## **Novel Web-Based Workflow For Neurorehabilitation** Design and Successful Implementation in an Inpatient Unit Swayne OBC<sup>1,2,3,4</sup>, Feeney S<sup>1,3,4</sup>, Tyagi H<sup>1,2,3,4</sup>

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### Background

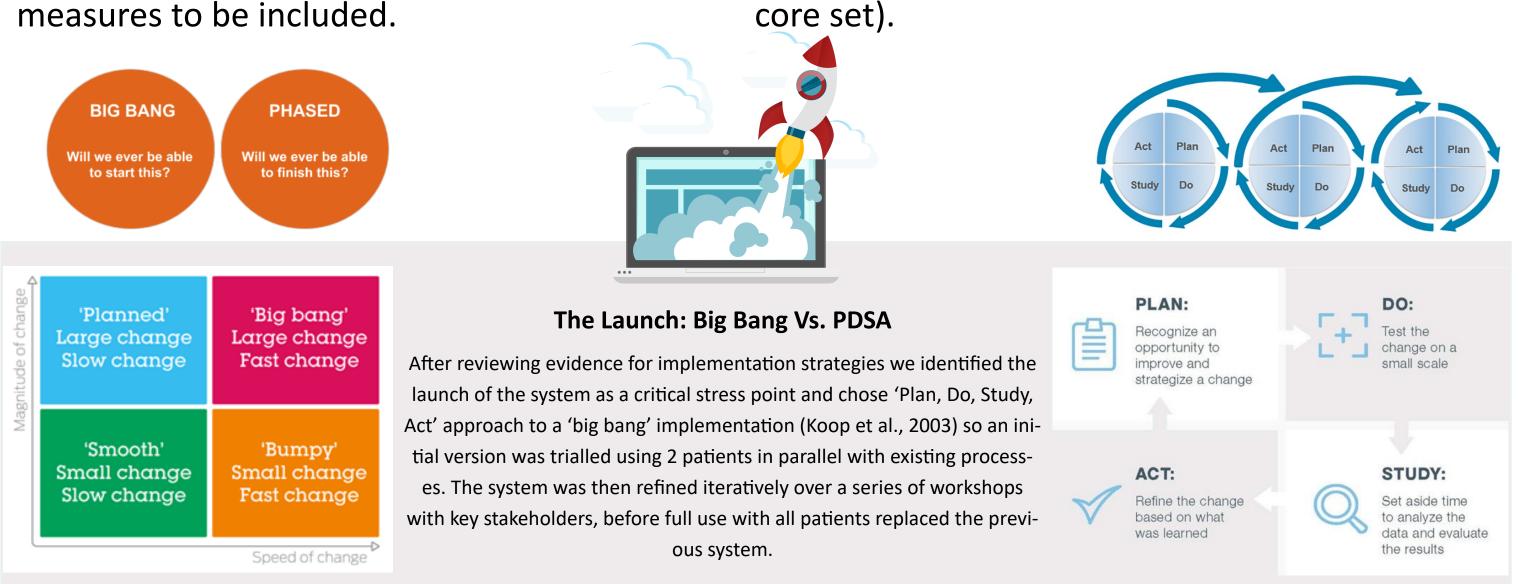
Effective Neurorehabilitation as it is currently practised depends upon robust core processes: a careful assessment of impairments, activities and participation followed by an iterative process of goal setting towards mutually agreed discharge goals (Wade et al 2009). Clinical workflows are increasingly moving into electronic health record systems (Illman 2016) but Neurorehabilitation is poorly represented in these systems, including in the software recently adopted for mandatory use across UCLH. The recent advent of secure webbased databasing tools allows us independently to create such a workflow for documentation of impairments etc. and for iterative goal setting that is designed by Neurorehabilitation clinicians. This also presents an opportunity to create a research database of patients who are accurately characterised according to neurological impairment. Here we present our efforts in this regard.

#### Methods

We built our platform using Redcap, a data collection tool developed by Vanderbilt University and held under licence by UCLH. This tool is based upon an SQL data structure, an architecture common to many databases, and is highly configurable. Our instance is hosted on an approved private server and meets legal requirements for data protection (Directive on Security of Network and Information Systems). In a nod to the previously used 'Finchley' database (in MS Access) we named it 21st Century Finch. The initial design was based upon the best elements of the old Finchley system but with a number of updates. We added a more detailed section for diagnosis and re-appraised the outcome measures to be included.

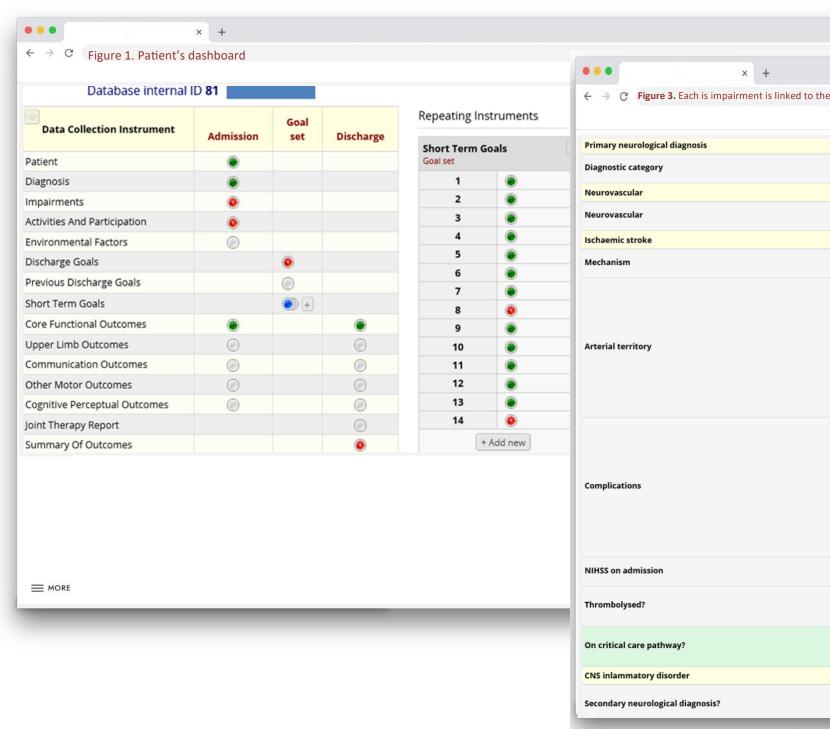
#### Results

Following a successful initial trial rehabilitation unit staff requested a full implementation within a month, with ongoing trouble-shooting but no major hiccups. The system has now been running for 20 months, and includes data from 111 patients. Each patient's record contains 15 types of page. These comprise one-off descriptive data collected on admission (Patient details, Diagnosis, Impairments, Activities & Participation, Environmental factors), outcome measures collected on admission and discharge (details below) and a page for each goal setting (discharge goals, with scope for them to be revised, and short term goals generated iteratively every 2 weeks). Each Impairment, and each Activities & Participation item, is linked to the WHO International Classification of Function (Neurology



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References: 1. Wade, D. T. (2009). Clinical Rehabilitation, 23(4), 291-5; 2. James Illman. Health Services Journal, 8th September 2016.; 2. The Process Edge. Harvard Business Press. Koop, R., Rooimans, R. and de Theye, M. (2003).



Outcome measures include core outcomes for all patients (FIM-FAM, Barthel, VAS difficulty) plus optional sections depending upon the need: upper limb outcomes (ARAT, Fugl-Meyer, trunk impairment scale, Chedoke arm & hand inventory), communication outcomes (comprehensive aphasia test, word fluency test, Mt Wilga high level language test, video pragmatic rating scale, video discourse rating scale, Duffy intelligibility rating scale, eating assessment tool), other motor outcomes (timed walk), and cognitive perceptual outcomes (star cancellation task, KF-Neglect Assessment Protocol). On discharge a joint therapy report is created automatically from the previously entered data, including impairments, A&Ps, sections for each discharge goal with space for comments) and a summary of core outcome measures. At present for technical reasons we are unable to print this off directly, meaning that the text must be copied and pasted into a Word document. This will require a software interface to correct, and is in progress. From an organisational perspective the transition from the previous system to 21st Century Finch went remarkably smoothly and the system continues in daily use.

	× +	Figure 5. Joint Therapy Report
	← → C Figure 4. Short term goals. This is one of 8 such goal settings for this pate	Discharge destination
WHO International Classification of Function	📓 Short Term Goals	Treating team
	Current instance: 💿 8 🗢	Rebecca Walters, Physiotherapist (Key worker)
	Cliting existin ID 64 (Instance #8) Mohamed Nor	
H	Event Name: 2	Laura O'Flaherty, Occupational therapist
Neurovascular	Database intern	Impairments (on admission)
	Mohamed 55 58492	Reduced adjustment to limitation, assistance for coping strategies.
Bischaemic stroke	Current planned 6 te: 28-01-2019	Reduced sensation bilaterally ankles and feet. Sensation intact in hands and arms bilaterally.
Ģ [	Date short term  7  25-01-2019	Reduced proprioception to the knee on right, ankle on the left. Intact in upper limbs.
	Goals set by	
Cause not identified	Lead team member for goal setting	Allodynia in feet.
	Goals	Pain on passive stretch in all joints including spine.
□ L ACA ☑ L MCA	Goal 1	Reduced lower limbs more than upper limbs bilaterally. Stronger left upper limb vs right.
	On going (13/12/18) To independently put shoes and socks on in sitting or lying.	Reduced static and dynamic sitting balance
Basilar		Reduced passive range of movement.
		Fatigue
	Linked discharge goal	nfor morr Activities & Participation (on admission)
Unclear		Assistance of one to two.
	Goal 1 status	Dependent on others.
None	Goal 2	Hoist assistance of two
☐ Multiple ☑ Chest infection	On going (10.1.19) To be able to get on and off a chair 15 1/2" high (as height of sofa at home)	Dependent on others to push wheelchair
Urinary Tract Infection		
Deep vein thrombosis		Assistance of two to roll in bed and change position in the chair.
Pulmonary embolism		Unable to return to college
	Linked discharge goal	g around Dependent for eating and drinking
Other diarrhoea		Apathetic encouragement to initiate daily routine
	Goal 2 status	Unable to partake in leisure activities. Assistance to set up TV.
Not recorded	Goal 3	Environmental factors
⊣ OYes	To order one healthy meal per day from the menu. (meals consisting of either vegetables, salad or fruit). with	the aim to
⊖	least 3 of my 5 a day.	Review of discharge goals
	reset	1. To complete a 5 month admission on the Neuro rehab unit having achieved the following go
H) O Yes		further rehabilitation at home with the community team and re-ablement single handed once
• No	reset	
		Goal status Achieved
⊛ OYes		
No		Discharge goal 1 Notes

### Discussion

Our 21st Century Finch adaptation of the Redcap system has proven a robust way to ensure that patients' goals and outcomes are documented. It is also a useful tool to promote the review and discussion of goals at MDT meetings. There are number of ongoing issues that need addressing. The most pressing is the difficulty in printing or generating PDF files from the sections. A custom interface will be necessary in order to allow joint therapy reports, goals etc. to be printed off in an acceptable format. This is a work in progress, but means that for now therapists must still copy and paste the goals into a Word document. Likewise the reporting / search capability is currently poor: we would like this system to act as a database that may be queried by researchers according to impairments.

Ultimately it would make sense for the underlying data structure to be transferred to UCLH's recently implemented Epic electronic health record system, so that it may be integrated with the main health record. This should in theory be easy to achieve: in practice the governance around EHRS implementation makes this complex, so for now the two systems run in parallel.





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oals by 25/02/19 e per day in the

One intriguing possibility is that this system may easily be shared between neurorehabilitation units. An anonymised version of the data set may in theory be created across multiple units, creating a much larger neurorehabilitation database. This would require careful data protection and governance, but could potentially create a hugely valuable research resource.

airment 1	Voice & speech function	Save & Go T
	20	Cancel
Voice & speech function	Articulation functions	~
	Severe expressive and re	ceptive aphasia
Details	•	
	<i>~</i>	
		Expan
irment 2	Voice & speech function	$\checkmark$
Voice & speech function	Fluency & rhythm of spee	ch functions 🗸
	Severe apraxia of speech	
Details	•	
	9	
	L	Expan
airment 3	🕖 Neuromusculoskeletal &	movement related 🔽
Neuromusculoskeletal & movement related functions	Muscle power Right sided hemiplegia U facial weakness	L>LL and mild Right sided
Neuromusculoskeletal & movement related functions	Right sided hemiplegia U	L>LL and mild Right sided
Details	Right sided hemiplegia U facial weakness	L>LL and mild Right sided
Details	Right sided hemiplegia U facial weakness	L>LL and mild Right sided
	Muscle power  Right sided hemiplegia U facial weakness  Sepsory functions & pain	L>LL and mild Right sided
Details airment 4	Right sided hemiplegia U facial weakness	L>LL and mild Right sided Expan
Details airment 4	Muscle power          Right sided hemiplegia U         facial weakness         Sensory functions & pain         Seeing         Right hemianopia	L>LL and mild Right sided
Details airment 4 Sensory functions & pain	Muscle power     Right sided hemiplegia U     facial weakness     Sensory functions & pain     Seeing     Right hemianopia	L>LL and mild Right sided
Details airment 4 Sensory functions & pain	Muscle power         Right sided hemiplegia U         facial weakness         Sensory functions & pain         Seeing         Right hemianopia	L>LL and mild Right sided
Details airment 4 Sensory functions & pain Details	Muscle power          Right sided hemiplegia U         facial weakness         Sensory functions & pain         Seeing         Right hemianopia	L>LL and mild Right sided
Details airment 4 Sensory functions & pain Details	Muscle power  Right sided hemiplegia U facial weakness  Sensory functions & pain  Seeing  Right hemianopia  Right hemianopia	L>LL and mild Right sided
Details airment 4 Sensory functions & pain Details airment 5	<ul> <li>Muscle power</li> <li>Right sided hemiplegia U facial weakness</li> <li>Sensory functions &amp; pain</li> <li>Seeing</li> <li>Right hemianopia</li> <li>Sensory functions &amp; pain</li> </ul>	L>LL and mild Right sided
Details airment 4 Sensory functions & pain Details airment 5	<ul> <li>Muscle power</li> <li>Right sided hemiplegia U facial weakness</li> <li>Sensory functions &amp; pain</li> <li>Seeing</li> <li>Right hemianopia</li> <li>Sensory functions &amp; pain</li> <li>Sensory functions &amp; pain</li> <li>Seeing</li> </ul>	L>LL and mild Right sided



