

Developing a Modelling Resource to understand the rehabilitation needs of people during, and following, the Covid-19 pandemic

Purpose

In May 2020 Welsh Government produced a policy document '[Rehabilitation: a framework for continuity and recovery 2020 to 2021](#)'. This framework supports services to plan for the anticipated increased demand for rehabilitation of population groups, including both adults and children, affected both directly and indirectly by Covid-19. Associated [rehabilitation guidance](#) provided a resource to support practitioners and service providers to deliver appropriate and timely rehabilitation through a stepped care rehabilitation model to enable people affected by the impact of Covid-19 in Wales to return to their optimal level of independence and well-being.

As part of this national rehabilitation guidance it was essential to develop a modelling resource to underpin this work and guide all services to predict the demand for rehabilitation and consider whether health, social care and other rehabilitation services are available and in the right places to deliver what is required. Service modelling is used frequently within modern care delivery to help support understanding of the need for services within communities and to match capacity, and the utilisation of resources to match this demand. The modelling resource has been developed using analysis of data, published and unpublished evidence and local anecdotal information. This information has included estimated parameters which have been assigned to enable quantification of how surge demand will present over time. The modelling resource is a visual aid to help service managers, professional leads and planners to explore true demand for rehabilitation needs and to map current and future services to meet the rehabilitation needs of national and local populations. The collection of accurate and meaningful data, which is explored in the associated [rehabilitation evaluation guidance](#) and [framework](#), will feed through the model to enable more realistic predictions of current and future rehabilitation needs.

Process of developing the first version of the modelling resource

This document includes the first iteration of the modelling resource which has been developed through a collaborative approach between Welsh Government, practitioners from health and social care, service managers and data analysts /mathematical modellers.

Evidence has been drawn from national and international data and research that links to Covid-19 but also similar pandemics or disasters, as well as local Welsh data and anecdotal information from services delivering care. It is recognised that the novel nature and rapidly evolving impact of the Covid-19 virus does not allow services to draw on wide ranging and robust evidence. The team creating this have therefore used all available resources, including those from other pandemics and disasters, to predict who, when and how much

rehabilitation may be required for the 4 population cohorts following Covid-19 and it is likely to change and adapt as new evidence/information emerges.

The modelling professionals guided the group using an Operational Research Problem Structuring approach¹, and worked with the work-stream group to develop a conceptual stepped care rehabilitation model of the possible flow of cohorts into and between services. The collaborative brought their extensive experiential and research knowledge to work together to structure, initially, a series of rich pictures of the key aspects of flow for each cohort, and which were refined into a structured conceptual stepped care rehabilitation model of requisite detail through several subsequent meetings where participants reflected on the evidence and local intelligence. This resulted in a flow diagram representing tiered intensity / complexity of services, as an effective means of capturing the pathways of care.

Following the above approach to create a stepped care rehabilitation model diagram, values have been assigned to the proportion of a cohort that will flow through each route, and how long a member of the cohort will spend at each stage. These are represented as a system of waits and activities (or nodes) which allow, with the use of key assumptions and data available, to construct an initial mathematical modelling resource which starts to allow for the forecasting of service demand over time.

It is important to recognise that the modelling resource is initially designed to act as a challenge to services and enable us to check whether the design of the resource reflects local presentations. It is worth noting that we have not previously modelled rehabilitation needs for the people of Wales and thus we do not have a sound baseline of rehabilitation during non-Covid-19 times which has made the challenge of this work more difficult. The flexibility of the approach we have used at this early stage ensures that its value is not restricted to the pandemic, and can be used to support the consideration of demand on services under more usual circumstances.² The proposed deterministic (i.e. no randomness is involved) modelling resource can be relatively simple in nature but should give a high level overview of predicted demand over time and could be used for a variety of scenarios (e.g. best case, worst case etc.).

The team who have worked together to develop this model are keen to engage with a wide number of partners to test and refine the proposed model in all parts of the health and care system across Wales.

¹ DOI: [10.1016/j.ejor.2007.02.027](https://doi.org/10.1016/j.ejor.2007.02.027) Howick, Susan & Eden, Colin & Ackermann, Fran & Williams, Terry. (2008). Building confidence in models for multiple audiences: The modelling cascade. *European Journal of Operational Research*. 186. 1068-1083. [10.1016/j.ejor.2007.02.027](https://doi.org/10.1016/j.ejor.2007.02.027).

² This form of modelling utilises an iterative approach, where the first objective is to properly reflect demand pre-Covid-19 by validating model inputs against known outputs and then moving on to making predictions based on known or predicted variation in the inputs, e.g. the effect of Covid-19 and so on.

The Rehabilitation Modelling Tool

The model was developed using the dimensions from the Welsh Government Rehabilitation framework which describe the cohorts of individuals who are known to, or may, require rehabilitation services as a direct or indirect result of Covid-19. The details of these 4 population cohorts are summarised in the table below:

POPULATION 1	People post Covid-19: those recovering from extended time in critical care and hospital and those with prolonged symptoms of Covid-19 recovering in the community
POPULATION 2	People awaiting paused urgent and routine planned care who have further deterioration in their function
POPULATION 3	People avoiding accessing services during the pandemic who are now at risk of harm e.g. disability and ill-health
POPULATION 4	Socially isolated/shielded groups where the lockdown is leading to decreased levels of activity and social connectivity, altered consumption of food, substance misuse, the loss of physical and mental wellbeing and thus increased health risk

We are still learning about the impact of Covid-19 on individuals and communities and the development of the modelling resource has had to take into account many unknowns. We are hoping that, as we work with services, teams and local planners, we can build the evidence to help us further develop and change the model to accurately reflect the rehabilitation needs of people following Covid-19 and beyond.

We have had to use some principles and assumptions to underpin the modelling resource; **as you view the model you will have many questions, so please consider how the guiding principles have shaped this work.**

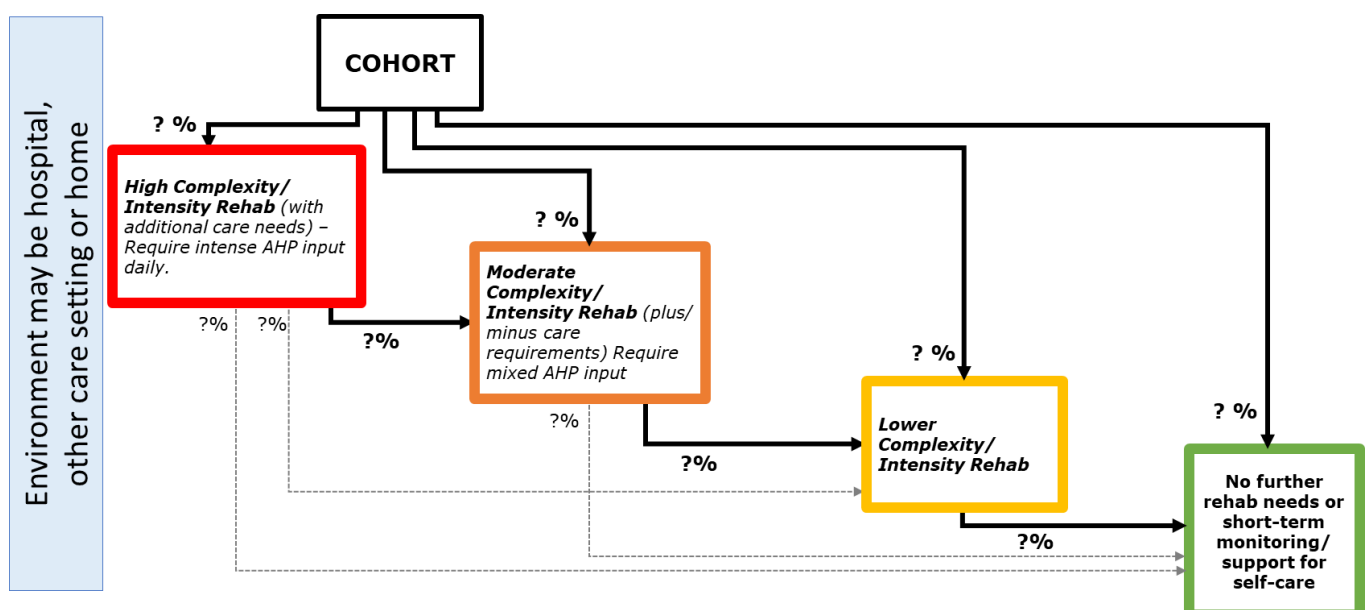
These are summarised below:

- The modelling resource is designed to reflect rehabilitation needs and does not include the provision of care related activities that may be required in addition to rehabilitation.
- The modelling resource has not been fully tested with services that deliver rehabilitation to, for example, children and families or mental health (to name a few) or with scrutiny of the types of rehabilitation offered (e.g. specific therapies/ reablement/ prehabilitation). It is anticipated that the flexibility of the resource will be applicable to all these types of services but further testing and collaboration with people delivering these services is crucial to the development of the modelling resource.
- Whilst developed as a national model for understanding demand, the model will be applied at a local level to incorporate specific population

demographics, cultural differences and local data related to COVID-19 incidence.

- d. The model is not based on a single time point as people may present at different times. It is anticipated that people in cohort 1 requiring rehabilitation are likely to present early in the timeline but the longer reaching impact of covid-19 is not known and people from cohorts 2, 3 and 4 may present at any point along the time continuum. This factor will be integrated into future iterations of the modelling resource.
- e. It is feasible that because of the nature of covid-19 and the wider indirect impact of the virus there may be some double counting of individuals requirements for rehabilitation but it is anticipated that there will be a time lag for people accessing different pathways for rehabilitation.
- f. The rehabilitation model is not focussed on the environments where rehabilitation takes place (e.g. hospital/ care settings). Each service may currently deliver rehabilitation in a variety of settings and the level of rehabilitation required should not be associated with specific places. The resource emphasises the extent and nature of rehabilitation needs so that the model is flexible to reflect local service delivery and the wide-ranging and multi-agency approaches used to deliver rehabilitation in different parts of Wales. Additional information on the factors that may determine where rehabilitation takes place is contained in appendix one in the [Rehabilitation Needs of People Affected by the Impact of Covid-19](#) guidance document.
- g. This resource is designed so that it can also be utilised to predict demand for rehabilitation when usual services resume post-pandemic, and into the future. This is important for understanding and predicting the demand for all rehabilitation services in the future.
- h. The rehabilitation modelling resource is designed to complement other modelling resources related to e.g. right-sized communities' and discharge planning.

Pictorial representation of the overall structure of the model (for a pictorial representation of the structure for each cohort, please see Annex 1 at the end of this document):



How can you use this model as a resource for learning in your organisation?

1. In the first instance, use the model as a different way to view your own system – does my system look like this? If I had to summarise my system in this way, what would it look like?
2. Do you have access to the data that you will 'run through' the model- how does it make you aware of the information that is missing?
3. Consider the proportions and the durations within the model: explore what 'adding 1000 people at the top' will look like over time. Does this match with what was expected or what you have or are experiencing? Are you able to provide an answer with respect to your system?
4. Consider your definitions and understanding of the cohorts: do you concur, do you know more or less about them than stated in the definitions? Could you express the cohorts as a graph over time? i.e. when did/will they present to become an 'arrival' to services in the top of the model?
5. Piecing it all together: It is possible to feed through what you understand your cohorts to be into the model? Is it possible to obtain that same picture of your real system? If not, why not – data capture or access? What do you need to inform your planning – this or more/less detail?

Contacting us

Please contact Jacqui Thornton (Jacqui.Thornton@wales.nhs.uk) if you wish to comment or further discuss how you use the modelling resource.

Annex 1

COHORT 1 ONLY

The percentages shown are for illustration – drawing from limited literature and local knowledge. These need to be explored in more detail.

COHORT 1

COHORT 1: people who require rehabilitation as a direct result of contracting Covid-19

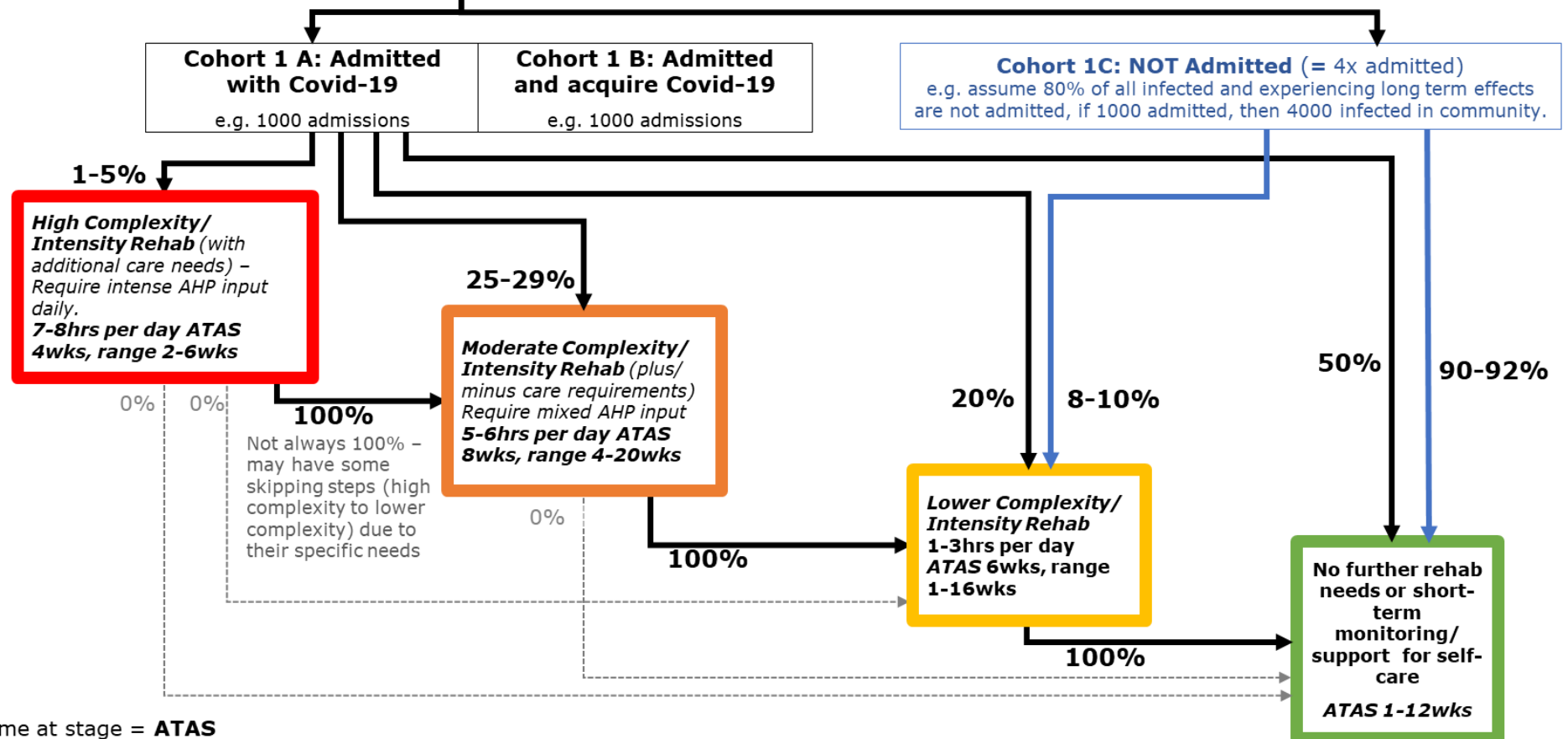
Three pathways:

1A People admitted to hospital with Covid-19

1B Those people in hospital who acquire Covid-19 during their admission

1C People who have contracted Covid-19 and are not admitted to hospital so remain in their place of residence (and are experiencing longer term effects of the virus)

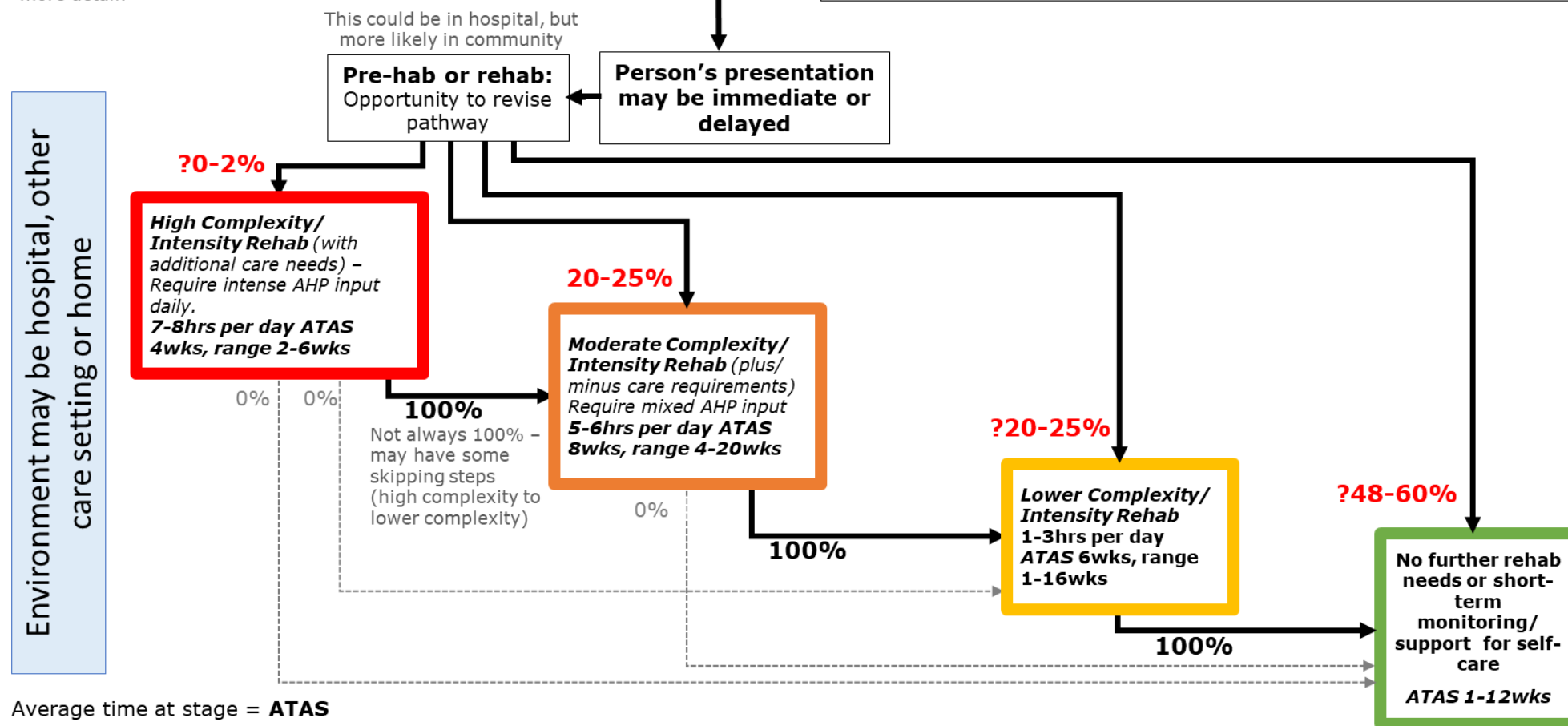
Environment may be hospital, other care setting or home



COHORT 2 ONLY

The percentages shown are for illustration. Limited information was available in the literature and so these illustrative numbers are from one site. These need to be explored in more detail.

COHORT 2: People who require rehabilitation who are awaiting paused planned care where the pause in service delivery has led to a further deterioration in their function or affected the potential outcome.



Note – we assume that no patients pause and no patients skip in this version of the model

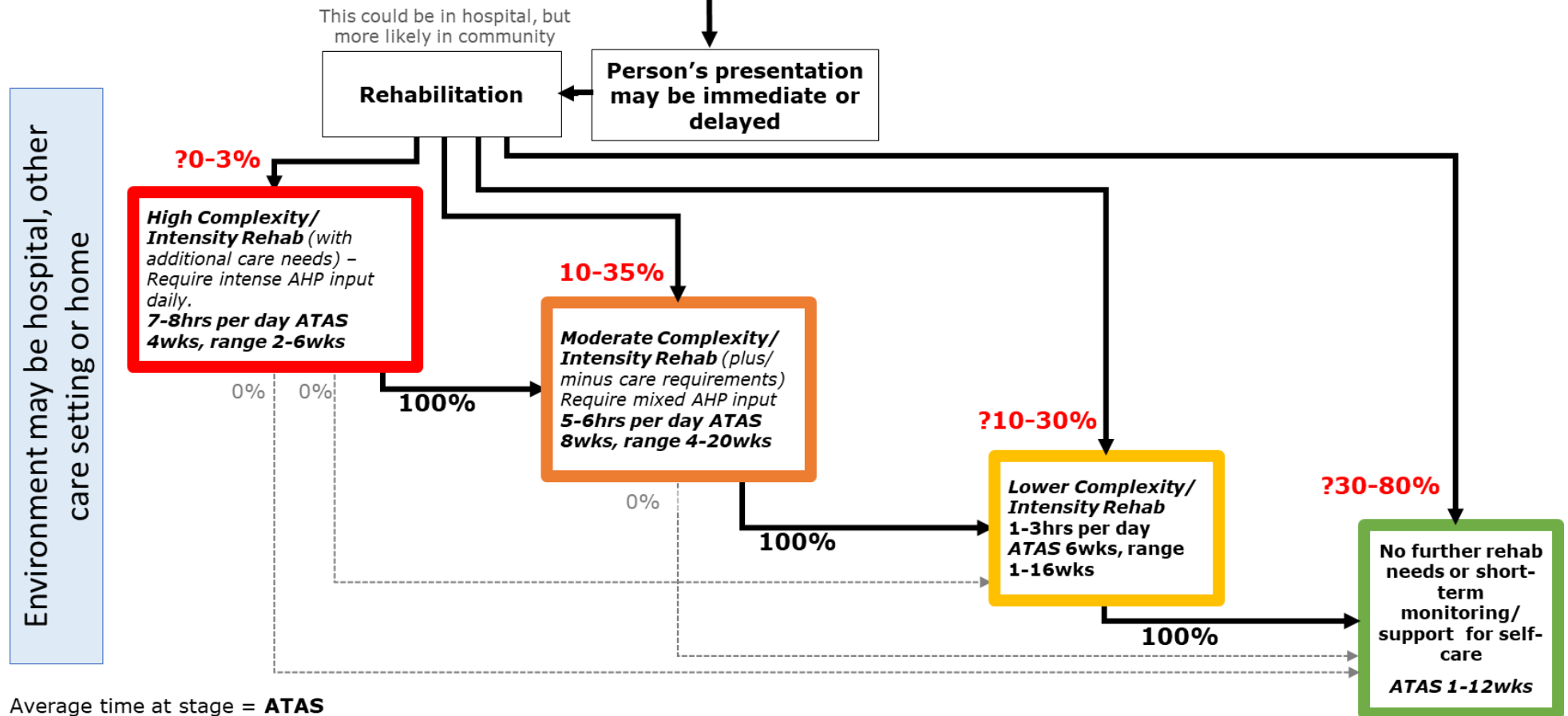
Note – the proportions requiring higher intensity will reduce as the complexity of delayed patients reduces as we get through the backlog. Expert view needed on the drop off over time, and what these percentages look like

COHORT 3 ONLY

The percentages shown are for illustration. Limited information was available in the literature and so these illustrative numbers are from one site. These need to be explored in more detail.

COHORT 3

COHORT 3: People requiring rehabilitation who have avoided accessing services for urgent health and care needs during the pandemic and are now at risk of increased ill-health/ disability.



COHORT 4 ONLY

The percentages shown are for illustration. Limited information was available in the literature and so these illustrative numbers are from one site. These need to be explored in more detail.

COHORT 4: People who require rehabilitation because they have shielded and the lockdown has reduced their levels of activity and social contact which has impacted on wellbeing and longer term health.

