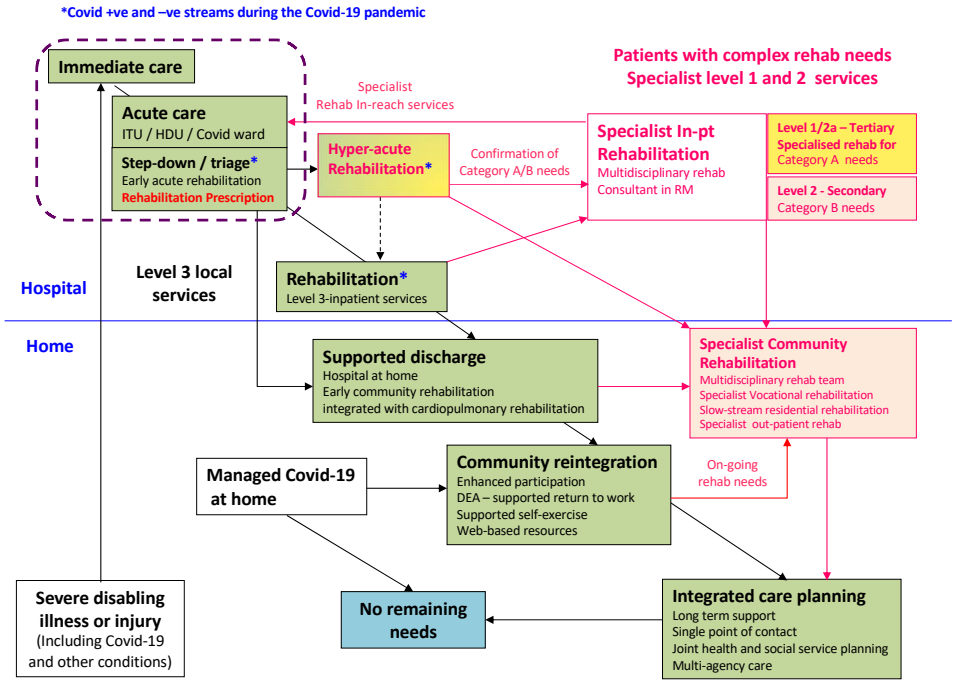
Online Supplement

Turner-Stokes et al. The Post-ICU Presentation Screen (PICUPS) and Rehabilitation Prescription (RP) for Intensive Care survivors Part I: Development and preliminary clinimetric evaluation.

1. The context for this development:

The British Society of Rehabilitation Medicine has set out of the care pathways for rehabilitation following severe illness/injury(11). The developments described in this paper address the first stage (shaded in purple) (Figure A).

OLS-Figure A: The recovery pathway following severe illness or injury



2. The Pilot study – geographic spread and data collection

Twenty-six centres participated in the pilot study, representing a wide geographic spread across England (see paper II (ref) and encompassing a wide range of different settings including ICUs and acute wards.

A standardised data collection tool has been developed to collate the data. In this first evaluation, the dataset was designed to mirror the rehabilitation prescription (RP) dataset collected by the Trauma Audit and Research Network (TARN) for trauma patients, with a view to determining how well this reflects the needs of patients after critical care or in which respect(s) it may need adjusting. The dataset comprises:

- **Basic Demographic data** (including age, gender, ethnicity and a summary of diagnoses and organ support requirements while on the ICU)
- **The Post-ICU Presentation Screen (PICUPS)-Basic and PICUPS-Plus scores**
- A **minimum dataset for the Rehabilitation Prescription** (including checklists of physical, cognitive and psychosocial needs, the level of rehabilitation needs, the patient's destination and whether or not it is the appropriate facility to meet their needs (and if not the reason(s) for variance).
- If patients are thought to require further in-patient rehabilitation, teams are also requested to complete the Rehabilitation Complexity Scale (v 13) and Complex Needs Checklist(10).

The tool is available from the Intensive Care Society's web page at the following link: https://members.ics.ac.uk/ICS/ICS/GuidelinesAndStandards/Framework_for_assessing_early_rehab_needs_following_ICU.aspx

3. Clinimetric analysis

The COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN) initiative has published a framework to encourage transparent methodology in the evaluation of outcome measurement tools for research and clinical practice(13). This framework is used to describe the different components of clinimetric evaluation of the PICUPs using classical test theory - the parameters of interest being its face and content validity, utility, structural validity and responsiveness to change.

Statistical Analysis methods

Data were extracted and cleaned using Microsoft Excel and exported to the Statistical Package for Social Sciences (SPSS, IBM Inc) version 26 for analysis.

Missing data were expected due to the rapidity of development and dissemination. More than one rating was only expected in the slower-track cases. In addition, some teams still scored only the relevant items of the PICUPS-plus and, due to the rolling recruitment, some teams used a 13-item version (the 14th item "Family Distress", which was still undergoing development at the time). No data were imputed. Total PICUPS-Basic and PICUPS-Plus scores were only computed if all subscale

items were complete (14 and 10 respectively). Total combined PICUPs scores were computed if all 24 items were complete.

Score distribution is relevant to describe the sample and to determine the extent to which it represents the full range of scores for each item. It was examined case-wise on the whole dataset. Descriptive statistics were calculated for item and total scores including median, interquartile range (25^{th} and 75^{th} centiles) and total range.

Internal consistency was examined on the dataset that comprised complete scores only (n=306) using Cronbach's alpha and item-total correlations. Exploratory factor analysis was conducted using principal components analysis with varimax rotation, extracting factors with eigenvalues >1.

For cases with >=2 ratings at different time points, responsiveness was assessed by examining for statistically significant differences between the first and last rating. Differences were examined using non-parametric tests (Wilcoxon Signed Rank). P values were corrected to allow for multiple tests using the formula '0.05/no. of tests'.

Utility was examined from qualitative analysis of the feedback questionnaires. Thematic analyses were performed, establishing hierarchies and sub-themes with coding used to establish the areas of focus and consensus(13, 14). The Gioia Method was used to structure, code and through the construction of "first order concepts", "second order themes" and finally combining into "aggregate dimensions" (15). First order (participant based) concepts were generated from the language and words of the participants. These were then organised into a logical flow allowing the emergence of second order themes at a higher level of abstraction. The flow of material was then finally collapsed into aggregate dimensions, representing a number of second order themes that shared common issues, presented in a data structure diagram.

Results

OLS-Table A shows the distribution of PICUPS scores across the whole sample (all time points).

OLS-Table A: Distribution of item and total PICUPS scores

PICUPS-Basic items		No. cases		Range	Median	Interquartile range
		Valid	Missing	Min-Max		$25^{th} – 75^{th}$
1	Medical stability	551	1	0-5	2	1-4
2	Medical care	551	1	0-5	3	2-4
3	Ventilator	551	1	0-5	5	4-5
4	Tracheostomy care	549	3	0-5	5	5-5
5	Tracheostomy weaning	549	3	0-5	5	5-5
6	Cough	549	3	0-5	5	4-5
7	Nutrition	550	2	0-5	3	1-5
8	Repositioning	551	1	0-5	3	2-5
9	Transfers	551	1	0-5	2	1-4
10	Communication	548	4	0-5	5	3-5
11	Cognition	549	3	0-5	4	3-5
12	Behaviour	548	4	0-5	5	4-5
13	Mental health	548	4	0-5	4	3-5
14	Family distress	380	172	1-5	4	4-5
Total Basic Subscale		**173**	**379**	**14-70**	**53**	**43-62**
PICUPS-Plus items						
1	Breathing	430	122	0-5	3	1-5
2	Voice	432	120	0-5	5	3-5
3	Swallow	444	108	0-5	4	2-5
4	Posture	440	112	0-5	5	2-5
5	Personal hygiene	445	107	0-5	3	1-4
6	Physical care	440	112	0-5	3	1-4
7	Mobility	446	106	0-5	3	1-4
8	Upper limb	442	110	0-5	4	2-5
9	Fatigue	447	105	0-5	2	1-3
10	Pain	432	120	0-5	4	3-5
Total Plus Subscale		**410**	**142**	**0-50**	**33**	22-41
Total PICUPS Score		**306**	**246**	**16-120**	**84**	**64-101**

OLS-Table B shows the Cronbach's alpha and item-total correlations for the PICUPS-Basic- and Plus Subscale, and the full scale scores.

OLS-Table B: Internal consistency of the subscale and full scale scores (n=306): Cronbach's alpha and item total correlations.

		PICUPS-Basic Cronbach's alpha = 0.92		**PICUPS-Plus** Cronbach's alpha = 0.91		**Full Scale** Cronbach's alpha = 0.95	
	Item	**Item total correlation**	**Alpha if item deleted**	**Item total correlation**	**Alpha if item deleted**	**Item total correlation**	**Alpha if item deleted**
1	Medical stability	0.66	0.91			0.69	0.95
2	Medical care	0.82	0.91			0.81	0.95
3	Ventilator	0.57	0.92			0.55	0.95
4	Tracheostomy care	0.65	0.92			0.63	0.95
5	Tracheostomy weaning	0.65	0.91			0.64	0.95
6	Cough	0.72	0.91			0.71	0.95
7	Nutrition	0.75	0.91			0.78	0.95
8	Repositioning	0.78	0.91			0.81	0.95
9	Transfers	0.80	0.91			0.85	0.95
10	Communication	0.75	0.91			0.76	0.95
11	Cognition	0.76	0.91			0.76	0.95
12	Behaviour	0.48	0.92			0.44	0.95
13	Mental health	0.25	0.93			0.26	0.96
14	Family distress	0.41	0.92			0.40	0.95
15	Breathing			0.30	0.93	0.27	0.96
16	Voice			0.65	0.90	0.71	0.95
17	Swallow			0.73	0.90	0.79	0.95
18	Posture			0.76	0.90	0.76	0.95
19	Personal hygiene			0.88	0.89	0.88	0.95
20	Physical care			0.83	0.89	0.84	0.95
21	Mobility			0.82	0.89	0.83	0.95
22	Upper limb			0.75	0.90	0.77	0.95
23	Fatigue			0.71	0.90	0.65	0.95
24	Pain			0.40	0.91	0.42	0.95

OLS-Table C shows the factor loadings on the first principal components, and on the four factors with eigenvalues >1.

OLS-Table D: Exploratory factor analysis (n=306): Factor loadings for initial and rotated solutions

		Initial solution	Rotated Solution*			
	Item	**First component**	**Factor 1 Physical**	**Factor 2 Respiratory**	**Factor 3 Psychosocial**	**(Factor 4)**
1	Medical stability	0.711	**0.565**			
2	Basic care and safety	0.837	**0.697**			
3	Respiratory support	0.574		**0.675**		
4	Tracheostomy care	0.672		**0.887**		
5	Tracheostomy weaning	0.683		**0.910**		
6	Cough	0.742		**0.779**		
7	Nutrition / feeding	0.809	**0.630**			
8	Repositioning within bed	0.840	**0.818**			
9	Transfers: bed/ chair	0.870	**0.873**			
10	Communication	0.805		**0.594**		
11	Cognition / delirium	0.792	(0.552)	(0.510)	**(0.405)**	
12	Behaviour	0.466			**0.802**	
13	Mental health	0.267			**0.761**	
14	Family/friends distress	0.430			**0.593**	
15	Breathing	0.290		(0.178)		**0.860**
16	Voice	0.741		**0.716**		
17	Swallowing	0.812	**0.591**			
18	Postural management	0.797	**0.726**			
19	Personal hygiene	0.900	**0.850**			
20	Care needs	0.866	**0.812**			
21	Moving around (indoors)	0.855	**0.865**			
22	Arm / hand function	0.801	**0.644**			
23	Fatigue	0.658	**0.575**			
24	Pain	0.452	**0.587**			
	Cronbach's alpha	0.954	0.957	0.845	0.707	

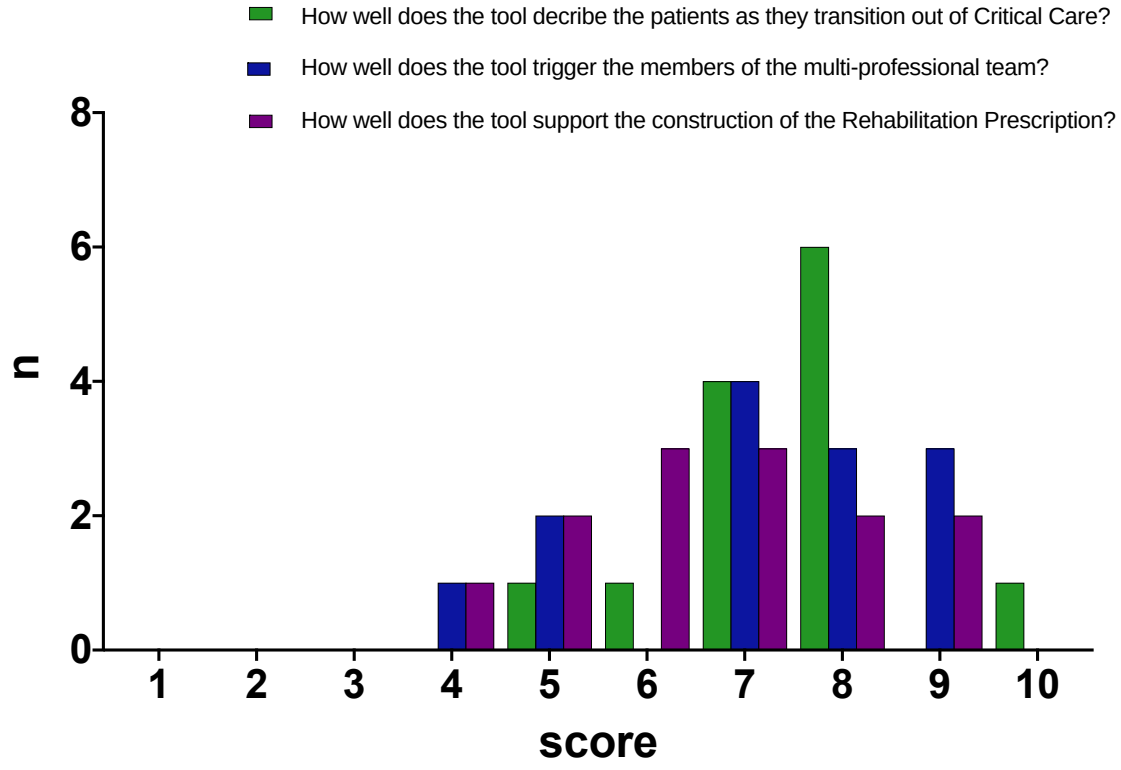
*Loadings <0.56 suppressed (except for Breathing in Factor 2 and Cognition)

4. Utility

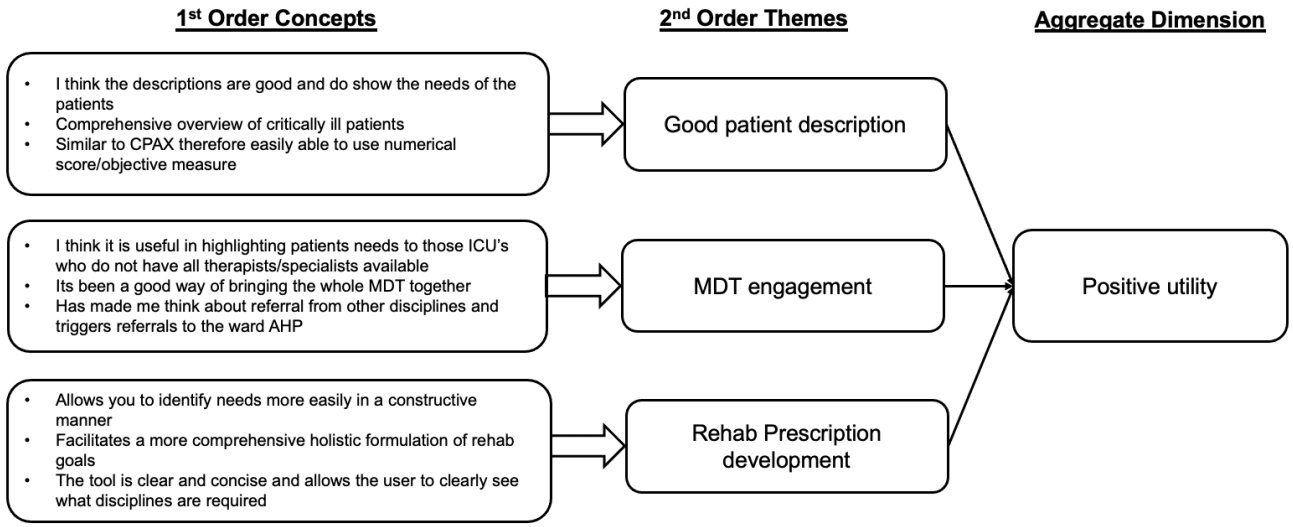
OLS-Figure D summarises the frequency of scores provided by users (on a scale of 0-10) on the usefulness of the PICUPS for describing patients as they transition out of critical care, for triggering referrals to the various professions as a tool to support construction of a personalised Rehabilitaton Prescription.

OLS-Figures E and F summarise the key themes arising from qualitative analysis of respondent feedback on positive utility (E) and on challenges and recommendations (F).

OLS-Figure D. User feedback from the PICUPS tool and Rehabilitation Prescription



OLS-Figure E Qualitative analysis - Positive Utility



OLS-Figure F: Qualitative analysis- Respondents areas of challenge and recommendations