GMs and LAPI. These
268 tests, which have a discriminative and predictive function, evaluate posture, tone and the
269 quality of movements in premature infants. The main differences are related to the
270 administration time, infant handling involvement, equipment and training requirements (Kant,
271 2013). The tendency of utilising more than two outcome measures (67.7%, $n=23/34$),
272 confirms the need for further studies to evaluate whether the concurrent use of those tools
273 would increase the ability to detect or discriminate typically developing preterm infants to

274 ensure the resources are targeted. In addition, size of caseload or local trust policies could
275 be influencing factors in outcome measure preference and frequency of use, since Ronan
276 and Barron (2012) identified that 39% of level 2 and 3 units (n=22/57, excluding 13 units that
277 did not offer a neonatal physiotherapy service) had an ad hoc service, which was offered
278 after a direct referral only.

279 The overall positive attitude towards the use of outcome measures (39/43) and the strong
280 consensus regarding the utility of outcome measures to provide insight for parents into their
281 child's physical functioning (39/43) differed from findings by King et al. (2011). Those authors
282 suggested that paediatric physiotherapists perceived the utilisation of outcome measures to
283 be less important to parents. King et al. (2011) undertook a thorough literature review
284 regarding barriers and facilitators to outcome measure use in paediatric physiotherapy,
285 summarising that the unwillingness of physiotherapists to utilise standardised measurements
286 may be related to the incapacity of those tools to detect small changes in children with
287 physical and developmental disabilities. Thus, they preferred an individualised approach that
288 celebrated small achievements in order to maintain the children's motivation and parents'
289 appreciation for long-term therapies. These differences between paediatric and neonatal
290 fields might be related to the type of condition and care. Although both fields adopt a family-
291 centred approach, particular attention has been directed to parent-child interactions, parent
292 education and early parent-administered physiotherapy on neonatal units in recent years
293 (Ustad et al., 2016; Sweeney et al., 2009; Sweeney et al., 2010). In addition, the predictive
294 nature of developmental tools might assume particular importance to parents at this early
295 stage.

296 High costs were described as significant limitations to the use of outcome measures on
297 neonatal units, which reflected former findings from other physiotherapy specialist areas
298 including musculoskeletal, neurological and paediatric fields (Jette et al., 2009; Wedge et al.,
299 2012; Van Peppen et al., 2008; King et al., 2011). Moreover, finding the opportune moment
300 for outcome measure use was perceived as a barrier by the majority of respondents

301 (81.4%). From the literature, it seems that this limitation is specific to the neonatal setting
302 and might partially explain the physiotherapists' tendency to integrate different tools, some of
303 which involve purely observational assessment, into the neonatal assessment.

304 Significant differences were found between those physiotherapists that used outcome
305 measures and those that did not. In particular, there was strong consensus among
306 respondents who used outcome measures that they 'fit into the way of working on units'
307 (94.1%) and are a 'starting point for physiotherapy intervention and further referrals' (94.1%).

308 There were also significant differences between respondents using outcome measures and
309 those not, in terms of the level of support offered by fellow physiotherapists and other
310 professionals. Those respondents using outcome measures felt significantly more
311 supported by their colleagues and peers, ($p < 0.001$ and $p = 0.005$ for therapists and other
312 professionals respectively). As opposed to former studies, which identified culture and
313 organisation as determining factors in outcome measure implementation (Jette et al., 2009;
314 King et al., 2001; Wedge et al., 2012), interdisciplinary support assumed significant
315 importance in the neonatal physiotherapy field. This suggests that where a supportive
316 environment exists, physiotherapists feel comfortable utilising outcome measures.

317 It is acknowledged that this survey has several limitations. The non-standardised term,
318 'developmental outcome measure', was utilised to group different neurological, behavioural
319 or motor performance tests, since they assess various areas of neonatal development and
320 they were designed for serial/longitudinal use to track the developmental evolution of infants
321 (Brazelton and Nugent, 2011; Dubowitz et al., 1999; Einspieler, 2004, Lacey, 2004). The
322 lack of consensus regarding this terminology may have impacted on the interpretation of
323 questions and statements, leading to ambiguity of findings. There were a significant number
324 of non-responses to certain individual items, which could have impacted on the validity of
325 findings. These may have been reduced with a longer piloting process. However, the study
326 was undertaken within the context of a fairly limited time-frame and the findings remain a
327 useful addition to the literature. The use of an electronic survey may explain some of the

328 problems in completeness, consistency and a lower response rate compared to the
329 epistolary method (Bethlehem, 2009; Ritter et al., 2004; Sivo et al., 2006). However, given
330 that neonatal physiotherapy is a fairly small subspecialty, the response rate was deemed to
331 be sufficient and representative of this group.

332 **Conclusion**

333 The results of this study suggest that outcome measures are commonly used by neonatal
334 physiotherapists in the UK. The most frequently used outcome measures were HNNE/HINE,
335 GMS and LAPI. There was generally a positive attitude towards outcome measure usage,
336 but with some barriers to their implementation including the high cost. The non-use of
337 outcome measures could be attributed to the level of expertise, type of training and a lack of
338 interdisciplinary support. This provides a useful discussion point for experts in the field, when
339 considering the impact that staff development and support could have on outcome measure
340 utilisation in the future.

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458

459 **List of Tables**

460

461 **Table 1: Summary of participants**

	Use of OMs (YES) n=34 (79%)	Non-use of OMs (NO) n=9 (21%)	Total n=43 (100%)	Significance
Highest level of neonatal care provided				
1	4 (12%)	0	4 (9%)	U = 110.5 p = 0.177
2	8 (24%)	4 (44%)	12 (28%)	
3	17 (50%)	2 (22%)	19 (44%)	
Other	1 (3%)	1 (11%)	2 (5%)	
Not reported	4 (12%)	2 (22%)	6 (14%)	
Physiotherapy band levels present on the neonatal unit				
Band 6	1 (3%)	1 (11%)	2 (5%)	U = 132.5 p = 0.513
Band 7	15 (44%)	2 (22%)	17 (40%)	
Band 8	3 (9%)	0	3 (7%)	
Bands 6 & 7	12 (35%)	5 (56%)	17 (40%)	
Bands 6 & 8	1 (3%)	0	1 (2%)	
Bands 7 & 8	1 (3%)	0	1 (2%)	
Bands 5, 6 & 7	0	1 (11%)	1 (2%)	
Bands 4, 6, 7 & 8	1 (3%)	0	1 (2%)	
Number of years using developmental outcome measures				
no years	0	3 (33%)	3 (7%)	U = 90 p = 0.041
< 2 years	6 (18%)	2 (22%)	8 (19%)	
2-5 years	9 (26%)	1 (11%)	10 (23%)	
> 5 years	19 (56%)	3 (33%)	22 (51%)	
Training received in the use of developmental outcome measures				
Yes	30 (88%)	3 (33%)	33 (77%)	p = 0.002
No	4 (12%)	6 (67%)	10 (23%)	
Whether therapists have read the APCP competence framework for working in neonatal care				
Yes	31 (91%)	8 (89%)	39 (91%)	p = 1.00
No	3 (9%)	1 (11%)	4 (9%)	

462 OMs: developmental outcome measures; APCP: Association for Paediatric Chartered
 463 Physiotherapists; Statistical Significance p<0.05; 'Other' refers to: n=1 'unsure'; n=1 consultant level
 464 therapist

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469 **Table 2: Frequency of the use of developmental outcome measures**

OMs	Never n (%)	<5 times n (%)	5-10 times n (%)	11-25 times n (%)	>25 times n (%)	Response rate ^a n (%)
HNNE/HINE	4 (11.8%)	4 (11.8%)	4 (11.8%)	4 (11.8%)	12 (35.3%)	28 (82.4%)
GMs	5 (14.7%)	3 (8.8%)	1 (3%)	6 (17.6%)	12 (35.3%)	27 (79.4%)
LAPI	8 (23.5%)	2 (5.9%)	1 (3%)	1 (3%)	14 (41.2%)	26 (76.5%)
NBAS	11 (32.4%)	7 (20.6%)	1 (3%)	0	3 (8.8%)	22 (64.7%)
NIDCAP	17 (50%)	0	0	1 (3%)	2 (5.9%)	20 (58.8%)
TIMP	17 (50%)	1 (3%)	0	0	0	18 (53%)
NAPI	19 (55.9%)	0	0	0	0	19 (55.9%)
Others: AIMS	0	0	0	0	5 (14.7%)	5 (14.7%)
Others: Bayley	0	2 (5.9%)	0	0	1 (3%)	3 (8.8%)

470 OMs: developmental outcome measures; HNNE/HINE: Hammersmith Neonatal Neurological
 471 Examination/Hammersmith Infant Neurological Examination; GMs: Prechtl's Method of Qualitative
 472 Assessment of General Movements; LAPI: Lacey Assessment of Preterm Infants; NBAS: Brazelton
 473 Neonatal Behavioural Assessment Scale; NIDCAP: Newborn Individualised Care and Assessment
 474 Program; TIMP: Test of Infant Motor Performance; NAPI: Neurobehavioural Assessment of the
 475 Preterm Infant; AIMS: Alberta Infant Motor Scale; Bayley: Bayley Scales of Infant and Toddler
 476 Development

477 ^a[Total number of responses: n=34]

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Table 3: Summary of barriers and facilitators questionnaire section

Items	Use of OMs	Strongly disagree n (%)	Disagree n (%)	Do not agree nor disagree n (%)	Agree n (%)	Strongly agree n (%)	Total n (%)	Mann-Whitney U test p-value
8. I feel that I have a positive attitude towards the use of developmental outcome measures [Barrier (1) → Facilitator (5)]	Yes	2 (5.9%)	0	0	14 (41.2%)	18 (53%)	34 (100%)	U = 115 p = 0.208
	No	0	0	2 (22.2%)	4 (44.5%)	3 (33.3%)	9 (100%)	
9. The use of a developmental outcome measure fits into my way of working at my unit [Barrier (1) → Facilitator (5)]	Yes	1 (3%)	0	1 (3%)	13 (38.2%)	19 (55.9%)	34 (100%)	U = 18.5 p < 0.001
	No	0	4 (44.5%)	4 (44.5%)	1 (11.1%)	0	9 (100%)	
10. I regard the use of a developmental outcome measure to be a good starting point for my physiotherapy interventions and for further referrals [Barrier (1) → Facilitator (5)]	Yes	1 (3%)	0	1 (3%)	10 (29.4%)	22 (64.7%)	34 (100%)	U = 46 p < 0.001
	No	0	0	6 (66.7%)	2 (22.2%)	1 (11.1%)	9 (100%)	
11. It is important that developmental outcome measures can be used before 38-40 weeks postmenstrual age [Barrier (1) → Facilitator (5)]	Yes	1 (3%)	3 (8.8%)	3 (8.8%)	16 (47.1%)	11 (32.4%)	34 (100%)	U = 117 p = 0.246
	No	0	1 (11.1%)	2 (22.2%)	5 (55.6%)	1 (11.1%)	9 (100%)	
12. I consider that a complex layout of a developmental outcome measure can be an obstacle to using it [Facilitator (5) ← Barrier (1)]	Yes	0	4 (11.8%)	4 (11.8%)	19 (55.9%)	7 (20.6%)	34 (100%)	U = 145.5 p = 0.804
	No	0	0	2 (22.2%)	5 (55.6%)	2 (22.2%)	9 (100%)	
13. The need for additional equipment (such as a video camera) can be an obstacle to using the developmental outcome measure in my unit [Facilitator (5) ← Barrier (1)]	Yes	1 (3%)	6 (17.6%)	4 (11.8%)	14 (41.2%)	9 (26.5%)	34 (100%)	U = 123.5 p = 0.35
	No	0	1 (11.1%)	0	5 (55.6%)	3 (33.3%)	9 (100%)	
14. The number of items that require infant handling can be an obstacle to using a developmental outcome measure [Facilitator (5) ← Barrier (1)]	Yes	0	6 (17.6%)	2 (5.9%)	16 (47.1%)	10 (29.4%)	34 (100%)	U = 96 p = 0.067
	No	0	3 (33.3%)	1 (11.1%)	5 (55.6%)	0	9 (100%)	

15. I feel that the use of developmental outcome measures can be too time-consuming [Facilitator (5) ← Barrier (1)]	Yes	6 (17.6%)	17 (50%)	3 (8.8%)	6 (17.6%)	2 (5.9%)	34 (100%)	U = 108
	No	0	4 (44.5%)	2 (22.2%)	2 (22.2%)	1 (11.1%)	9 (100%)	p = 0.15
16. The cost of acquiring certain developmental outcome measures (such as courses and materials) can be an obstacle to using them [Facilitator (5) ← Barrier (1)]	Yes	1 (3%)	1 (3%)	3 (8.8%)	20 (58.8%)	9 (26.5%)	34 (100%)	U = 124.5
	No	0	0	1 (11.1%)	4 (44.5%)	4 (44.5%)	9 (100%)	p = 0.341
17. It is difficult to understand the use of developmental outcome measures in patients who seem healthy [Facilitator (5) ← Barrier (1)]	Yes	12 (35.3%)	16 (47.1%)	4 (11.8%)	1 (3%)	1 (3%)	34 (100%)	U = 120
	No	1 (11.1%)	6 (66.7%)	2 (22.2%)	0	0	9 (100%)	p = 0.281
18. Finding the right moment (such as infant awake) for the developmental assessment is often challenging [Facilitator (5) ← Barrier (1)]	Yes	0	5 (14.7%)	1 (3%)	22 (64.7%)	6 (17.7%)	34 (100%)	U = 148
	No	0	0	2 (22.2%)	5 (55.6%)	2 (22.2%)	9 (100%)	p = 0.863
19. The use of developmental outcome measures in neonatal units is too stressful for the infant [Facilitator (5) ← Barrier (1)]	Yes	5 (14.7%)	19 (55.9%)	5 (14.7%)	3 (8.8%)	2 (5.9%)	34 (100%)	U = 127.5
	No	0	5 (55.6%)	4 (44.5%)	0	0	9 (100%)	p = 0.399
20. Developmental outcome measures can be adapted to the individual needs of the infants [Barrier (1) → Facilitator (5)]	Yes	0	3 (8.8%)	6 (17.7%)	20 (58.8%)	5 (14.7%)	34 (100%)	U = 79.5
	No	0	3 (33.3%)	3 (33.3%)	3 (33.3%)	0	9 (100%)	p = 0.016
21. Developmental outcome measures give parents an insight into their child's physical functioning [Barrier (1) → Facilitator (5)]	Yes	0	1 (3%)	1 (3%)	18 (53%)	14 (41.2%)	34 (100%)	U = 96
	No	0	0	2 (22.2%)	6 (66.7%)	1 (11.1%)	9 (100%)	p = 0.055
22. Fellow neonatal physiotherapists cooperate in applying the developmental outcome measures [Barrier (1) → Facilitator (5)]	Yes	0	0	6 (17.7%)	20 (58.8%)	8 (23.5%)	34 (100%)	U = 34
	No	1 (11.1%)	1 (11.1%)	6 (66.7%)	1 (11.1%)	0	9 (100%)	p < 0.001
23. Other professionals support the use of developmental outcome measures	Yes	0	0	2 (5.9%)	22 (64.7%)	10 (29.4%)	34 (100%)	U = 70

[Barrier (1) → Facilitator (5)]	No	2 (22.2%)	1 (11.1%)	2 (22.2%)	3 (33.3%)	1 (11.1%)	9 (100%)	p = 0.005
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24. **Managers/directors support** the use of developmental outcome measures

	Yes	0	1 (3%)	7 (20.6%)	17 (50%)	9 (26.5%)	34 (100%)	U = 92.5
[Barrier (1) → Facilitator (5)]	No	2 (22.2%)	0	3 (33.3%)	3 (33.3%)	1 (11.1%)	9 (100%)	p = 0.053

Oms: developmental outcome measures
 Statistical significance (**p<0.05**)

Appendix 1: Questionnaire

Developmental outcome measures

Following are a couple of questions about the utilisation of developmental outcome measurement.

1.	Do you currently use a developmental outcome measure on your unit?	<input type="checkbox"/> Yes <input type="checkbox"/> No: Please go to question number 4				
2.	How often have you used the following developmental outcome measures?					
	<i>If you use other developmental outcome measures, please specify in the text boxes</i>	Never	<5 times	5-10 times	11-25 times	>25 times
	Hammersmith Neonatal/Infant Neurological Examination (Dubowitz or NANI)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Lacey Assessment of Preterm Infants (LAPI)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Brazelton Neonatal Behavioural Assessment Scale (NBAS)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Neurobehavioural Assessment of the preterm Infant (NAPI)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Newborn Individualised Care and Assessment Program (NIDCAP)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Prechtl's Method of Qualitative Assessment of General Movements (GMs)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Test of Infant Motor Performance (TIMP)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Other/further comments					
3.	What is the youngest postmenstrual age range (weeks) that you would assess a baby using a developmental outcome measure?	<input type="checkbox"/> 24-27 <input type="checkbox"/> 28-29 <input type="checkbox"/> 30-31 <input type="checkbox"/> 32-34 <input type="checkbox"/> 35-37 <input type="checkbox"/> 38-40 <input type="checkbox"/> >40: Please Specify				
	<i>(please add additional comments in the box provided)</i>					
	<i>Please go to question number 5</i>					
	Other/further comments:					

4.	If it were possible, which outcome measure/s would you like to introduce <i>(tick all that apply on the list)</i>	<input type="checkbox"/> Hammersmith Infant Neurological Examination (Dubowitz or NANI) <input type="checkbox"/> Lacey Assessment of Preterm Infants (LAPI) <input type="checkbox"/> Brazelton Neonatal Behavioural Assessment Scale (NBAS) <input type="checkbox"/> Neurobehavioural Assessment of the preterm Infant (NAPI) <input type="checkbox"/> Newborn Individualised Care and Assessment Program (NIDCAP) <input type="checkbox"/> Prechtl's Method of Qualitative Assessment of General Movements (GMs) <input type="checkbox"/> Test of Infant Motor Performance (TIMP) <input type="checkbox"/> I don't know <input type="checkbox"/> None <input type="checkbox"/> Other: Please Specify
		Other/further comments:
5.	What is your level of experience with the use of developmental outcome measures	<input type="checkbox"/> I have no experience <input type="checkbox"/> <2 years of experience <input type="checkbox"/> 2-5 years of experience <input type="checkbox"/> >5 years of experience
		Other/further comments:
6.	Have you received training in the use of developmental outcome measures?	<input type="checkbox"/> Yes <input type="checkbox"/> No Please state the outcome measure/s that you have been trained to use, and the type of training that you undertook (e.g. inservice training, APCP course, etc):

Barriers and facilitators to the implementation of tests of infant development

The Association of Paediatric Chartered Physiotherapists (APCP) published on 2011 and updated on 2015 "A Competence Framework and Evidenced-Based Practice Guidance for the Physiotherapist working in the Neonatal Intensive Care and Special Care Unit in the United Kingdom", in which is recommended the use of developmental outcome measures.

7.	Which of the following statement is true?	<input type="checkbox"/> I read the APCP guidance <input type="checkbox"/> I am aware of the APCP guidance, but I have not read them yet <input type="checkbox"/> I am not aware of the APCP guidance
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Following are a couple of statements about the use of developmental outcome measures. We would like to know whether you agree with the statement or not and in what degree. If you do not have a strong opinion, please try to find out if it is more like 'agree' or more like 'disagree'. If you really do not know, you can select the option 'do not agree nor disagree'.

	Strongly disagree	Disagree	Do not agree nor disagree	Agree	Strongly agree
8. I feel that I have a positive attitude towards the use of developmental outcome measures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. The use of developmental outcome measures fits into my way of working at my unit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. I regard the use of a developmental outcome measure to be a good starting point for my physiotherapy interventions and for further referrals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other/further comments:					
11. It is important that developmental outcome measures can be used before 38-40 weeks postmenstrual age	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other/further comments:					
12. I consider that a complex lay-out of a developmental outcome measure can be an obstacle to using it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other/further comments:					
13. The need for additional equipment (such as a video camera) can be an obstacle to using the developmental outcome measure in my neonatal unit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other/further comments:					
14. The number of items that require infant handling can be an obstacle to using a developmental outcome measure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other/further comments:					
15. I feel that the use of developmental outcome measures can be too time-consuming	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other/further comments:					
16. The cost of acquiring certain developmental outcome measures (such as courses and materials) can be an obstacle to using them	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other/further comments:					

17. It is difficult to understand the use of developmental outcome measures in patients who seem healthy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other/further comments:					
18. Finding the right moment (such as infant awake) for the developmental assessment is often challenging	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other/further comments:					
19. The use of developmental outcome measures in neonatal units are too stressful for the infant	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other/further comments:					
20. Developmental outcome measures can be adapted to the individual needs of the infant	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other/further comments:					
21. Developmental outcome measures give parents an insight into their child's physical functioning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other/further comments:					
22. Fellow neonatal physiotherapists cooperate in applying the developmental outcome measures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other/further comments:					
23. Other professionals support the use of developmental outcome measures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other/further comments:					
24. Managers/directors support the use of developmental outcome measures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other/further comments:					

Neonatal physiotherapy service provision and training

Following are a couple of questions about your neonatal physiotherapy service and training.

<p>25.</p>	<p>What is the name of the hospital in which you work?</p> <p>This question is to account for multiple responses from the same unit. The name of the unit will NOT be revealed in the analysis or dissemination of findings</p>	
	<p>How many beds does your neonatal unit have, and at what level are these beds?</p>	<p>26. Level 1: 27. Level 2: 28. Level 3:</p>
<p>29.</p>	<p>What bands of physiotherapy staff work on the neonatal unit?</p> <p><i>(tick all that apply)</i></p>	<p>Other/further comments:</p> <p><input type="checkbox"/> Band 3 assistant <input type="checkbox"/> Band 4 assistant / T.I <input type="checkbox"/> Band 5 <input type="checkbox"/> Band 6 <input type="checkbox"/> Band 7 <input type="checkbox"/> Band 8</p> <p>Please specify approximately how many hours per week your physiotherapy team spends on the neonatal unit:</p>
<p>30.</p>	<p>Where does your physiotherapy input come from?</p> <p><i>(tick all that apply)</i></p>	<p><input type="checkbox"/> Neonatal-specialist physiotherapist</p> <p><input type="checkbox"/> Predominantly paediatric physiotherapists from acute trust</p> <p><input type="checkbox"/> Predominantly adult or general physiotherapists from acute trust</p> <p><input type="checkbox"/> Paediatric physiotherapists from community trust</p> <p>Other/further comments:</p>
<p>31.</p>	<p>What types of physiotherapy interventions are your neonatal physiotherapists involved with?</p> <p><i>(tick all that apply)</i></p>	<p><input type="checkbox"/> Neuro-developmental evaluation <input type="checkbox"/> Neuro-developmental interventions <input type="checkbox"/> Respiratory / chest clearance <input type="checkbox"/> Orthopaedic – e.g. OBPP, Talipes (Obstetric Brachial Plexus Palsy) <input type="checkbox"/> Psychosocial meetings <input type="checkbox"/> Neonatal follow-up clinics <input type="checkbox"/> Parent’s education/collaboration</p> <p>Other/further comments:</p>

32.	<p>As a neonatal physiotherapist, what specialist training and support have you undertaken?</p> <p><i>(tick all that apply)</i></p>	<p><input type="checkbox"/> I am a member of APCP (Association of Paediatric Chartered Physiotherapists) neonatal group</p> <p><input type="checkbox"/> I have attended courses related to neonatal care</p> <p><input type="checkbox"/> I have undertaken postgraduate education, which included neonatal care</p> <p><input type="checkbox"/> I have been involved in peer learning and support within the trust</p> <p><input type="checkbox"/> I have received teaching/training from senior colleagues</p> <p><input type="checkbox"/> I have undertaken my own self-directed learning</p> <p><input type="checkbox"/> Other (please state)</p>
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