The Networked Data Lab

Topic 4: Intermediate Care Final Report

NDL - *Cheshire & Merseyside lab*

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Glossary

ASC	Adult Social Care
ASCD	Adult Social Care Dataset
C&M	Cheshire and Merseyside
CSDS	Community Services Data Set
EHR	Electronic Health Record
IC	Intermediate Care
ICB	Integrated Care Board
ICRAS	Integrated Community Reablement and Assessment Service
IMD	Index of Multiple Deprivation
LSOA	Lower Super Output Area
MHLDSC	Mental Health, Community and Learning Disability Collaborative
NWAS	North West Ambulance Service
SUS-APCS	Secondary Uses Service – Admitted Patient Care Spells
SUS-ECDS	Secondary Uses Service – Emergency Care Data Set
UPRN	Unique Property Reference Number
PSM	Propensity Score Matching
LTC	Long-Term Conditions

Contents

1. Introduction

Intermediate care (IC) provides support for a short time to help people recover and increase their independence following a hospital admission. It includes reablement, crisis response, home-based, and bed-based support. It is usually provided by a mix of health and social care professionals with a range of different skills including nurses, social workers, doctors, and a range of therapists.

Cheshire & Merseyside Integrated Care Board covers a geographical area in the North West of England, with a population of 2.7 million people, 17 NHS Trusts, 349 GP practices, and 9 local authorities. Within Cheshire & Merseyside we have focused on the Liverpool area **(Liverpool Place)** due to data availability and existing engagement from Intermediate Care & Social Care services. The Integrated Community Reablement and Assessment Service (ICRAS) is commissioned by Mersey Care and includes inpatient Intermediate Care beds (Hub Rehabilitation Units across Liverpool), as well as community services across Liverpool and South Sefton.

The ICRAS team at Mersey Care manage the overall package of care for patients. This team is pivotal in ensuring seamless care transitions, managing both health care aspects to address the holistic needs of patients. Specifically, the ICRAS team is responsible for delivering the healthcare services involved, ensuring medical, rehabilitation, and recovery needs are met. In parallel, Liverpool City Council plays a crucial role by providing the necessary social care services. Their involvement ensures that aspects such as home adaptations, social support, and long-term care planning are addressed, contributing to a well-rounded care approach. A key feature of this model is the situational assessments for discharge, which the ICRAS team performs. These assessments are critical for understanding the specific needs of each patient and planning the subsequent steps in their care journey. Initial video triage is carried out by ImmediCare (independent sector triage service) although specific data regarding this process is not available. To ensure effective decision-making and resource allocation, a network of key decision-makers has been meticulously mapped out for the Liverpool Place IC services. Three Intermediate Care Facilities: Granby, Sedgemoor & Townsend provide a range of care services and each facility is equipped with 30 beds to offer a supportive environment for patients during their recovery.

There is an ongoing system-wide Intermediate Care transformation project in train in C&M, with the transformation lead being one of our key stakeholders. This transformation project was designed to coalesce around a single Intermediate Care model across the ICS. To enable this the team needed to identify the patients, capture the volume (and demographics) of those entering intermediate care pathways, and subsequently look at the outcomes for these cohorts. Following this insight being generated, the ICB can design and embed a consistent integrated care pathway across C&M geography. These analytical challenges were tackled as part of the our NDL scope.

Aims and objectives

The aim of this project is to link routinely collected health and social care data for Liverpool in order to better understand who is using IC, what is being delivered as IC (and to whom), and if it possible to detect any impact of IC on patient outcomes.

Objective 1. Establish linkage between health (NHS) and social care (local authority) datasets and use this to identify individuals on alternative pathways of care.

Objective 2. Describe and explore the demographic and health characteristics of people on the alternative pathways of care.

Objective 3. Describe different forms of IC services received and explore how the intensity of support received is related to individual level of need.

Objective 4. Compare the characteristics of patients receiving home-based or bed-based IC support and those without an assigned pathway.

Objective 5. Explore the impact of IC by comparing the health outcomes of those who received it with (clinically/demographically) similar people who did not receive it.

2. Methods

2.1 PPIE and stakeholder engagement

On 7th March 2024, we hosted an engagement session with local stakeholders to discuss our initial results and gather their feedback on how this information might be leveraged to enhance Intermediate Care services in the C&M area. The meeting brought together key local stakeholders, including the Head of Transformation at Cheshire and Merseyside Mental Health, Community and Learning Disability Collaborative (MHLDSC) Provider Collaborative, the Clinical Lead for Integration at Liverpool Place, and a Senior Analyst from the Intelligence & Analytics Team at Liverpool City Council. This diverse panel offered a wealth of insights to understand the current landscape of health and social care, considerations for how IC is captured in electronic health records in the region and identifying opportunities for improvement. Building on this valuable dialogue, a follow-up meeting has been scheduled for 28th March. We will use this opportunity to further refine the analysis for objectives 3, 4, and 5.

A patients and public involvement workshop is planned for late spring where we will present the results and discuss interpretation and implications for service improvement.

2.2 Data extraction & processing

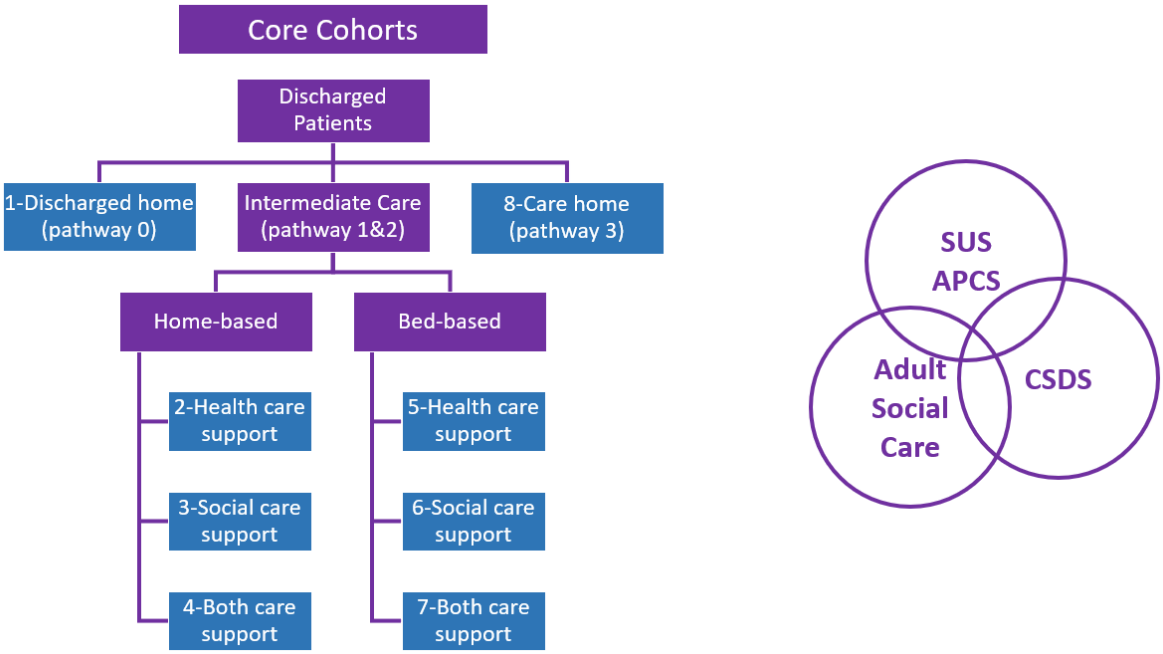
Data on IC services have been linked with routinely collected electronic health record (EHR) data sources within the C&M ICB Secure Data Environment. Linkage is only possible for individuals with an NHS number which currently stands at 98% in Cheshire & Merseyside.

Datasets below have been linked using a pseudonymised key:
NHS - Primary care data
NHS - Secondary Uses Service – Admitted Patient Care Spells (SUS-APCS)
NHS - Community Services Data Set (CSDS) inc. ICRAS
NHS - Secondary Uses Service – Emergency Care Data Set (SUS-ECDS)
NHS – North-West Ambulance Service (NWAS) - 111 calls
Local Authority Adult Social Care - ASCD (Adult Social Care Dataset)
Open data linked to LSOAs – Index of Multiple Deprivation (IMD) 2019 (Ministry of Housing, Communities & Local Government, 2019).

Table 1 (in section 2.3.4 below) and Appendix 1 contain additional details of the variables extracted from each dataset used.

To establish linkage between health (NHS) and social care (local authority) datasets and use this to identify individuals on alternative pathways of care, we first created the intermediate care 'core cohorts' (shown in Figure 1). To do this we linked Acute data (SUS-APCS) (to identify people who had been discharged from an inpatient hospital admission, between April 2021 and December 2022) with the community and social care data, CSDC and ASC dataset respectively (to identify IC received).

Figure 1: Patient Pathways and Care Integration following hospital discharge logic outline



The patient cohorts have been aligned with the IC pathways described below:

0 –Discharged home without IC

1 – Discharged home with IC

2 – Discharged to bed-based IC

3 – Discharged into a care home

4 – Not enough information to assign pathway

<u>Discharged to home without IC (Pathway 0)</u>

This includes patients that have been discharged to their usual place of residence and have not been referred to/accessed IC. The inclusion criteria for this cohort are:

- Discharged from hospital between April 2021 and December 2022.
- Secondary care records (SUS) indicate discharge to usual residence.

- No record of accessing IC in community care (CSDS) or social care (ASC) records within 7 days of discharge.

Discharged to home or to bed-based care with IC (Pathways 1 & 2)

This includes patients who have accessed IC following hospital discharge. IC delivered in usual place of residence or bed-based care is included. The inclusion criteria for this cohort are:

- Discharged from hospital between April 2021 and December 2022.
- Secondary care records (SUS) indicate discharge to usual residence or alternative short-term facility (i.e. not a care home).
- Record of accessing IC in community care (CSDS) or social care (ASC) records within 7 days of discharge. Patient's access to CSDS care defined as a referral that occurs within 7 days following patient's discharge, and this referral must result in a care contact where the patient is present for the scheduled appointment. Appendix 2 provides further details on the approach used for assigning pathways to each patient with available IC information in APCS, CSDS and ASC datasets.

Discharged into a care home (Pathway 3)

This includes patients that have been discharged to a residential care home. They have not referred for IC because they already have long-term care provision established. The inclusion criteria for this cohort are:

- Discharged from hospital between April 2021 and December 2022.
- Secondary care records (SUS) indicate discharge to a residential care home.

Not enough information to assign pathway (Pathway 4)

This refers to patients who were discharged from the hospital, but the destination code was not sufficient for assigning a specific pathway. Integration with CSDS and ASC data was not successfully performed for these patients. The inclusion criteria for this cohort are:

- Discharged from hospital between April 2021 and December 2022.
- Secondary care records (SUS) where discharge destination could not indicate a specific pathway (e.g. discharge destination not coded)
- No record of accessing IC in community care (CSDS) or social care (ASC) records within 7 days of discharge.

2.3 Data analysis

2.3.1 Study design

This is a retrospective cohort study including quantitative analysis of electronic health record data that is underpinned by insights from IC clinical staff and managerial staff across IC services within Mersey Care.

2.3.2 Study period

The study includes data from patients discharged from hospital during a 1 year and 9 months period of April 2021- December 2022 inclusive. The outcome variables (see Section 3.4) include the period up to March 2023 so that we can explore at least 3-month outcomes for all patients. We have restricted the study period to predominantly post-COVID lockdowns (the second national lockdown ended in July 2021) so that we can better understand the current state-of-play for IC services.

2.3.3 Study population

The study cohort consists of individuals discharged from the Liverpool University Hospitals NHS Foundation Trust (provider code = REM) between April 2021 and December 2022, specifically targeting those aged 18 and over. To align with our research goals, we selected our dataset with the following criteria:

- Exclusion of all maternity-related admissions, specifically those with Admission Method codes 31 and 32.
- Inclusion of Elective and Emergency admissions, as well as transfers from other hospitals that are not classified as emergencies, indicated by Der_Management_Type codes EL, EM, and NE.
- The cohort is limited to admissions of patients categorized under NHS and Amenity care, with Administrative Category codes 01 and 03.
- Exclusion of any admissions resulting in the death of the patient, indicated by a Discharge Method code 4.

2.3.4 Definitions of outcomes and exposures

In Table 1, patient demographic and health characteristics alongside outcome variables are defined, drawing from a variety of datasets to offer a comprehensive overview. Age, sex, and ethnicity data are sourced from the SUS-APCS dataset, while living arrangements such as living alone, with those under 18, or the total number of people in a household come from Primary Care records. Additionally, date of death within 30, 60, and 90 days post-discharge is tracked through Primary Care, providing essential mortality data.

Geographical data, including the LSOA 2011 areas and indices of deprivation, are also derived from SUS-APCS. The length of the index hospital admission is calculated based on the interval between admission and discharge, while levels of frailty and long-term conditions (LTCs) such as hypertension, cancer, and diabetes, among others, are documented via Primary Care data.

Outcomes are measured in terms of readmissions to acute settings, the time to such readmissions, and contacts with primary care, A&E, and the 111 call service within 30 days after hospital discharge. Moreover, the period between discharge and the initiation of IC is considered, as well as the overall length of engagement with these services. The selected outcomes provide a comprehensive understanding of patient care transitions and resource utilisation.

Table 1: Definitions of patient's Demographic, Health characteristics and Outcomes

Outcome/exposure variables	Definition criteria	Dataset(s) from which the variable is derived
Demographic and Health characteristics		
Age	Age	SUS-APCS
Sex	Sex	SUS-APCS
Ethnicity	Ethnicity	SUS-APCS
Living Alone	Living Alone (binary) - derived from the primary care UPRN data.	Primary Care
Living with Under 18	Living with Under 18 (binary) - derived from the primary care UPRN data.	Primary Care
Total people in Household	Number of people living in Household - derived from the primary care UPRN data.	Primary Care
Date of Death	Date of Death (within 30, 60 and 90 days of hospital discharge)	Primary Care
Geography	LSOA 2011	SUS-APCS
Deprivation IMD	Deprivation IMD 2019	SUS-APCS
Length of index hospital admission	Number of days between admission and discharge of first admission in the study period	SUS-APCS
Frailty	Frailty score (Score, 4 levels of frailty: Fit, Mild frailty, Moderate frailty, Severely frail)	Primary Care
LTCs	Long Term conditions (binary)	Primary Care
Health Conditions	Hypertension, Cancer, Diabetes, CVD, Heart failure, CKD, Asthma, COPD, Depression (binary)	Primary Care
Outcomes		
Readmission	Readmission to Acute setting within 30, 60 and 90 days of hospital discharge	SUS-APCS
Time to readmission	Readmission to acute setting following index admission	SUS-APCS
Engagement with Primary Care within 30 days after discharge	Count of GP events	Primary Care
Attendance at A&E within 30 days after discharge	Count of attendances	SUS-ECDS

Engagement with 111 call service within 30 days after discharge	Count of 111 calls	NWAS
Time between discharge and initiation of IC	Time between discharge and initiation of IC	SUS-APCS, CSDS, ASC
Length of engagement with service	Length of engagement with service: Time between first and last contact/event	CSDS, ASC
Patients requiring >91 days of support at home	Patients requiring >91 days of support at home	CSDS, ASC

2.3.5 Statistical approaches

All analysis has been carried out within the C&M ICB Secure Data Environment using R and RStudio.

Objective 2. Describe and explore the demographic and health characteristics of people on the alternative pathways of care.

Descriptive statistical methods form the base of the Objective 2 analysis. Through the use of frequencies and percentages, we outlined the distribution of hospital discharges, highlighting the majority that return home without IC support and those that engage with various forms of IC. This approach extends to the detailed demographic breakdown of the IC cohort, including sex, age, ethnic group, and deprivation based on the Index of Multiple Deprivation (IMD). We also generated descriptive statistics for health characteristics of the sample including prevalence of comorbidities, frailty, and length of stay in IC settings, providing a comprehensive snapshot of the patient population.

We employed subgroup analysis to compare characteristics and outcomes across different cohorts within the IC population, specifically between those receiving community care and social care support. This involves comparing proportions (for demographic variables) and means or medians (for continuous variables like length of stay) to explore similarities and differences between groups.

To study the patient pathways into home-based IC support and bed-based IC support, we analysed the demographic profiles, household compositions, deprivation levels, health conditions, and frailty levels across these pathways. Comparative analysis here aimed to reveal the nuances of care needs and service utilisation among different patient groups, facilitated by descriptive statistics to highlight the distribution of patient characteristics within each IC pathway.

Objective 3. Describe different forms of IC services received and explore how the intensity of support received is related to individual level of need.

We developed an operational definition for level of need based on the duration of index hospital admission and frailty to explore IC received at different levels of need.

Levels of Need

- Low: Patients with short hospital stays (less than 21 days, (NHS England, 2024)) and low frailty scores (Fit, Mild frailty).
- Moderate: Patients with longer hospital stays (over 21 days) and low frailty scores (Fit, Mild frailty).
- High: All patients with moderate frailty scores including patients with short hospital stays (less than 21 days) and severe frailty scores.
- Very high: Patients with longer hospital stays (over 21 days) and severe frailty scores.

To analyse the intensity of support received, descriptive statistics (mean, median) have been generated for the length of engagement with IC services and the proportion of patients requiring extended support (>91 days) has been calculated. Subgroup analyses were conducted to compare these metrics across the different levels of need and within the different IC pathways.

Correlation analysis have been used to explore the relationship between the frailty score and the number of engagement points with health services post-discharge (e.g., GP contact, A&E attendance , call to 111 service).

Objective 4. Compare the characteristics of patients receiving home-based or bed-based IC support and those without an assigned pathway.

It is possible that the patients who could not be assigned to an IC pathway due to insufficient data are not random and actually represent a distinct subgroup of the population. This objective aims to explore similarities and differences between those with no assigned IC pathway (pathway 4) and those who received IC (pathway 1 and 2). We compared proportions (for demographic variables) and means or medians (for continuous variables like length of stay in IC setting) to identify significant trends and differences. We used levels of need (see Objective 3) to explore whether patients of pathway 4 have similar characteristic to patients who received home-based or bed-based IC support.

Objective 5. Evaluate the impact of IC by comparing the health outcomes of those who received it with (clinically/demographically) similar people who did not receive it.

We investigated the impact of IC services on hospital readmission rates within 90 days post-discharge. First, we used a logistic regression model to estimate the probability of receiving IC based on patient characteristics, including age, gender, length of stay in hospital (LoS), frailty score, LTCs count, ethnicity, living alone and IMD 2019 score.

$$\log(p/1-p) = \beta 0 + \beta 1 \cdot \text{Age} + \beta 2 \cdot \text{Female} + \beta 3 \cdot \log(\text{LoS}) + \beta 4 \cdot \text{FrailtyGroupMind} + \beta 5 \cdot \text{FrailtyGroupModerate} + \beta 6 \cdot \text{FrailtyGroupHigh} + \beta 7 \cdot \text{LTCs} + \beta 8 \cdot \text{EthnicMinorities} + \beta 9 \cdot \text{LivingAlone} + \beta 10 \cdot \text{IMD\_Score}$$

where p is the probability of receiving IC support.

Patients are then assigned to the IC pathways, and their outcomes, particularly mortality and readmission rates, are examined through a weighted Cox proportional hazards model, adjusting for potential confounders using inverse probability of treatment weighting (IPTW). The primary objective is to assess how different IC services affect the risk of mortality and

readmission, accounting for various patient characteristics and health conditions. Survival analysis, complemented by Kaplan-Meier curves and adjusted through propensity score weighting, offer us insights into the effectiveness of IC support in reducing readmissions.

We used statistical matching-based approaches to construct a cohort of people from pathway 0 who are similar to those who did receive IC (pathway 1 and 2) but did not receive it. We compared the outcomes for people who received IC to a cohort who did not receive IC to estimate the impact of receiving IC on the outcomes.

2.3.6 Methods for addressing missing data

Missing data was rare (<10%) so no imputation was conducted.

3. Results

3.1 Descriptive analysis of intermediate care cohort

Figure 2 presents a detailed overview of hospital discharge pathways over the study period. A total of 91,444 hospital discharges are accounted for, with the majority, 82,916 (90.7%), being sent home without receiving any type of IC support. A significant number, 5,805 (6.3%), received IC, highlighting a pathway that includes a more coordinated approach to patient aftercare (pathways 1 or 2). Notably, 2,431 received IC via community care, and 2,853 received IC via adult social care, indicating a substantial crossover with community and social services post-discharge. There were 521 cases where patients received IC services from both community and social care, which may indicate the presence of complex care needs. Discharges to care homes were recorded for 872 patients (pathways 3).

A smaller subset of the cohort, consisting of 1,089 patients identified as "No IC," appears to have received IC support according to discharge destination codes, yet could not be matched with any records from CSDS and ASC. Additionally, another group of 762 patients, categorized as "Other," represents various discharge destinations that do not align with a specific care pathway and also could not be linked to CSDS and ASC records. These groups are combined into a single cohort, referred to as pathway 4, which is subject to further analysis in Objective 4.

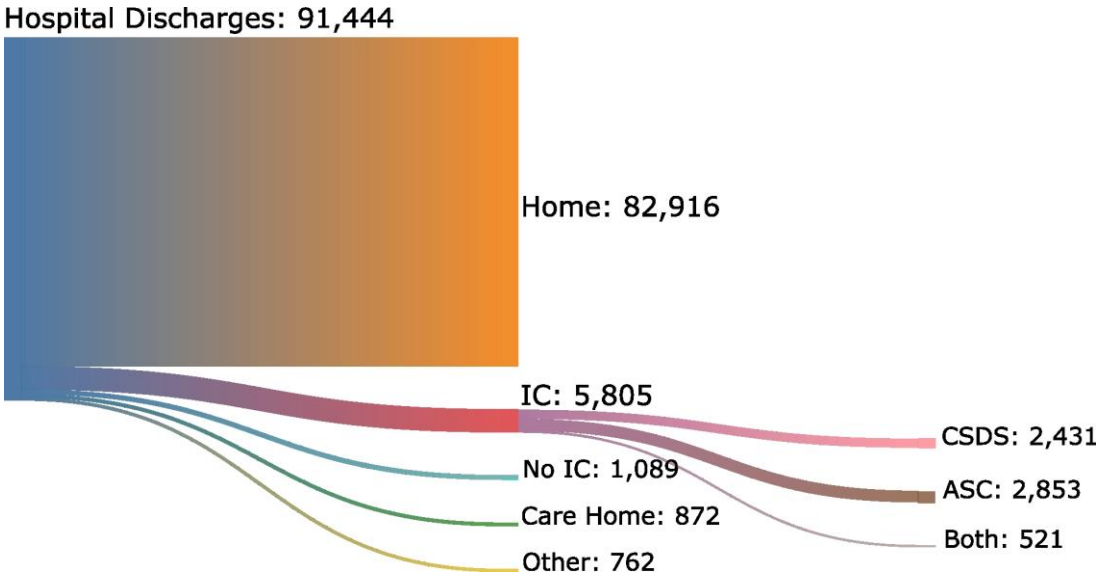


Figure 2: Overview of Post-Discharge Patient Pathways and Integrated Care Involvement

Focussing on the 5,805 patients who received IC (Table 2), there was a higher proportion of females (59%) compared to males (41%) (see Figure 3). The age distribution indicates a larger number of older adults, with the highest percentages in the 80-84 (20.4%) and 85-89 (19.2%) age groups, followed by those over 90 years of age (13.7%). A vast majority of the cohort is identified as White (92.6%), which is greater than the general population of Liverpool, where 84% of the population are White (Liverpool City Council, 2024). The data reflects a significant trend toward higher service usage in the most deprived category, with 63.6% of patients coming from the 5th (most deprived) IMD quintile(national level). This is comparable to the general population of Liverpool, where 63% of residents live in LSOAs ranked as the most deprived. The mean length of stay in intermediate care is 27.6 days, with a median of 21 days. Comorbidity prevalence is high, with cardiovascular diseases (62%) and hypertension (60.6%) being the most common, followed by other conditions such as diabetes (27.9%) and chronic kidney disease (38.2%). Additionally, the cohort includes a substantial number of patients, 92.4%, who are living with at least one long-term condition (LTC). In terms of frailty within the cohort, 31.9% are identified as severely frail, while a substantial portion, 18%, fall into the moderately frail category.

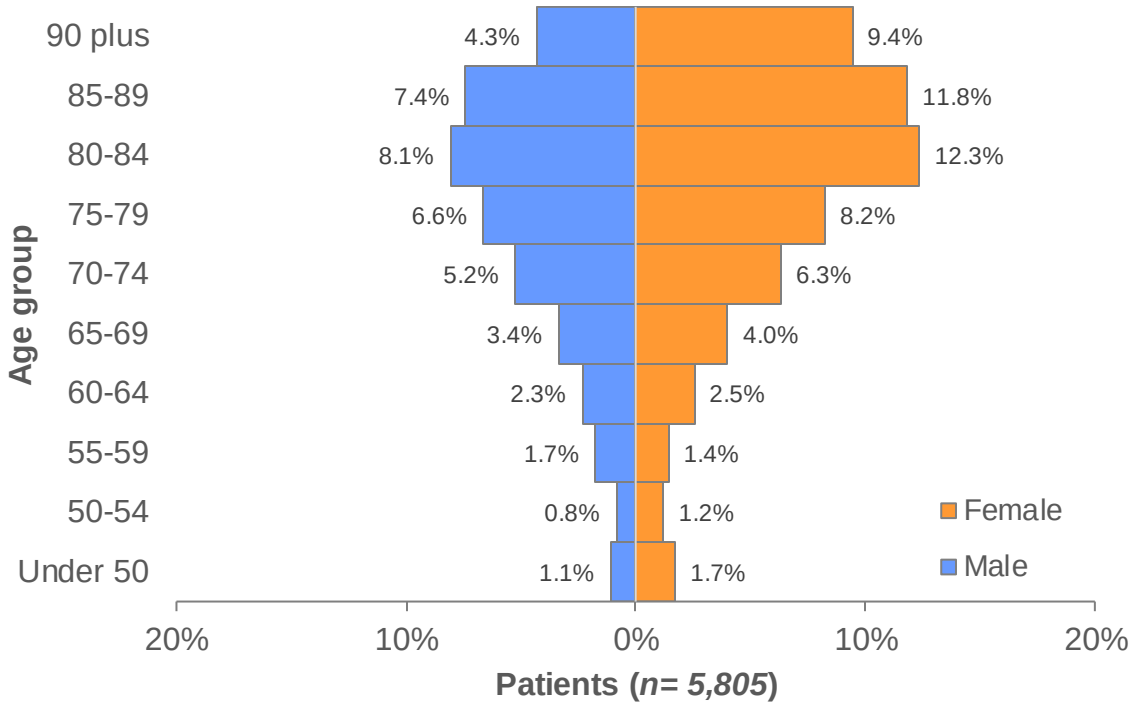


Figure 3: Cross-tabulation of sex distribution across different age groups.

The data comparison between the CSDS (n=2,952) and ASC (n=3,374) cohorts reveals several noteworthy differences. Both groups have a higher percentage of females, with 58.9% in the CSDS and 59.6% in the ASC cohort, indicating a greater use of IC by women. Age-wise, the most substantial representation is among the older populations, particularly in the 80-84 and 85-89 age groups, which shows the increasing need for care services as age progresses. Notably, the ASC cohort has a slightly higher percentage of individuals over the age of 90, compared to the CSDS cohort.

A striking difference is observed in the Index of Multiple Deprivation (IMD) quintile, where a larger percentage of the ASC cohort falls into the most deprived quintile nationally (67.5%) compared to the CSDS cohort (59.7%), indicating that those with higher deprivation levels are more likely to utilise ASC services. This also reflects the high level of deprivation in Liverpool, where 145 of 298 LSOAs (49%) in Liverpool are in the most deprived 10% nationally (Liverpool City Council, 2020).

In terms of health conditions, both cohorts show a high prevalence of hypertension and cardiovascular diseases, underlining the burden of these chronic conditions on care services. However, there is a notable difference in heart failure and CKD, with the ASC cohort showing higher percentages, which could suggest a trend of more severe conditions being managed within ASC settings.

Furthermore, the ASC cohort shows a higher percentage of severe frailty at 34.4% versus 29.9% in the CSDS cohort, which aligns with the increased need for adult social care services among the more frail population.

The mean length of stay for the CSDS cohort is 21.2 days, while the ASC cohort averages a longer stay at 29 days. The median stay, which provides a midpoint of the data and can be less

affected by outliers, is 10 days for CSDS patients and almost three times longer for those in ASC care at 26 days.

Table 2: Overview of intermediate care cohort including CSDS and ASC cohorts.

	IC Cohort (n=5,805)		**CSDS (n=2,952*)**		**ASC (n=3,374*)**	
	n	%	n	%	n	%
Sex						
Male	2,379	41.0%	1213	41.1%	1363	40.4%
Female	3,426	59.0%	1739	58.9%	2011	59.6%
Age group						
Under 50	163	2.8%	129	4.4%	42	1.2%
50-54	120	2.1%	68	2.3%	60	1.8%
55-59	184	3.2%	92	3.1%	104	3.1%
60-64	283	4.9%	148	5.0%	154	4.6%
65-69	428	7.4%	226	7.7%	237	7.0%
70-74	671	11.6%	357	12.1%	369	10.9%
75-79	862	14.8%	416	14.1%	532	15.8%
80-84	1,183	20.4%	598	20.3%	693	20.5%
85-89	1,113	19.2%	549	18.6%	674	20.0%
90+	798	13.7%	369	12.5%	509	15.1%
Ethnic group						
Asian or Asian British	38	0.7%	17	0.6%	23	0.7%
Black or Black British	76	1.3%	34	1.2%	51	1.5%
Mixed	23	0.4%	13	0.4%	13	0.4%
Other	66	1.1%	31	1.1%	41	1.2%
White	5,377	92.6%	2713	91.9%	3148	93.3%
Not Stated	225	3.9%	144	4.9%	98	2.9%
IMD quintile						
1 – least deprived	130	2.2%	84	2.8%	52	1.5%
2	660	11.4%	381	12.9%	333	9.9%
3	499	8.6%	284	9.6%	258	7.6%
4	514	8.9%	245	8.3%	319	9.5%
5 – most deprived	3,690	63.6%	1761	59.7%	2276	67.5%
NA	312	5.3%	197	6.7%	136	4.0%
Length of Stay in intermediate care						
Mean (SD)	27.6	-	21.2	-	29	-
Median (IQR)	21	-	10	-	26	-
LTCs,Co-morbidities						
LTCs	5362	92.4%	2724	92.3%	3123	92.6%
Hypertension	3520	60.6%	1757	59.5%	2102	62.3%
Cancer	811	14.0%	500	16.9%	379	11.2%
Diabetes	1622	27.9%	826	28.0%	947	28.1%
CVD	3602	62.0%	1825	61.8%	2105	62.4%
Heart Failure	3099	53.4%	1608	54.5%	1790	53.1%
CKD	2215	38.2%	1090	36.9%	1336	39.6%
Asthma	1777	30.6%	980	33.2%	956	28.3%

COPD	1239	21.3%	650	22.0%	702	20.8%
Depression	1376	23.7%	737	25.0%	764	22.6%
Frailty						
Fit	1823	31.4%	975	33.0%	1004	29.8%
Mild frailty	716	12.3%	372	12.6%	393	11.6%
Moderate	1046	18.0%	516	17.5%	615	18.2%
Severely frail	1850	31.9%	882	29.9%	1161	34.4%
NA	370	6.4%	207	7.0%	201	6.0%
Total people in Household (HH)						
Up to 4 people living in HH (includes Living Alone)	4503	77.6%	2381	80.7%	2519	74.7%
Over 4 people living in HH	830	14.3%	346	11.7%	575	17.0%
Living Alone						
Yes	2296	39.6%	1114	37.7%	1402	41.6%
NA	472	8.1%	225	7.6%	280	8.3%

** Within each cohort, a subset of 521 patients was identified as having received care services from both the CSDS and ASC.*

In the household composition analysis of the cohorts (Table 2), a clear majority, representing 77.6%, reside in households with up to four individuals. This trend is more pronounced in the CSDS cohort, where 80.7% live in households of this size, compared to 74.7% in the ASC cohort. Conversely, households with more than four individuals account for 14.3% of the whole IC cohort, with the ASC cohort showing a higher proportion at 17.0% compared to 11.7% in the CSDS group.

Figure 4 illustrates statistics on living arrangements for the IC cohort, revealing that a vast majority of patients, at 99.3%, do not have a carer, recorded in their primary care record. A small percentage, 4.6%, report living with someone under the age of 18, suggesting few cohabit with children or young dependents. Interestingly, the group living alone accounts for 39.6%, indicating a significant portion of the cohort possibly faces the challenges of managing their health independently. Within the IC cohort, the proportion of people living alone is slightly higher in the ASC group (41.6%) than the CSDS group (37.7%).

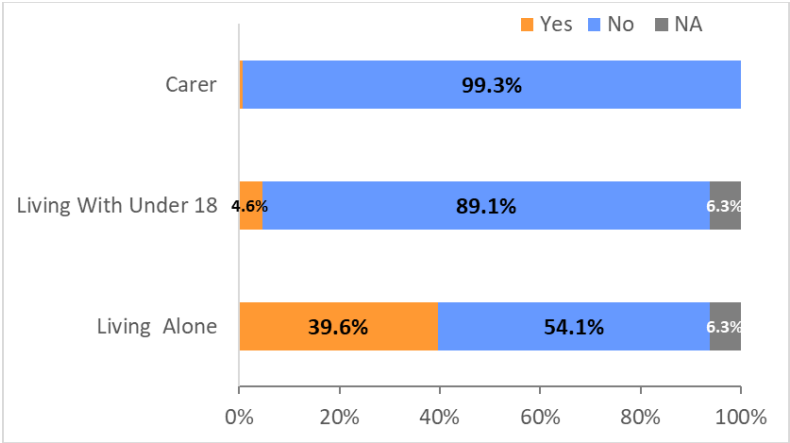


Figure 4: Living arrangements for the Intermediate Care cohort.

3.2 Descriptive analysis of intermediate care pathways

In the subsequent phase of our analysis concerning the community and social care intermediate care cohorts, we delineated two primary patient pathways: Home-Based IC support (Pathway 1) and Bed-Based IC support (Pathway 2). Additionally, a subset of patients for whom the specific nature of IC support—whether at home or bed-based—remains undetermined (Pathway 1/2).

Table 3 presents the distribution of intermediate care support across two distinct pathways: Pathway 1 & 2, highlighting differences in gender, age groups, and the type of care received—home-based or bed-based. In Pathway 1, comprising 5,018 individuals, there's a noticeable predominance of female patients, who make up 58.9% of this group, compared to 41.1% male. This gender distribution is similarly observed in Pathway 2 (n=576), with females at 57.8% and males slightly higher at 42.2% than in Pathway 1. The subset within Pathway 1/2 (n=211) underscores a more significant female majority at 64.9%.

Age-wise, the data shows a shift towards older age groups, especially notable in the 80-89 age group, representing the largest segment in both Pathways 1 and 2, underscoring the heightened need for intermediate care amongst the elderly. Interestingly, the 90+ age group constitutes a substantial portion across all pathways, with its highest representation in Pathway 2 at 19.8%.

We observe a majority residing in households with up to four people, 79.6% for Pathway 1 and 61.3% for Pathway 2. However, there's a notable shift in Pathway 2 and Pathway 1/2, where a greater proportion of patients live in households with over 4 people.

The deprivation, indicated by IMD quintiles, shows a significant majority from the most deprived quintile, especially pronounced in Pathway 2 at 65.8%, suggesting socioeconomic factors play a crucial role in the need for and type of intermediate care received.

Health conditions and co-morbidities highlight the prevalent health challenges faced by these cohorts. Hypertension and cardiovascular conditions are notably high across all pathways. However, Pathway 1/2 patients show a higher prevalence of hypertension (67.3%), indicating specific health profiles within this subgroup. Furthermore, the length of stay in intermediate care settings varies, with Pathway 2 and 1/2 showing longer stays, reflecting perhaps more intensive care needs or complexities in patient conditions.

The distribution of frailty levels across pathways highlights the vulnerability within these populations, with a significant portion classified as severely frail, especially in Pathway 1/2 at 35.5%. Having said this, there were comparable proportions of people without frailty and severe frailty in both pathway 1 (31.5% vs 31.7%) and pathway 2 (32.5% vs 32.3%).

Table 3: Overview of Home and Bed-based intermediate care support (Pathways 1 & 2).

	Pathway 1 (n=5,018)		**Pathway 2 (n=576)**		**Pathway 1/2 (n=211)**	
	n	%	n	%	n	%
Sex						
Male	2062	41.1%	243	42.2	74	35.1
Female	2956	58.9%	333	57.8	137	64.9
Age group						
Under 60	427	8.5%	25	4.3%	15	7.1%
60-69	613	12.2%	72	12.5%	26	12.3%

70-79	1346	26.8%	130	22.6%	57	27.0%
80-89	1979	39.4%	235	40.8%	82	38.9%
90+	653	13.0%	114	19.8%	31	14.7%
Ethnic group						
White	4637	92.4%	537	93.2%	*	*
Minority ethnic group	186	3.7%	14	2.4%	*	*
NA	195	3.9%	25	4.3%	*	*
IMD quintile					*	*
1 – least deprived	111	2.2%	15	2.6%	*	*
2	565	11.3%	65	11.3%	*	*
3	437	8.7%	50	8.7%	*	*
4	447	8.9%	50	8.7%	*	*
5 – most deprived	3173	63.2%	379	65.8%	*	*
NA	285	5.7%	17	3.0%	*	*
Length of Stay in intermediate care						
Mean (SD)	26.2	-	35.9	-	37.6	-
Median (IQR)	20	-	28	-	28.5	-
LTCs, Co-morbidities						
LTCs	4644	82.5%	521	90.5%	197	93.4%
Hypertension	3034	60.5%	344	59.7%	142	67.3%
Cancer	749	14.9%	38	6.6%	24	11.4%
Diabetes	1426	28.4%	133	23.1%	63	29.9%
CVD	3131	62.4%	332	57.6%	139	65.9%
Heart Failure	2705	53.9%	280	48.6%	114	54.0%
CKD	1910	38.1%	228	39.6%	77	36.5%
Asthma	1570	31.3%	157	27.3%	50	23.7%
COPD	1113	22.2%	92	16.0%	34	16.1%
Depression	1205	24.0%	123	21.4%	48	22.7%
Frailty						
Fit	1583	31.5%	187	32.5%	*	*
Mild frailty	622	12.4%	64	11.1%	*	*
Moderate	890	17.7%	109	18.9%	*	*
Severely frail	1589	31.7%	186	32.3%	*	*
NA	334	6.7%	30	5.2%	*	*
Total people in Household (HH)						
Up to 4 people living in HH	3995	79.6%	353	61.3%	155	73.5%
Over 4 people living in HH	614	12.2%	175	30.4%	41	19.4%
Living Alone						
Yes	2009	40.0%	195	33.9%	92	43.6%

** Details have been omitted to maintain confidentiality due to the number of individuals in one or more cell being less than 10.*

3.3 Descriptive statistics of different forms of IC services, IC pathways and intensity of support received in relation to individual level of need.

Table 4 summarises the characteristics of the IC cohort by level of need. The majority of the cohort were of high need (42.4%), followed by low need (30.5%), then moderate (16.2%), with fewest in the very high need group (10.9%). The proportion of female patients was notably

higher in the high and very high groups compared with the lower levels of need. The proportion of people with LTCs and proportion of patients with a GP event increased with level of need. Other characteristics did not show a directional relationship with level of need.

Table 4: Overview of IC cohort by level of need.

	Low (n=1,659)	**Moderate (n=880)**	**High (n=2,302)**	**Very High (n=594)**
	n (%)	n (%)	n (%)	n (%)
Sex				
Male	736 (44.4%)	430 (48.9%)	865 (37.6%)	216 (36.4%)
Female	923 (55.6%)	450 (51.1%)	1437 (62.4%)	378 (63.6%)
Age group				
Under 60	176 (10.6%)	91 (10.3%)	139 (6.0%)	27 (4.5%)
60-69	214 (12.9%)	114 (13.0%)	287 (12.5%)	51 (8.6%)
70-79	416 (25.1%)	219 (24.9%)	620 (26.9%)	185 (31.1%)
80-89	621 (37.4%)	333 (37.8%)	934 (40.6%)	248 (41.8%)
90+	232 (14.0%)	123 (14.0%)	322 (14.0%)	83 (14.0%)
LTCs, Co-morbidities				
LTCs	1472 (88.7%)	785 (89.2%)	2206 (95.8%)	585 (98.5%)
Intermediate care				
Length of Stay (days) Mean (Median)	23.4 (16)	30.6 (25)	28.7 (22)	31.3 (27)
Contacts Mean (Median)	5.3 (2)	3.7 (1)	5.6 (2)	3.1 (1)
Intensity (days/cont.) Mean (Median)	10.1 (3.5)	18.1 (13.5)	13.4 (6.1)	19.8 (17)
Hosp. Re-admission				
Days from discharge (within 30 days) Mean (Median)	12.0 (11)	12.4 (10)	12.4 (11)	11.4 (9)
Patients (30 days)	477 (28.8%)	242 (27.5%)	588 (25.5%)	158 (26.6%)
Days from discharge (within 60 days) Mean (Median)	21.0 (17)	20.4 (16)	21.9 (18)	21.2 (17)
Patients (60 days)	671 (40.4%)	322 (36.6%)	843 (36.6%)	228 (38.4%)
Days from discharge (within 90 days) Mean (Median)	28.3 (21)	29.8 (23)	30.1 (24)	29.6 (23)
Patients (90 days)	776 (46.8%)	389 (44.2%)	1000 (43.4%)	272 (45.8%)
Extended IC support				
Patients received IC support >91 days	44 (2.7%)	37 (4.2%)	83 (3.6%)	17 (2.9%)
GP events				
Days from discharge (within 30 days) Mean (Median)	10.5 (9)	11.8 (10)	10.0 (8)	11.5 (10)
Patients (30 days)	1554 (93.7%)	839 (95.3%)	2235 (97.1%)	581 (97.8%)
A&E Attendances				

Days from discharge (30 days) Mean (Median)	1.2 (1)	1.2 (1)	1.4 (1)	1.2 (1)
Patients (30 days)	513 (30.9%)	276 (31.4%)	582 (25.3%)	167 (28.1%)
111 calls				
Days from discharge (30 days) Mean (Median)	1.3 (1)	1.3 (1)	1.3 (1)	1.3 (1)
Patients (30 days)	217 (13.1%)	127 (14.4%)	254 (11.0%)	69 (11.6%)

Table 5 shows the distribution of level of need across the IC services and pathways. Firstly comparing pathways 1 and 2, the largest group in both pathways were people of high need, however low need was the second largest group in pathway 1 whereas the low group was the smallest in pathway 2. For both CSDS and ASC, the largest group were of high need, and the very high need group is the smallest. The proportion of people in the very high need group is higher in the ASC group (14.4%) than the CSDS group (5.1%) whereas the proportion of low need people is higher in the CSDS group (36.3%) compared with the ASC group (21.4%).

Table 5: Distribution of level of need across IC services and pathways.

	Total IC (5,805)	**Pathway 1 (n=5,018)**	**Pathway 2 (n=576)**	**Pathway 1/2 (n=211)**	**CSDS IC (n=2,952)**	**ASC IC (n=3,374)**
	n (%)	n (%) %	n (%) %	n (%) %	n (%) %	n (%) %
Level of Need						
Low	1659 (28.6%)	1516 (30.2%)	97 (16.8%)	*	1073 (36.3%)	721 (21.4%)
Moderate	880 (15.2%)	689 (13.7%)	154 (26.7%)	*	274 (9.3%)	676 (20.0%)
High	2302 (39.7%)	2016 (40.2%)	196 (34.0%)	*	1248 (42.3%)	1290 (38.2%)
Very High	594 (10.2%)	463 (9.2%)	99 (17.2%)	*	150 (5.1%)	486 (14.4%)
NA	370 (6.4%)	334 (6.7%)	30 (5.2%)	*	207 (7.0%)	201 (6.0%)

** Details have been omitted to maintain confidentiality due to the number of individuals in one or more cell being less than 10.*

3.4 Characteristics of patients receiving home-based or bed-based IC support and those without an assigned pathway.

There was a higher proportion of male (49.8%) and young (under 60) patients (23.7%) among those who were not assigned to a pathway compared with the other groups (Table 6). A smaller proportion of these patients had any LTC (80.3%) and each of the separate conditions were less frequent in this group other than depression. Those with no pathway were more likely to be fit (44.7%) than those in the other groups. The level of need showed a linear trend in the group with no pathway (i.e. highest proportion were in the low need group which decreased

with the smallest proportion in the very high need group). In contrast, for those assigned to a pathway the largest proportion of patients were in the high need group for all pathways.

Table 6: Descriptive statistics of patients receiving home-based or bed-based IC support and those without an assigned pathway.

	No pathway* (1,851)	**Pathway 1 (n=5,018)**	**Pathway 2 (n=576)**	**Pathway 1/2 (n=211)**
	n (%)	n (%)	n (%)	n (%)
Sex				
Male	922 (49.8%)	2062 (41.1%)	243 (42.2%)	74 (35.1%)
Female	929 (50.2%)	2956 (58.9%)	333 (57.8%)	137 (64.9%)
Age group				
Under 60	439 (23.7%)	427 (8.5%)	25 (4.3%)	15 (7.1%)
60-69	188 (10.2%)	613 (12.2%)	72 (12.5%)	26 (12.3%)
70-79	349 (18.9%)	1346 (26.8%)	130 (22.6%)	57 (27.0%)
80-89	608 (32.8%)	1979 (39.4%)	235 (40.8%)	82 (38.9%)
90+	267 (14.4%)	653 (13.0%)	114 (19.8%)	31 (14.7%)
LTCs, Co-morbidities				
LTCs	1487 (80.3%)	4644 (92.5%)	521 (90.5%)	197 (93.4%)
Hypertension	833 (45.0%)	3034 (60.5%)	344 (59.7%)	142 (67.3%)
Cancer	171 (9.2%)	749 (14.9%)	38 (6.6%)	24 (11.4%)
Diabetes	403 (21.8%)	1426 (28.4%)	133 (23.1%)	63 (29.9%)
CVD	861 (46.5%)	3131 (62.4%)	332 (57.6%)	139 (65.9%)
Heart Failure	709 (38.3%)	2705 (53.9%)	280 (48.6%)	114 (54.0%)
CKD	493 (26.6%)	1910 (38.1%)	228 (39.6%)	77 (36.5%)
Asthma	384 (20.7%)	1570 (31.3%)	157 (27.3%)	50 (23.7%)
COPD	234 (12.6%)	1113 (22.2%)	92 (16.0%)	34 (16.1%)
Depression	428 (23.1%)	1205 (24.0%)	123 (21.4%)	48 (22.7%)
Frailty				
Fit	828 (44.7%)	1583 (31.5%)	187 (32.5%)	53 (25.1%)
Mild frailty	232 (12.5%)	622 (12.4%)	64 (11.1%)	30 (14.2%)
Moderate	234 (12.6%)	890 (17.7%)	109 (18.9%)	47 (22.3%)
Severe	387 (20.9%)	1589 (31.7%)	186 (32.3%)	75 (35.5%)
Level of Need				
Low	585 (31.6%)	1516 (30.2%)	97 (16.8%)	46 (21.8%)
Moderate	475 (25.7%)	689 (13.7%)	154 (26.7%)	37 (17.5%)
High	422 (22.8%)	2016 (40.2%)	196 (34.0%)	90 (42.7%)
Very High	199 (10.8%)	463 (9.2%)	99 (17.2%)	32 (15.2%)

* No pathway cohort includes “No IC” and “Other” groups as in Figure 2.

3.5 Evaluation of the IC impact by comparing the health outcomes (mortlity, readmission) of those who received it with matched patients who did not receive it.

The logistic regression analysis conducted on a total of 67,539 hospital discharged patients, of whom 4,887 received IC support, reveals significant associations between several demographic and clinical factors and the likelihood of receiving IC (Table 7).

The analysis found that age significantly increases the odds of receiving IC, with an odds ratio (OR) of 1.056 (CI: 1.053-1.059, p < 0.0001), indicating that for each additional year of age, the odds of receiving IC support increase by approximately 5.6%. Gender also plays a crucial role, with females having higher odds (OR: 1.184, CI: 1.110-1.264, p < 0.0001) of receiving IC compared to males. The length of stay (log(LoS)), significantly increases the likelihood of IC support, with an OR of 2.375 (CI: 2.304-2.448, p < 0.0001), suggesting that longer hospital stays are associated with a higher probability of receiving IC support. Among frailty groups, those categorised as 'Severe' have a 30.2% higher chance of receiving IC compared to the 'Fit' group (OR: 1.302, CI: 1.199-1.414, p < 0.0001). Patients with more long-term conditions (LTCs) are slightly less likely to receive IC, with an OR of 0.963 (CI: 0.945-0.981, p < 0.0001), indicating a small decrease in odds with each additional LTC. Ethnic minorities showed marginally higher odds of receiving IC compared to Whites, although this was not statistically significant (OR: 1.186, CI: 0.995-1.405, p = 0.053). Furthermore, living alone significantly increases the odds of receiving IC (OR: 1.388, CI: 1.299-1.482, p < 0.0001), and a higher IMD Score, which indicates greater deprivation, slightly increases the likelihood of receiving IC support (OR: 1.006, CI: 1.004-1.007, p < 0.0001).

Table 7: Odds Ratios (OR) and Confidence Intervals (CI) for factors associated with receiving Integrated Care support among hospital discharged patients.

	O.R.	***p***	**sig**	**CI 2.5%**	**CI 97.5%**
Age	1.056	0.000	***	1.053	1.059
Gender					
Male (baseline)	1.000	-	-	-	-
Female	1.184	0.000	***	1.110	1.264
log(LoS)	2.375	0.000	***	2.304	2.448
Frailty group					
Fit (baseline)	1.000	-	-	-	-
Mild	0.915	0.089	.	0.826	1.013
Moderate	1.050	0.297		0.958	1.150
Severe	1.302	0.000	***	1.199	1.414
LTCs	0.963	0.000	***	0.945	0.981
Ethnicity					
White (baseline)	1.000	-	-	-	-
Ethnic minorities	1.186	0.053	.	0.995	1.405
LivingAlone	1.388	0.000	***	1.299	1.482
IMD_Score	1.006	0.000	***	1.004	1.007

In our analysis, we employed Propensity Score Matching (PSM) to balance the cohort receiving Integrated Care (IC) support with a matched comparison group. The matching variables included Age, Gender, logarithm of Length of Stay (LoS), Frailty Group, Long-Term Conditions (LTCs), whether individuals are from ethnic minorities, living status (Living Alone), and the IMD score. Utilising the Nearest Neighbour Matching algorithm with a caliper set to 0.1 times the standard deviation of the propensity score ensured a precise match between groups.

Post-matching, the demographic and clinical characteristics between the IC support group (N=4,867) and the matched group (N=4,867) showed remarkable similarity, indicating effective matching (Table 8). The mean and median ages were nearly identical at 77.9 (median 80) and 78.1 (median 80), respectively. Gender distribution across groups was also closely aligned, with 1,994 males in the IC support group compared to 1,992 in the matched group, and 2,873 females compared to 2,875. Similar patterns were observed in the distribution across frailty categories, with minor variations but overall balance. The mean and median LTCs were consistent at 3.4 and 3, respectively. Ethnic composition was predominantly White, with very similar counts in both groups, alongside a minimal difference in the number of people from ethnic minority groups. The average IMD scores were closely matched, with means of 43.3 and 43.1 and medians both at 43.5, underscoring the successful alignment of socioeconomic status between the groups.

Table 8: Summary statistics between the IC support group and the matched group.

	IC support (N=4,867)	**Matched (N=4,867)**
Age Mean(Median)	77.9(80)	78.1(80)
Gender		
Male	1,994	1,992
Female	2,873	2,875
log(LoS) Mean(Median)	2.6(2.6)	2.5(2.6)
Frailty Group		
Fit	1,559	1,619
Mild	645	584
Moderate	946	884
High	1,717	1,780
LTCs Mean(Median)	3.4(3)	3.4(3)
Ethnicity		
White	4,691	4,694
Ethnic minorities	176	173
Living Alone	2,071	2,049
IMD Score Mean(Median)	43.3(43.5)	43.1(43.5)

We applied a Cox proportional hazards model to the selected cohort to evaluate the effect of IC support on the time to death. We examined data from 9,734 patients, with 1,178 death events observed. The results showed that the coefficient for patients that received IC support (ICFlag1) was -0.067, corresponding to an exponentiated coefficient (hazard ratio) of 0.935. This indicates that patients that received IC support had a hazard of death that was approximately 6.5% lower compared to those without the IC support, although this difference was not statistically significant ($p = 0.263$). The 95% confidence interval for the hazard ratio ranged from 0.8325 to 1.051, including the null value of 1, which further suggests no significant impact of ICFlag1 on the hazard of death.

The Kaplan-Meier survival curves presented in the figure 5 shows the survival probabilities (mortality) over time for patients with and without Integrated Care (IC) support. As time progresses up to 90 days, the survival probability for both groups decreases, with the IC support group showing a slightly higher survival probability than the group without IC support. By day 90, the number at risk has decreased to 4,280 in the IC support group and to 4,311 in the non-IC support group, indicating that the non-IC group experienced slightly fewer events or censoring over the observed time period.

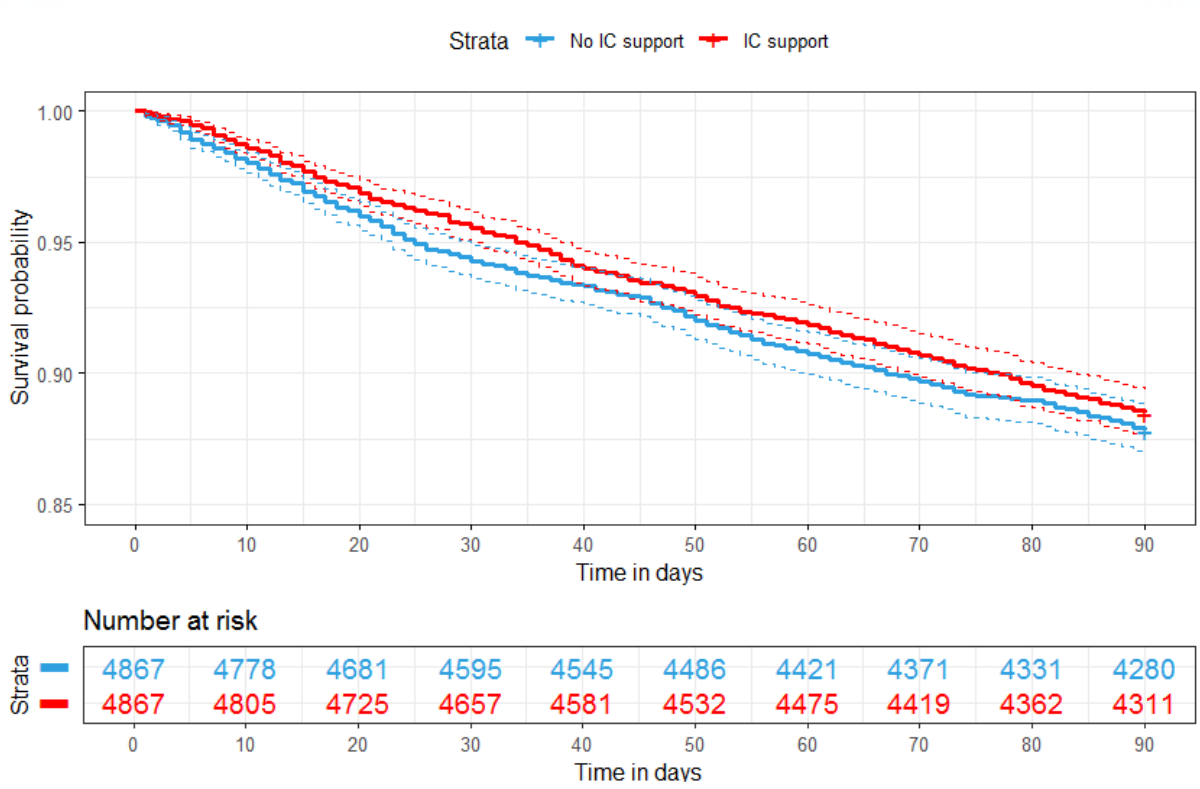


Figure 5: Survival curves comparing patient outcome (mortality) with and without Integrated Care (IC) support over a 90-day period.

Next, we assessed the impact of Integrated Care on readmission rates within 90 days using a Cox proportional hazards model. We analysed data from 9,734 patients, observing a total of 4,420 readmission events. The results indicated a coefficient of 0.010 for ICFlag1, translating into a hazard ratio of 1.010. This suggests a marginal increase in the hazard of readmission associated with ICFlag1; however, the effect was not statistically significant, with a p-value of 0.744. The 95% confidence interval for the hazard ratio ranged from 0.951 to 1.073, including the null value of 1 and indicating that the presence of ICFlag1 does not significantly alter the risk of readmission.

The survival curves presented in the figure 6 shows the survival probabilities (readmission) over time for patients with and without Integrated Care (IC) support. As time progresses up to 90 days, the probability of readmission for both groups decrease, with both groups showing an almost identical probability of readmission.

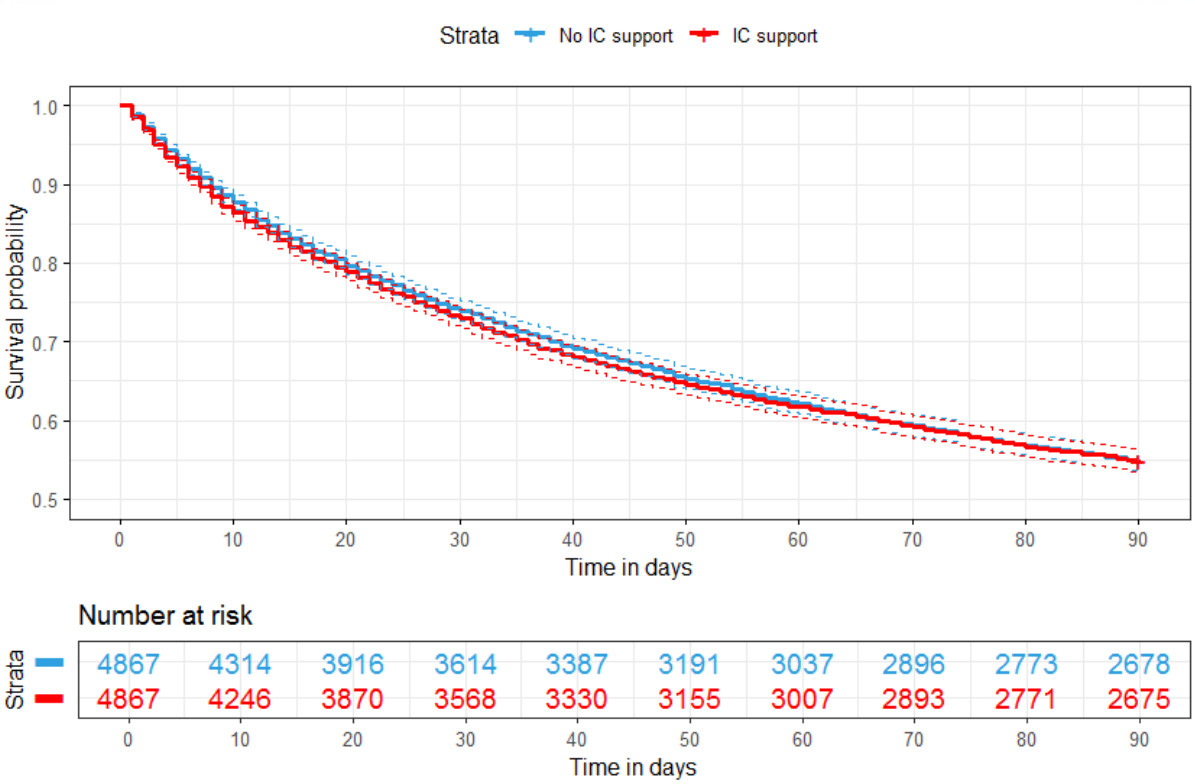


Figure 6: Survival curves comparing patient outcome (readmission) with and without Integrated Care (IC) support over a 90-day period.

4. Discussion

Objectives 1 is an enabler for the later objectives, focussed on establishing the link between data assets (understanding who are our IC patients) and building a foundational data model for Intermediate Care. Following the successful development of the model we began to focus on our insight-based objectives (2 – 5).

The findings from our analysis on IC pathways in Liverpool highlight the key role of IC in supporting the recovery and independence of a predominantly older and female patient population. With the majority of IC patients identified as female and significantly represented in older age groups, particularly those aged 80-89, our results highlight the patients most impacted by and in need of IC services, although this may also reflect the demographics of the population. The high prevalence of comorbid conditions, such as cardiovascular diseases and hypertension, among this cohort further heightens the complex health needs that IC aims to address.

Notably, the analysis revealed a considerable segment of the IC cohort dealing with varying degrees of frailty, with a significant proportion classified as severely frail. This underscores the necessity of IC services for patients who are among the most vulnerable to adverse health outcomes, stressing the importance of tailored care that aligns with the specific needs and frailty levels of each patient.

The findings of our study highlight several critical aspects of patient care needs and the effectiveness of integrated care (IC) systems. Patients identified with 'very high' levels of need

demonstrate a threefold greater likelihood of requiring social care over community care. This significant distinction underscores the reliance of patients with complex and acute conditions on specialised social services.

Additionally, our results indicate that patients not aligned with specific pathways (pathway 4) tend to be younger, with fewer comorbidities and less evidence of frailty, categorising them as lower risk. Notably, approximately 75% of these patients exhibit a minimal need for intensive care support.

Furthermore, our analysis did not find a significant impact of IC support on reducing hospital readmissions. This suggests that while IC may be effective in coordinating care and managing patient needs, its role in directly preventing readmissions may be limited under the current system configuration. These insights are crucial for refining patient categorisation and optimising resource allocation in C&M healthcare settings.

Next steps for the ICB

In C&M NDL lab, we have enabled a deeper understanding of IC patients by building a foundational IC data model. Working with our stakeholders, there is demand to take this work forwards. Proposed next steps on the analytics are as follows,

- **Service type efficacy:** Look at outcomes (our descriptive characteristics) by service type. Service type would need to be manually mapped. The desired output is a pre-during-post view on outcomes/ service utilisation.
- **Exhaustive Pathways:** Build a view of exhaustive pathways against condition profile, inc patients without assigned pathway (Objective 4), to understand if same cohorts/ condition profiles are offered same package of care
- **Financials:** To include a financial lens on our existing analysis to understand the cost implications of each pathway/ package of care.

Conducting above analytics would enable the system to see which pathways have most positive outcomes for the range of condition profiles, and the associated cost of these outcomes to the system.

The resource to support this work is to be agreed and managed the project through the Data into Action programme.

5. Limitations

Enhancing intermediate care services requires a comprehensive understanding of the current landscape of available data. It is evident that there is a scarcity of information regarding intermediate care that can become a barrier for significant improvements in intermediate care services.

Patients on an end-of-life pathway are included in this study. Future research could focus on identifying these patients to either exclude them from the analysis or analyse them separately. Similarly, patients residing in IC facilities but not utilising health or social care services as part of their IC should be distinctly identified in future analyses, to better understand their specific needs and service use patterns.

We have limited our analysis to each individual's index hospital admission in order to differentiate between readmission as an outcome and as an opportunity for exposure to IC.

However, it is likely to also be important to understand how IC can best serve the needs of people who have frequent hospital admissions.

Due to varying commissioning arrangements for IC services across Cheshire and Merseyside, this analysis focuses only on Liverpool, which may limit the generalisability of our findings to other geographic areas, narrow the sample size and potentially reduce the applicability of results across different settings.

The study period has been restricted to largely post-COVID lockdowns, considering the pandemic's impact on the provision, assessment, and delivery of IC, as well as on key outcomes like hospital readmission. There are likely to still be some impacts of the pandemic in our data but it will not be possible to differentiate these from other effects in our analysis.

6. Impact and dissemination

The research findings will potentially help in reviewing the Liverpool discharge model with a view of learning best practice across Cheshire and Merseyside and ensuring patients are discharged onto the optimum intermediate care pathway. In addition to Health Foundation led publications, the code for our analysis (SQL, R and R Markdown files) will be made available on the Health Foundation GitHub: https://github.com/HFAnalyticsLab.

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Appendix 1

List of the variables extracted from each dataset

Dataset	Variable	Description
SUS-APCS	Pseudo_NHS_Number	Cheshire & Merseyside Pseudo Number
	Ethnic_Group	Ethnic Category - The 16+1 ethnic data categories defined in the 2001 census is the national mandatory standard for the collection and analysis of ethnicity
	Sex	Person gender code current - 0: Not Known, 1: Male, 2: Female, 9: Not Specified
	Spell_LoS	Spell Length of Stay (in days)
	Age	Age on Admission
	LSOA_2011_Code	Lower Super Output Area 2011 Code
	Diagnosis_All	All Diagnosis Codes
	Admission_Date	Date of Admission
	Discharge_Date	Date of Discharge
	Discharge_Destination	Discharge Destination code
SUS-ECDS	Pseudo_NHS_Number	Cheshire & Merseyside Pseudo Number
	Arrival_Date	Date of A&E attendance
GP – primary data	Pseudo_NHS_Number	Cheshire & Merseyside Pseudo Number
	FrailtyScore	Frailty Score
	IMD_decile	English indices of deprivation 2019 decile (1: most deprived area)
	Date_of_Death	Date of Death
	TotalHousehold	Number of people in Household
	LivingAlone	Living Alone
	LivingWithUnder18	Living with Under 18
	Carer	Carer
	Hypertension	Hypertension condition
	Cancer	Cancer condition
	Diabetes	Diabetes condition
	CVD	CVD condition
	Heart_failure	Heart failure condition
	CKD	CKD condition
	Asthma	Asthma condition
	COPD	COPD condition
	Depression	Depression condition
NWAS - 111 calls	Pseudo_NHS_Number	Cheshire & Merseyside Pseudo Number
	Triage_Start_Date	Date of call to 111 service
CSDS	Pseudo_NHS_Number	Cheshire & Merseyside Pseudo Number
	Unique_ServiceRequestID	Referral request unique identifier
	ReferralRequest_ReceivedDate	Date of Referral Request Received
	Contact_Date	Date of Contact
	TeamType	Type of Team
	AttendOrNot	Attend or not appointment
ASC	Pseudo_NHS_Number	Cheshire & Merseyside Pseudo Number
	Event_Start_Date	Date of first Event
	Event_End_Date	Date of last Event
	Request:_Route_of_Access	Route of access

Dataset	Variable	Description
	Assessment_Type	Assessment type
	Service_Type	Service type
	Service_Component	Service component

Appendix 2

Assigned pathways for APCS, CSDS and ASC datasets

For each APCS admission, pathways were determined based on Discharge Destination codes to reflect IC support involvement. Table 1 shows the association between the Discharge Destination codes and the assigned IC pathway, as defined by the C&M Lab team.

Table 1: Assigned IC pathways for APCS dataset.

APCS Discharge Destination code	Description	Assigned APCS IC pathway
19	The usual place of residence, including no fixed abode	Pathway 0/1
29	Temporary place of residence when usually resident elsewhere	Other
30	Repatriation from high security psychiatric hospital (from 1999-2000)	Other
48	High Security Psychiatric Hospital, Scotland	Other
49	NHS other Hospital Provider - high security psychiatric accommodation	Pathway 0
50	NHS other Hospital Provider - medium secure unit	Pathway 0
51	NHS other Hospital Provider - WARD for general PATIENTS or the younger physically disabled	Pathway 0
52	NHS other Hospital Provider - WARD for maternity PATIENTS or Neonates	Pathway 0
53	NHS other Hospital Provider - WARD for PATIENTS who are mentally ill or have Learning Disabilities	Pathway 0
54	NHS run Care Home (retired in 2022-23)	Pathway 2/3
55	Care Home With Nursing	Pathway 2/3
56	Care Home Without Nursing	Pathway 2/3
65	Local Authority residential accommodation i.e. where care is provided (retired in 2022-23)	Pathway 3
66	Local Authority foster care	Pathway 0
84	Independent Sector Healthcare Provider run hospital - medium secure unit	Other
85	Non-NHS (other than Local Authority) run Care Home (retired in 2022-23)	Pathway 2/3
87	Independent Sector Healthcare Provider run hospital - excluding medium secure unit	Pathway 2
88	Hospice	Pathway 3
89	ORGANISATION responsible for forced repatriation	Other
98	Not applicable - Hospital Provider Spell not finished at episode end (i.e. not discharged) or current episode unfinished	Other
99	Destination of Discharge Not Known	Other

For each CSDS contact, pathways were determined based on the Service type codes to reflect IC support involvement. Table 2 shows the association between the Service type codes and the assigned IC pathway, as defined by the C&M Lab team.

Table 2: Assigned pathways for CSDS dataset.

CSDS Service type code	Description	Assigned CSDS IC pathway
18	Intermediate Care Service (Retired 01 April 2020)	Pathway 1/2

CSDS Service type code	Description	Assigned CSDS IC pathway
51	Crisis Response Intermediate Care Service	Pathway 1/2
52	Reablement Intermediate Care Service	Pathway 1
53	Home-based Intermediate Care Service	Pathway 1
54	Community Bed-based Intermediate Care Service	Pathway 2

Next, we combined the assigned IC pathways for APCS and CSDS (tables 1 and 2) to produce the final CSDS IC pathway for each patient who received CSDS support (see table 3).

Table 3: Final CSDS pathways based on the initial assigned pathways for APCS and CSDS datasets.

Assigned APCS IC pathway	Assigned CSDS IC pathway	Final CSDS IC Pathway
Other	Pathway 1/2	Pathway 1/2
Other	Pathway 1	Pathway 1
Other	Pathway 2	Pathway 2
Pathway 0	Pathway 1/2	Pathway 1/2
Pathway 0	Pathway 1	Pathway 1
Pathway 0	Pathway 2	Pathway 2
Pathway 0/1	Pathway 1/2	Pathway 1
Pathway 0/1	Pathway 1	Pathway 1
Pathway 0/1	Pathway 2	Pathway 2
Pathway 2	Pathway 1/2	Pathway 2
Pathway 2	Pathway 1	Pathway 1
Pathway 2	Pathway 2	Pathway 2
Pathway 2/3	Pathway 1/2	Pathway 2
Pathway 2/3	Pathway 1	Pathway 1
Pathway 2/3	Pathway 2	Pathway 2
Pathway 3	Pathway 1/2	Pathway 2
Pathway 3	Pathway 1	Pathway 1
Pathway 3	Pathway 2	Pathway 2

For each ASC event, pathways were determined based on the Service Component codes to reflect IC support involvement. Table 4 shows the association between the Service Component codes and the assigned IC pathway, as defined by the C&M Lab team.

Table 4: Assigned pathways for CSDS dataset.

ASC Service Component code	Description	Assigned ASC IC pathway
1	Reablement	Pathway 1/2
2	Short Term Residential Care	Pathway 1
3	Short Term Nursing Care	Pathway 1/2
4	Other Short Term Support	Pathway 1/2

Finaly, we combined the assigned IC pathways for APCS and ASC (tables 1 and 4) to produce the final ASC IC pathway for each patient who received ASC support (see table 5).

Table 5: Final ASC pathways based on the initial assigned pathways for APCS and ASC datasets.

Assigned APCS IC pathway	Assigned ASC IC pathway	Final ASC IC Pathway
Other	Pathway 1/2	Pathway 1/2
Other	Pathway 1	Pathway 1
Other	Pathway 1/2	Pathway 1/2
Other	Pathway 1/2	Pathway 1/2
Pathway 0	Pathway 1/2	Pathway 1
Pathway 0	Pathway 1	Pathway 1
Pathway 0	Pathway 1/2	Pathway 1
Pathway 0	Pathway 1/2	Pathway 1
Pathway 0/1	Pathway 1/2	Pathway 1
Pathway 0/1	Pathway 1	Pathway 1
Pathway 0/1	Pathway 1/2	Pathway 1
Pathway 0/1	Pathway 1/2	Pathway 1
Pathway 2	Pathway 1/2	Pathway 2
Pathway 2	Pathway 1	Pathway 1
Pathway 2	Pathway 1/2	Pathway 2
Pathway 2	Pathway 1/2	Pathway 2
Pathway 2/3	Pathway 1/2	Pathway 2
Pathway 2/3	Pathway 1	Pathway 1
Pathway 2/3	Pathway 1/2	Pathway 2
Pathway 2/3	Pathway 1/2	Pathway 2
Pathway 3	Pathway 1/2	Pathway 2
Pathway 3	Pathway 1	Pathway 1
Pathway 3	Pathway 1/2	Pathway 2
Pathway 3	Pathway 1/2	Pathway 2