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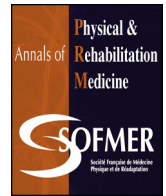


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Letter to the editor

Rehabilitation prioritization: Development of expert consensus on essential rehabilitation during pandemics



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Dear Editor. The impact of the COVID-19 pandemic on rehabilitation systems worldwide is enormous and disruptive [1]. Restrictions to inpatient and outpatient rehabilitation services are common as staff and facilities were repurposed or closed [1,2]. Recent reviews emphasize the importance of continuing rehabilitation services during pandemics [1,3]. However, a key question is how to prioritize rehabilitation services with resourcing limitations and safe practice considerations [3]. Here, we provide a consensus guideline on clinical criteria to prioritize patients for in-person rehabilitation during pandemics.

The consensus process integrated a 3-round Delphi iterative method [4]. The authors are senior experienced rehabilitation clinicians who first formed the core group that designed the Delphi questionnaire. Priority domains were based on the rehabilitation literature and general criteria used for rehabilitation admissions in local rehabilitation centres [4]. The priority domain statements agreed upon were as follows:

- the timing from the onset of illness or surgery prioritizing rehabilitation early from disease onset;
- the severity of disability, prioritizing limitations in basic activities of daily living (ADL) over instrumental ADL and participation restrictions;
- disease severity, whereby life or limb threatening conditions are prioritized for rehabilitation;
- the need for specialized rehabilitation with complex conditions requiring specialist skills or several different allied health professionals taking precedence;
- the trajectory of disability, prioritizing a faster rate of functional decline or potential rate of improvement in a specific disease;
- either the absence or presence of caregiver support;
- the comorbidity burden with more severe or higher comorbidity receiving prioritization.

The questionnaire comprised 2 sections. The first section consisted of 16 brief typical case scenarios that would all have

received rehabilitation in a non-pandemic milieu (Table 1). These scenarios were designed to embed various domain principles. Participants were asked to rank the cases from the highest to the lowest priority for in-person rehabilitation with no ranking ties. They were also asked to consider alternatives to in-person rehabilitation such as telerehabilitation.

The second section comprised the 7 key domains for consideration in prioritization (Table 2). Descriptions of the ordinal categories within each domain were provided to facilitate an understanding of the approximate gradations between extremes. Participants were also asked to rank the domains from the most to least important for prioritization with no ranking ties. Both sections gave participants opportunities to insert comments and reasons for their ranking.

The questionnaire was administered on the Qualtrics (Seattle, WA) survey platform. The survey was fully anonymized to the authors and participants to each other. Subsequently, we invited 27 expert participants according to the following criteria: board-registered rehabilitation physicians or allied health professionals holding (or having held) leadership positions, with 10 or more years of experience and familiar with local rehabilitation practices in Singapore. We included representatives from the acute hospital, community (rehabilitation) hospital and community rehabilitation providers.

Survey rounds were deemed complete when 100% of the questionnaires were received or when 4 weeks had elapsed. After each round, the case studies and priority domains were ranked from highest to lowest priority based on median scores. All experts were informed of the rank, median and interquartile range (IQR) and summed comments for each case or domain. The experts were then asked to review and re-rank the cases or the priority domains in the subsequent round. Consensus was defined as follows: first, there must be no more than one change (higher or lower) in rank for the case studies or the priority domains between rounds with the latest round binding; and second, for the case studies, the top 4 ranked cases and bottom 4 ranked cases (i.e., the top/bottom 25%) must remain the same between rounds. For the priority domains, the top 3 ranked priority domains must remain the same between rounds. Institutional Review Board approval (SingHealth CIRB 202012-0041) was waived for this survey. All participants gave email consent for the publication of aggregated results.

In total, 25 of 27 (93%) experts responded to the first round and 20 of 25 (80%) completed the second round. We did not proceed to a third round because the consensus criteria had been reached. In the 16 rehabilitation case scenarios, the order of prioritization ranking remained the same for 15 (94%) of the scenarios between rounds (Table 1). The top 5 ranked cases for rehabilitation priority were all within 2 months of disease onset and comprised patients with cervical traumatic spinal cord injury, traumatic brain injury, above-knee amputation, middle cerebral artery stroke and Guillain-Barré syndrome. For 15 of 16 (94%) scenarios, the IQR

Table 1
Common rehabilitation case scenarios to rank from 1 (highest priority) to 16 (lowest priority) for continued rehabilitation during a pandemic: 2 rounds of the Delphi process.

Case description	2nd round		1st round	
	Overall rank	Median (IQR)	Overall rank	Median (IQR)
54-year-old woman. No previous history. Traumatic spinal cord injury C7 ASIA C (incomplete motor injury), 2 months previous, tetraparetic. Autonomic (blood pressure) lability, bladder/bowel incontinence, on indwelling catheter. Moderate to maximal assistance required in most basic ADL. Lives with husband and teenage children. Deemed to have potential to achieve transfers with minimum assistance, independent wheelchair mobility, minimal to moderate assistance in most ADL. For spinal cord injury rehabilitation	1	2.5 (1–3.75) ^a	1	2.5 (1.25–3)
60-year-old man. History of peripheral vascular disease and DM. Admitted as emergency for left leg gangrene and is now 2 weeks after a left above knee amputation. Able to stand with a frame and transfer slowly. Lives with friend who is not keen to help with rehabilitation. For amputee rehabilitation	2	3 (2–4) ^b	2	3.5 (3–4)
43-year-old man. Previous DM, hypertension. Left middle cerebral artery stroke 1 month ago, modified Rankin scale score = 4 (moderately severe disability), moderate assistance with transfers, has lower limb strength but unable to walk and is depressed. Lives with wife. Current function: walking with a broad-based quad stick with 1-person moderate assistance 15 m, ADL moderate assistance. Possibly able to achieve minimal assistance with walking and ADL in 6 months. For stroke rehabilitation	3	3 (2–3.75) ^b	3	3.5 (2–5)
25-year-old man. No previous history. Day 9 Guillain–Barre syndrome with severe weakness in the lower limbs, required oxygen support from day 3 to 6 and monitoring in a high dependency ward, now medically stable in general ward although still requiring at least moderate assistance in all ADL except eating and grooming. Unable to walk yet but insists on discharge due to “pandemic fears”. Lives with parents who are able to generally care for him. For appropriate rehabilitation in the community	4	4 (2–4.75) ^b	4	4 (2–6)
48-year-old woman. Previous anxiety disorder, borderline hypertension. Traumatic, moderately severe brain injury 1 month ago with frontal lobe contusion and subarachnoid hemorrhage. Has mild memory impairments and emotional lability with alternating crying and laughing episodes. Has significant balance impairments, can stand with frame and minimal assistance, but safety issues when walking. Lives with husband and children who are well and can help with household chores and some simple rehabilitation. For traumatic brain injury rehabilitation	5	5 (4–5.75) ^b	5	5 (3–6)
68-year-old man. DM, hypertension, ischemic heart disease with CABG previously, end-stage renal failure on hemodialysis 3 times/week. Loss of weight, deconditioning and significant functional decline over 6 months, now requiring minimal to moderate assistance in basic ADL. Screening investigations show no significant new pathology, although appears depressed. Lives with wife who is also mildly disabled with generalized OA. For community rehabilitation	6	6 (5–6.75) ^b	6	8 (7–9)
56-year-old woman. Hyperlipidemia only. She underwent a total mastectomy and axillary clearance 3 weeks previous for locally invasive left breast cancer, currently on radiotherapy and oral chemotherapy. Has numbness of hands and feet, left shoulder stiffness, mild left arm lymphedema, and some overall fatigue. Is basically independent in ADL. Lives with husband who helps with daily chores and teenage children. For cancer rehabilitation	7	7.5 (7–8.75) ^b	7	8 (6–10)
75-year-old man. Hypertension, generalized OA, lumbar spondylosis, prostate cancer with completion of radiotherapy. Recurrent falls, last fall 2 months ago, hospitalized. Modified independence in ADL, still goes out to buy food occasionally. Lives alone in a public apartment. For community rehabilitation	8	8 (7–9) ^b	8	8 (6–11)
63-year-old man. Hypertension, gout, heavy smoker. Right total knee replacement 2 months previous, still weak in the lower limbs and occasional pain on the left knee. Requires a broad-based quad stick to walk, unable to climb stairs, but generally independent with transfers and self-care. Lives with wife who can “watch” him if he needs help but is unable to help with home rehabilitation. For gait training and community rehabilitation	9	9 (8.25–10) ^b	10	10 (9–12)
72-year-old woman. Hypertension, osteoporosis, knee OA, Frailty. Fall with hip fracture and underwent an operation 6 weeks ago. Minimal to moderate assistance in toileting, transfers, walks with handhold assistance slowly with walking frame. Lives with son and has a domestic helper. For community rehabilitation	10	9 (9–10) ^b	9	10 (8–12)
70-year-old woman. DM, hypertension, OA knees, Gout. Frail on (FRAIL scale) through community screening, walks slowly with a walking stick for at least 2 years. Lives alone in rental apartment. No recent significant functional decline, although risk for falls. For community rehabilitation	11	11 (11–11.75) ^b	11	11 (9–12)
51-year-old man. No previous history. Stiff shoulder for 2 years with some recurrent pain, recently diagnosed with partial rotator cuff tear and “frozen” shoulder. Had a steroid injection 3 months previous and on oral analgesia. Basically independent in ADL, minor difficulty with dressing. Refused any further operation or procedure. Lives alone with friend. For shoulder rehabilitation, ROM, stretching, strengthening, functional training	12	12 (12–12.75) ^b	12	13 (11–14)

Table 1 (Continued)

Case description	2nd round		1st round	
	Overall rank	Median (IQR)	Overall rank	Median (IQR)
35-year-old man. Hyperlipidemia only. Recurrent right ankle sprains for 5 years. Had lateral ligament complex right ankle sprain 1 week previous (pain score = 4/10), limps to walk. Lives alone in a private condominium. For rehabilitation of acute pain, chronic ankle instability	13	13 (12–13) ^b	13	13 (6–14)
42-year-old woman. DM, obstructive sleep apnea. Chronic back pain over 1 year with acute exacerbation 2 weeks ago. No “red flags” or neurological impairment. Can perform ADL but with pain (pain score 2–7). Already on medications and lumbar corset. Lives with husband. For therapeutic modalities and back rehabilitation	14	13.5 (13–14) ^b	14	13 (11–15)
82-year-old woman. Hypertension, DM, depression, late stage Alzheimer’s disease diagnosed 4 years previous, requiring maximum feeding assistance and bedbound mostly. Last admitted for pneumonia 6 months ago. Lives with a domestic helper and elderly (well) husband. For chest physiotherapy to reduce secretions, ROM and stretches to prevent contractures	15	15 (14.25–15) ^b	15	13 (8–15)
87-year-old woman. Endometrial cancer with total hysterectomy and completed radiation therapy 15 years ago, prior deep vein thrombosis on warfarin. Parkinson’s disease diagnosed 7 years previous. Hoehn and Yahr Stage 5 (total dependency with ADL), wheelchair-bound. Lives with frail, elderly husband and helper. Function stable in the last 1 year apart for decreased sitting tolerance. Rehabilitation for deconditioning and complications	16	16 (16–16) ^b	16	14 (12–15)

ADL: activities of daily living; CABG: coronary artery bypass graft; DM: diabetes mellitus; IQR: interquartile range; ROM: range of motion exercises; S/P: status-pos; OA: osteoarthritis.

^a Second round IQR is wider than first round.

^b Second round IQR is narrower than first round.

was narrower in the second than first round for the same scenario (Table 1), so the panel members had better agreement of the ranks in the second than first round.

In the ranking of the 7 priority domains for consideration in rehabilitation triage, all the domains were ranked in the same order in both rounds (Table 2). From highest to lowest importance, these were disease severity, disability trajectory, time from disease onset, disability severity, caregiver support status, need for specialized rehabilitation and comorbidity. The IQRs for 6 of the 7 domains were also narrower in the second than first round for the same domain (Table 2), which also indicates better agreement of the domain ranks in the second than first round. Fig. 1 graphically depicts the top 3 ranked domains (disease severity, disability trajectory and time from disease onset) as a prioritization framework.

In this study, there was strong consensus on domains to be considered for rehabilitation prioritization. Disease severity was the top consideration for rehabilitation triage. Conditions that are associated with high mortality or morbidity risks were considered priority. These conditions include major brain or spinal cord disorders requiring acute inpatient admission and severe musculoskeletal conditions requiring emergency surgery [3–5].

The trajectory of the disability was also an important prioritization domain. Rehabilitation is effective for many diseases, but the efficiency (rate of functional recovery) may differ considerably [5]. Progressive disorders with slower rates of functional recovery may be deferred when resources are limited [4,5]. These conditions include advanced Parkinson’s disease and dementia[5].

The timing from disease onset was also important. Early rehabilitation improves functional outcomes in a wide range of conditions including critical illness [4–7] Early rehabilitation also prevents the deleterious effects of bed rest such as weakness and contractures and maximizes the therapeutic window for neuroplasticity in rehabilitation [4–7]. The top 5 ranked priority cases had a disease onset of less than 2 months.

Disability severity was of intermediate importance as a prioritization factor, even if the ability to perform basic ADL is

often the largest determinant of burden of care [4,6]. Disability severity may not have received a higher rank because likely disability trajectory is often used for goal setting rather than disability severity.

Caregiver status was a less important criteria. In a pandemic, caregivers facilitate early supported discharge, provide emotional support, and help with therapeutic exercises and telerehabilitation sessions [3,4] Thus, either the absence or presence of a caregiver might prioritize rehabilitation. However, we believe that most clinicians provide rehabilitation based on clinical necessity as a primary consideration rather than caregiver availability.

The need for rehabilitation specialization skills was considered a lower priority domain. Various authorities advocate for instruments such as the Patient Categorization Tool to stratify patients with more complex needs [4,8]. These criteria include the number of disciplines required, medical stability, and patients with behavioral/emotional needs [4,8]. However, these instruments are often deployed for right-siting rehabilitation rather than prioritization of rehabilitation.

Finally, comorbidity burden was surprisingly deemed of low importance in determining rehabilitation provision [4]. A high comorbidity burden in seniors may be associated with increased risk of functional decline during a pandemic [3,4,9]. However, comorbidity could be more important as a functional outcome modifier rather than as a prioritization parameter for rehabilitation [5,9].

Our study has certain limitations. We were cognizant that domains are not mutually exclusive and overlap to various degrees with each other. There may be other domains such as age, employment status or motivation level that were not included [10]. The strengths of this study are that it used a novel case-domain approach to address rehabilitation prioritization. This gave the opportunity to evaluate whether the domain ranking was associated with prioritization of specific case scenarios.

We also highlight ethical issues in prioritization. There is significant tension between the principles of beneficence, autonomy, and distributive justice of limited rehabilitation resources [10,11]. A balance that maintains urgent accessibility

Table 2
Rehabilitation domains to rank from 1 (most important) to 7 (least important) for priority consideration during a pandemic: 2 rounds of the Delphi process.

Domain	Description or examples	2nd round		1st round	
		Overall rank	Median (IQR)	Overall rank	Median (IQR)
Disease severity	This is the severity of disease which are amenable to rehabilitation interventions Examples would be: life-threatening: pneumonia with ARDS Emergency Surgery or major trauma or dissecting aneurysm; severe: cortical stroke with motor or cognitive impairments, spinal cord injury with tetraplegia, severe traumatic brain injury, post-cancer surgery; moderate: pain, not resolved by medical or surgical treatment–progressive neurodegenerative disease (e.g. Parkinson's disease); less severe: deconditioning, falls, frailty, degenerative musculoskeletal conditions; minimal: ligament sprains, callosities	1	1 (1–1.75) ^a	1	1 (1–2)
Disability trajectory	This is the rate of decline or likely improvement regardless of time from injury Examples are: rapid decline (e.g. 1–3 months) or likely rapid expected improvement in function with rehabilitation: new young motor stroke with left hemiparesis (i.e., rapid decline of function/expected improvement), or history of recurrent falls, and a decline in function over 3 months; moderate decline or improvement in function expected: frailty with functional decline from independent to mod assistance with homebound ambulation in 6 months; slow decline or minimal improvement in unction expected: dementia or recent anoxic brain injury but severe disorder of consciousness (e.g., vegetative state)	2	2 (2–2) ^a	2	2 (2–4)
Time from event	This is the time from injury or disease onset General examples: hyperacute (within 1 week); acute (up to 1 month); early subacute (up to 3 months); late subacute (up to 6 months); chronic (more than 6 months)	3	3 (3–3.75) ^a	3	3 (2–4)
Disability severity	This refers to whether basic ADL, instrumental ADL or community participation are affected Examples: very severe: significant basic ADL affected (e.g., Functional Independence Measure [FIM] < 40, or maximal assistance in transfers and walking); severe: moderate basic ADL affected (e.g., FIM 40–79 or minimal or moderate assistance required in dressing or transfers or toileting); moderate: moderate to severe limitations in instrumental ADL (e.g., community ambulation, cooking, housework); less severe: at least moderate restrictions in community participation (e.g., sports and recreation, leisure, maintaining relationships); minimal: some restriction in community participation	4	4 (4–6) ^b	4	4 (3–5)
Caregiver status	Whether the presence or absence of a caregiver (can be either) would be taken as a domain for consideration to prioritize rehabilitation Examples: absent: no caregiver, living alone, no relations; vulnerable: no caregiver living in with patient so living alone but relations can call in occasionally; present: yes, caregiver living together, but unable to help except for emergencies (e.g., lives with very frail spouse); good: yes, living together, available to standby e.g. for falls, Basic ADL needs; very good: yes, living together and willing to help with rehabilitation	5	5 (4.25–5.75) ^a	5	5 (4–6)
Specialized rehabilitation needed	This refers whether complex or specialized rehabilitation is needed to optimize outcomes versus a more general standard level needed to manage rehabilitation For example: more specialized skills include managing autonomic complications in spinal cord injury, spasticity management, the use of advanced neurodevelopment techniques in stroke rehabilitation or the management of agitation in traumatic brain injury A more general standard level rehabilitation needed would be exercise prescriptions for strength, endurance, and balance in deconditioning, falls and frailty	6	5 (4.25–6) ^a	6	5 (4–6)
Comorbidity	This refers to the severity of associated comorbidities and not just the actual number of comorbidities or a summative score such as the Charlson Comorbidity Index Examples include: low: common vascular risk factors such as hypertension, hyperlipidemia; moderate: diabetes, gout or osteoarthritis with or without the “low” set; high: significant end-organ damage for example, concomitant heart or liver failure; very high: severe or end stage systemic disease (e.g., cancer, end stage chronic obstructive pulmonary disease, end stage renal disease)	7	7 (6.25–7) ^a	7	7 (6–7)

ARDS: acute respiratory distress syndrome; ADL: activities of daily living.

^a Second round IQR is narrower than first round.^b The interquartile range (IQR) is the same between the 2 rounds.

to in-person rehabilitation for severely disabled individuals coupled with novel telerehabilitation systems for less severe disability will optimize the equitable allocation of rehabilitation services [1,2,10,11].

We propose a broad working framework (Fig. 1) using similar domains (Table 2) that is adaptable across different rehabilitation systems and encourage similar studies worldwide [2,4]. Multidisciplinary groups comprising healthcare and hospital authorities,

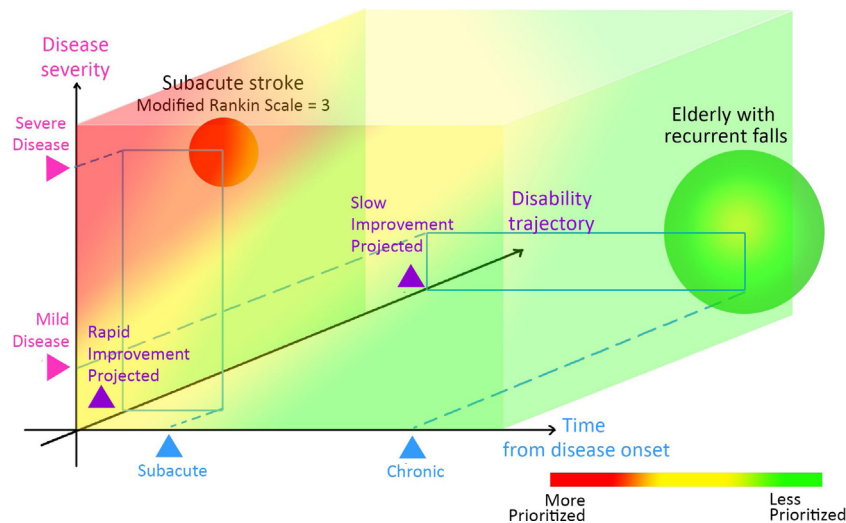


Fig. 1. Interacting priority domains in determining what is essential rehabilitation during a pandemic. The size of spheres represents approximate and relative sizes of specific disease cohorts. Threshold for determining priority can be set. In this diagram, the volume of the high priority rehabilitation zones (red and yellow zones) are arbitrarily set at about 30% of the entire volume.

rehabilitation clinicians and even patient groups within the same practice locality should review prioritization criteria to be implemented systematically during periods of service restrictions [3,6].

In summary, recent-onset, severe, systemic, disabling diseases with good recovery prognosis should be prioritized for in-person rehabilitation during pandemics when resources are limited. Other factors including the need for specialized rehabilitation, caregiver support status and comorbidity may be considered for rehabilitation right-siting or as modifiers of rehabilitation outcomes.

Contributions

NYS, PO and EC conceived and designed the study. SMM, CWCK and LYJ administered the survey and performed the analyses. All authors interpreted the data, read, and approved the final manuscript. All authors meet the criteria for authorship stated in the *Uniform Requirements for Manuscripts Submitted to Biomedical Journals*.

Disclosure of interest

The authors declare that they have no competing interest.

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Yee Sien Ng^{a,b,c,d,*}, Peck-Hoon Ong^e, Shi Min Mah^f, Charissa W.C. Koh^g, Yong Joo Loh^h, Effie Chew^{ij}

^aDepartment of Rehabilitation Medicine, Singapore General Hospital, Singapore

^bDepartment of Medicine, Sengkang General Hospital, Singapore

^cDuke-National University of Singapore (NUS) Medical School, Singapore

^dGeriatric Education and Research Institute, Singapore

^eHealth & Social Sciences Cluster, Singapore Institute of Technology, Singapore

^fDepartment of Physiotherapy, Sengkang General Hospital, Singapore

^gHealth Services Research and Evaluation, Singapore Health Services, Singapore

^hDepartment of Rehabilitation Medicine, Tan-Tock-Seng Hospital,
Singapore
ⁱDivision of Neurology, Department of Medicine, National University
Hospital, Singapore
^jYong-Loo-Lin School of Medicine, National University of Singapore,
Singapore

*Corresponding author
E-mail address: ng.yee.sien@singhealth.com.sg (Y.S. Ng)

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