Short communication

A demand–capacity mismatch between rehabilitation need and service provision as a result of the COVID-19 pandemic? Early clinical observations from a large teaching hospital in London

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Abstract

In this short report the authors characterise inpatient bed occupancy and predicted rehabilitation need of patients cared for in two acute hospitals of a large London NHS Trust during the first wave of the COVID-19 pandemic, including 394 people with confirmed COVID-19. Data were captured on a single day (17th April 2020) from the two Trust hospitals to inform discharge planning in line with national COVID-19 Hospital Discharge Service policy guidance. Our data suggests that the proportion of COVID-19 patients predicted to require rehabilitation upon hospital discharge may be greater than the estimates described in the national COVID-19 Hospital Discharge Service policy guidance; posing the question is there a demand–capacity mismatch between rehabilitation need and service provision as a result of the COVID-19 pandemic?

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Introduction

After the World Health Organisation declared the coronavirus disease 2019 (COVID-19) a pandemic, the UK became one of the worst affected areas in the world. In April 2020, during the first wave of the pandemic, England reported peak numbers of patients with confirmed COVID-19 in hospital beds [1], with the highest rates in London.

In this correspondence, the authors describe the clinical characteristics of all inpatients, those with confirmed COVID-19 and non-COVID-19 cases, and the predicted rehabilitation needs of both COVID-19 positive and non-COVID-19 patients in a large NHS Trust in South East London on a single day (17th April 2020). The Trust, which provides acute and specialist services to a population of over 1,000,000 people in inner South London and the surrounding area, has over 1300 beds across sites.

During the initial spread and peak of COVID-19, there was little published data regarding the rehabilitation needs of post COVID-19 survivors. London, like the rest of the UK and the world responded to the pandemic by transforming health services to increase critical care capacity and treat acutely unwell patients infected with COVID-19. Using a framework for emergency preparedness, the NHS in England implemented large scale repurposing of NHS services, staffing and capacity on 17th March 2020 [1]. NHS Trusts, community interest companies and private care providers of acute, community beds, community health services and social care staff in England were required to implement a COVID-19 Hospital Discharge Service (CHDS) in an effort to make available more than 15,000 NHS beds and main-

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tain high volumes of discharge [2,3]. The CHDS [3] outlined a "discharge to assess" model of service delivery with four discharge pathways for all NHS inpatients in acute and community hospitals, and allocated responsibility to providers accordingly. The CHDS requirements document has since been replaced, although current guidance outlined in the new Hospital discharge service: policy and operating model [4] remains consistent with the original in all aspects discussed in this communication.

The model stipulated the number of people to be assigned to each discharge pathway:

- **Pathway 0**: Simple discharge, no input from health/social care (50% of people).
- **Pathway 1**: Support to recover at home; able to return home with support from health and/or social care (45% of people).
- **Pathway 2**: Rehabilitation in a bedded setting (4% of people).
- **Pathway 3**: There has been a life changing event. Home is not an option at point of discharge from acute care (1% of people).

What the authors observed in our two large teaching hospitals based across geographically distinct sites, was that a large proportion of patients surviving COVID-19 had rehabilitation needs, potentially requiring additional support upon discharge. Quantifying the rehabilitation needs of these patients was paramount to inform organisational strategic planning. The authors therefore undertook a clinical review of bed occupancy and predicted discharge pathway as specified in the CHDS guidance. The aims were:

- To record and describe the characteristics of all inpatients at a large NHS Trust in South East London on a single day (17th April 2020).
- To predict the rehabilitation needs of, and discharge pathways for, all inpatients at a large NHS Trust in South East London on a single day (17th April 2020).
- To compare predicted discharge pathways of all inpatients at a large NHS Trust with those specified in the CHDS guidance.

Methods

Using a pragmatic approach, a targeted clinical review to record and report bed occupancy and potential discharge pathway, including rehabilitation need, was undertaken by physiotherapy and occupational therapy teams working in the two hospitals on Friday 17th April 2020. Staff captured information about all inpatients, including those infected with COVID-19 using a standardised *pro forma questionnaire* [supplement 1]. The *pro forma* included questions about patient demographics and bed occupancy, smoking status, comorbidities, pre-admission status, COVID-19 infection status and predicted discharge pathways. Therapists are routinely

assigned wards on which they work. Based on this allocation, therapy staff populated the spreadsheet for patients on their allocated ward using information from patient electronic medical records. All therapists were provided with the CHDS discharge guidance, and asked to use their clinical judgement, in addition to their established experience in hospital discharge planning, to predict individual patient discharge pathways. Race and ethnicity were consolidated to pre-specified fixed categories consistent with government reporting [5].

Therapy staff involved in data collection were qualified physiotherapists and occupational therapists ranging from junior to senior grades (defined as Band 5 to 8a in the NHS terms and conditions of service) with the combined total number across the two hospitals approaching 345 personnel. Clinical leads with oversight of a number of wards were responsible for co-ordinating local allocation and responding to staff queries.

Data were summarised, described, plotted and analysed. The data were non-normally distributed and analysed in Microsoft Excel using nonparametric statistics.

Results

A total of 884 patients were reviewed, of which 394 (45%) had a positive diagnosis of COVID-19. Tables 1 and 2 describe the clinical characteristics of the COVID-19 positive and non-COVID-19 patients.

Seventy-three (19%) of COVID-19 patients were identified as living at home with support (informal carers/family and/or health and social care support) prior to admission. Thirty (8%) were receiving residential/institutional care and two hundred and eighty (71%) were living independently.

One hundred and eleven (28%) of the COVID-19 patient's discharge needs could not be predicted, with the following reasons provided by the therapists: clinical instability, sedated and intubated, too early in the admission.

For patients with COVID-19 the predicted discharge demand for NHSE pathway 0 was 64 (16%). For NHSE pathway 1 predicted discharge demand was 127 (32%), while for pathway 2 it was 41 (10%), and for NHSE pathway 3, it was 51 (13%).

For the non-COVID-19 patients [490 (female: 210, male: 275, missing: 5) median age 68 (IQR: 52–81) years, critical care bed occupancy: 31], eighty-seven (18%) were identified as living at home with support (informal carers/family and/or health and social care support) prior to admission. Nineteen (four percent) were receiving residential/institutional care and three hundred and seventy four (76%) were living independently.

For the non-COVID-19 patients the predicted rehabilitation demand for NHSE pathway 0 was 166 (34%). For NHSE pathway 1 it was 147 (30%) and for NHSE pathway 2 it was 59 (12%) respectively. For NHSE pathway 3, it was 64 (13%).

Table 1
Clinical characteristics of COVID-19 patients.

	COVID-19 positive N = 394	Site 1 N = 273	Site 2 N = 121
Age	Median (IQ range) 69 (57 to 80)	Median (IQ range) 66 (56 to 79)	Median (IQ range) 73 (64 to 85)
Age category	N (%)	N (%)	N (%)
0 to 20	1 (0)	0 (0)	1 (1)
21 to 31	5 (1)	5 (2)	0 (0)
31 to 40	10 (3)	9 (3)	1 (1)
41 to 50	33 (8)	21 (8)	12 (10)
51 to 60	80 (20)	66 (24)	14 (12)
61 to 70	78 (20)	56 (21)	22 (18)
71 to 80	92 (23)	60 (22)	32 (26)
81 to 90	65 (16)	41 (15)	24 (20)
91 to 100	30 (8)	15 (5)	15 (12)
Sex	N (%)	N (%)	N (%)
M:F	226 (57):168 (43)	156 (57):117 (43)	70 (58):51(42)
Smoking status	N (%)	N (%)	N (%)
Smoker (former and current)	113 (29)	69 (25)	44 (36)
Non smoker	266 (68)	191 (70)	75 (62)
Missing	15 (4)	13 (5)	2 (2)
Ethnicity	N (%)	N (%)	N (%)
White	175 (44)	98 (36)	77 (64)
Mixed/multiple ethnic groups	5 (1)	5 (2)	0 (0)
Asian/Asian British	13 (3)	6 (2)	7 (6)
Black/African/Caribbean/Black British	115 (29)	109 (40)	6 (5)
Other ethnic group	40 (10)	37 (13)	3 (2)
Not specified	46 (12)	18 (7)	28 (23)
Comorbidities*	N (%)	N (%)	N (%)
None	52 (13)	39 (14)	13 (11)
Cardiovascular disease	102 (26)	65 (24)	37 (31)
Hypertension	198 (50)	136 (50)	62 (51)
Hypercholesterolemia	52(13)	42 (15)	10 (8)
Chronic Obstructive Pulmonary Disease	31 (8)	19 (7)	12 (10)
Asthma	25 (6)	22 (8)	3 (2)
Respiratory other	13 (3)	8 (3)	5 (4)
Renal disease	69 (18)	50 (18)	19 (16)
Stroke	50 (13)	36 (13)	14 (12)
Neurological (other)	7 (2)	4 (1)	3 (2)
Dementia	52 (13)	33 (12)	19 (16)
Diabetes type 2	129 (33)	90 (33)	39 (32)
Musculoskeletal conditions: Rheum/Non-Rheum	23 (6)/49 (12)	14 (5)/29 (11)	9 (7)/20 (17)
Hepatic disease	13 (3)	13 (5)	0 (0)
Cancer	63 (16)	40 (15)	23 (19)
Other	97 (25)	69 (25)	28 (23)
Cumulative comorbidities	N (%)	N (%)	N (%)
<2	123 (31)	83 (30)	40 (33)
≥2 but <4	172 (44)	123 (45)	49 (40)
≥4	99 (25)	67 (25)	32 (26)
Pre-admission residence	N (%)	N (%)	N (%)
Home, independently living	280 (71)	207 (76)	73 (60)
Home, with additional supported care needs	73 (19)	49 (18)	24 (20)
Residential / institutional care	30 (8)	11 (4)	19 (16)
Unknown	11 (3)	6 (2)	5 (4)
Bed occupancy	N (%)	N (%)	N (%)
Critical care & High Dependency Unit	92 (23)	72 (26)	20 (17)
COVID-19 specialist ward	302 (77)	201 (74)	101 (83)

Due to rounding errors, percentages may not add up to 100.
* Patients may have more than one comorbidity.

Table 2
Clinical characteristics of non-COVID-19 patients.

	Non-COVID-19 N = 490	Site 1 N = 278	Site 2 N = 212
Age	Median (IQ range) 68 (52 to 81)	Median (IQ range) 62 (48 to 75)	Median (IQ range) 72 (58 to 84)
Age category	N (%)	N (%)	N (%)
0 to 20	8 (2)	6 (2)	2 (1)
21 to 31	29 (6)	20 (7)	9 (4)
31 to 40	28 (6)	22 (8)	6 (3)
41 to 50	47 (10)	33 (12)	14 (7)
51 to 60	70 (14)	46 (17)	24 (11)
61 to 70	91 (19)	54 (19)	37 (17)
71 to 80	90 (18)	44 (16)	46 (22)
81 to 90	102 (21)	42 (15)	60 (28)
91 to 100	20 (4)	10 (4)	10 (5)
Missing	5 (1)	1 (0)	4 (2)
Sex	N (%)	N (%)	N (%)
M:F	275 (56):210 (43)	170 (61):107 (39)	105 (50):103 (49)
Missing	5 (1)	1 (0)	4 (2)
Smoking status	N (%)	N (%)	N (%)
Smoker (former and current)	150 (31)	99 (36)	51 (24)
Non smoker	330 (67)	177 (64)	153 (72)
Missing	10 (2)	2 (1)	8 (4)
Ethnicity	N (%)	N (%)	N (%)
White	226 (46)	152 (55)	74 (35)
Mixed/multiple ethnic groups	3 (1)	1 (0)	2 (1)
Asian/Asian British	21(4)	16 (6)	5 (2)
Black/African/Caribbean/Black British	77 (16)	70 (25)	7 (3)
Other ethnic group	9 (2)	5 (2)	4 (2)
Not specified	150 (31)	33 (12)	117 (55)
Missing	4 (1)	1 (0)	3 (1)
Comorbidities*	N (%)	N (%)	N (%)
None	92 (19)	57 (21)	35 (17)
Cardiovascular disease	124 (25)	58 (21)	65 (31)
Hypertension	199 (41)	109 (39)	90 (42)
Hypercholesterolemia	55(11)	22 (8)	33 (16)
Chronic Obstructive Pulmonary Disease	43 (9)	25 (9)	18 (8)
Asthma	38 (8)	18 (6)	20 (9)
Respiratory other	24 (5)	17 (6)	7 (3)
Renal disease	57 (12)	28 (10)	29 (14)
Stroke	46 (9)	25 (9)	21(10)
Neurological (other)	65 (13)	31 (11)	34 (16)
Dementia	40 (8)	19 (7)	21 (10)
Diabetes type 2	105 (21)	60 (22)	45 (21)
Musculoskeletal conditions: Rheum/Non-Rheum	41 (8)/74 (15)	25 (9)/32 (12)	16 (8)/42 (20)
Hepatic disease	22 (4)	15 (5)	7 (3)
Cancer	76 (16)	47 (17)	29 (14)
Other	128 (26)	84 (30)	44 (21)
Missing	1 (0)	0 (0)	1 (0)
Cumulative comorbidities	N (%)	N (%)	N (%)
<2	171 (35)	110 (40)	61 (29)
≥2 but <4	197 (40)	103 (37)	94 (44)
≥4	121 (25)	65 (23)	56 (26)
Missing	1 (0)	0 (0)	1 (1)
Pre-admission residence	N (%)	N (%)	N (%)
Home, independently living	374 (76)	224 (81)	150 (71)
Home, with additional supported care needs	87 (18)	44 (16)	43 (20)

Table 2 (*Continued*)

	Non-COVID-19 N = 490	Site 1 N = 278	Site 2 N = 212
Residential/institutional care	19 (4)	7 (3)	12 (6)
Unknown	10 (2)	3 (1)	7 (3)
Bed occupancy	N (%)	N (%)	N (%)
Critical care & High Dependency Unit	31 (6)	25 (9)	6 (3)
Ward	459 (94)	253 (91)	206 (97)

Due to rounding errors, percentages may not add up to 100.

*Patients may have more than one comorbidity.

The authors were unable to predict the discharge pathway for 54 (11%) of non-COVID-19 patients.

Pooling these data (COVID-19 and non-COVID-19 patients), predicted demand for NHSE pathway 0 was 232 (26%). Predicted demand for NHSE pathway 1 was 272 (31%), while for NHSE pathways 2 and 3, it was 100 (11%) and 117 (13%) respectively on discharge. The predicted discharge demand is summarised in Table 3.

Discussion

The CHDS [3] and the updated document which recently replaced it [4] outlines a "discharge to assess" model of service delivery with four distinct discharge pathways applicable to all NHS inpatients. The cross-sectional data presented in this targeted clinical review provide evidence that the percentage of people predicted to be discharged with pathway 2 (bedded rehabilitation need) and pathway 3 (unable to return home) needs substantially exceeds those set out in the national discharge to assess model (CHDS). This notable departure from national estimates, and the potential impact of this demand for both post-acute service providers and patients, is concerning. This is because bedded rehabilitation and institutional care facilities such as nursing and residential care homes are a finite resource, as are the staff required to service them.

Key finding

To our knowledge, this is the first explorative data matching nationally mandated discharge pathways to predictions made in real-time within an acute hospital Trust. Our analysis highlights the need for robust, systematic assessment of demand and capacity within community and bed-based rehabilitative supportive interventions for patients following COVID-19 in order to plan for any future periods of high hospital acute admissions.

These data, captured on a single day in a large London NHS Trust, suggest that the number of COVID-19 patients requiring post – discharge rehabilitation exceeds estimates laid out in the CHDS guidance (which applied to *all* hospital inpatients).

Of the COVID-19 patients included in this report, 47% were over 71 years old, and there was increased prevalence of COVID-19 in people of Black/African/Caribbean/Black British ethnicity and those with type 2 diabetes.

It must be acknowledged that patients admitted with COVID-19 predicted to need extra supportive pathways might be overestimated, as the data in Table 3 is reported as absolute numbers, without adjusting for pre admission residence (which could be argued, is a proxy measure of health and social care needs). Conservatively, if it is assumed that of those admitted with COIVD-19 from residential/institutional care (eight percent) were discharged back to pre-admission care setting, the predicted discharge demand on pathway 3 would reduce from 13% to 5%. However, this remains five times greater than the anticipated CHDS capacity.

Conversely, if one adjusts for those admitted with COVID-19 from home with no documented therapy needs (71%), assuming that they are discharged to pathway 0 (71% *vs* 16%) or pathway 2 (71% *vs* 32%), our model may be underestimating both the acute and the long term rehabilitative demands of COVID-19 across the sector.

Although it is not entirely clear, the CHDS appears to provide "addition funding, alongside existing use of local authority and Clinical Commissioning Group (CCG) budgets to help cover the cost of post-discharge recovery and support services in addition to what was provided prior to admission¨(section 2.6) [4]. The CHDS prediction model therefore predicts 'new' membership within each pathway at the end of admission. Even with conservative assumptions, our data suggest that 'new' membership is in excess of that predicted in the CHDS model. Our findings highlight potential limitations in the assumption that "individuals would be expected to return to ¨the quality of life they had prior to their most recent admissionäccording to the CHDS, and would not count as new members of those pathways, since funding for their needs would already have been established.

Our pooled data of COVID-19 and non COVID-19 patients suggests that the demand for supportive and bed based rehabilitative services were in excess of that described in the national discharge to assess model (CHDS). The data the authors captured during the 'acute', first wave of the COVID-19 crisis draws attention to an issue around the availability of community and bed-based rehabilitative interventions. Our COVID-19 and non COVID-19 patients exhibited a high prevalence of multi-morbidity; COVID-19 ≥ 2 comorbidities = 69% and non COVID-19 ≥ 2 comorbidities = 65%.

Table 3
Predicted discharge demand.

Pathway	Predicted CHDS capacity[a] %	Covid-19 patient predicted demand ($n = 394$) %[a]	Non Covid-19 patient predicted demand ($n = 490$) %	Pooled patient predicted demand ($n = 884$) %
Unable to predict	N/A	28	11	19
0	**50**	16	34	26
1	**45**	32	30	31
2	**4**	10	12	11
3	**1**	13	13	13

Predicted capacity as defined by the CHDS discharge to assess pathway [2].

  [a] Due to rounding errors, percentages may not add up to 100.

Recognition of additional demand for bedded rehabilitation and institutional care beyond current planning estimates may serve useful in future planning during further periods of high acute hospital admissions. Furthermore, our findings pose a number of questions. First, is this observed rehabilitation need reflective of the increase in critical care beds generated capacity? Second, do these data reflect wider national/regional rehabilitation needs?

Limitations

In this report, the authors provide clinically informed predictions for discharge based on therapists' expert clinical judgement, rather than actual patient discharge destinations, and as such interpretation of our findings should be cautious. While predicting discharge was imperative to the Trust's ongoing clinical and strategic response to COVID-19, the resulting data acts as an exemplar to further explore generalisability of these data across the UK. Future explorations could benefit from comparing the expert clinical judgement of experienced therapists with capturing actual discharge destinations. However, our findings highlight that for many COVID-19 patients, experienced clinical therapists, who play a central role in discharge planning, predicted increased rehabilitation needs.

Additionally, staff were asked to use their professional judgement in order to predict the discharge pathway, and were not directed towards particular questions to assist decision making. While such an approach is routine and reflective of daily practice, it may account for some variation in the discharge destination proportions described. Furthermore, the staff ranged between Band 5 to 8a, and this difference in level of experience may have contributed to additional variance in precision of decisions. This variability in experience is typical of many clinical settings, but it may have reduced the objectivity of our method.

The data presented in this report suggest the necessity for core outcome measures that specifically identify rehabilitation need, in order to support clinical judgements and underpin more timely and effective discharge planning. This review and its analysis was undertaken rapidly so as to offer the greatest clinical utility during an emergency response. It was not possible to complete a more detailed analysis of patient needs within the specified pathways, for example, the use of a validated tool for categorising patient rehabilitation complexity such as the RCS-E [6]. Such a sub-analysis would provide valuable information regarding the *type* of bedded rehabilitation required and allow for more precise planning.

Conclusion

In response to the COVID-19 pandemic, the NHS and UK government issued guidance for the repurposing of NHS services, staffing and capacity. Hospitals were required to categorise patient discharge needs (including rehabilitation) and expedite safe discharge in order to make available beds for patients with acute care needs. Although this guidance has subsequently been replaced, these requirements remain in place. Data collected in an NHS Trust in London from two large teaching hospitals across geographically different sites, suggested a demand–capacity mismatch between the number of patients with bedded rehabilitation needs and national guidance.

Ethical approval: Ethical approval was not required for this study as all patients were receiving routine care provided by King's College Hospital NHS Foundation Trust. Local approvals were obtained prior to undertaking this service evaluation.

Conflicts of interest: None declared.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.physio.2021.03.007.

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