ASSESSING RISK OF COVID-19
IN AGED CARE

Outcomes from infection with COVID-19 (coronavirus) vary from completely asymptomatic to serious morbidity and mortality. Factors that are consistently associated with poor outcomes are advanced age, frailty and multiple co-morbidities.

KEY POINTS

Cardiovascular disease (specifically hypertension), chronic kidney disease, diabetes, chronic lung disease (specifically chronic obstructive pulmonary disease – COPD), cerebrovascular disease and malignancy all more than double the risk of death with COVID-19.

People aged over 80 years old are at significantly higher risk of poor outcomes from COVID-19 than those aged 70 to 80 years old.

A COVID-19 severity score may assist in selecting people where pre-emptive changes to medications may reduce risk of poor outcomes with COVID-19.

Pre-emptive changes to medication include optimisation of management of modifiable risk factors (e.g. diabetes, hypertension, COPD) and simplification/ rationalisation of medication regimen.

In Australia, as at June 2021, there had been 908 deaths due to COVID-19 from approximately 30,000 coronavirus-positive people.

While many people who contract COVID-19 recover over time, there are a number of factors that result in more serious outcomes (such as hospitalisation, ICU admission or death) with COVID-19 infection. It would obviously be advantageous if it were possible to predict which people would be more likely to do poorly, particularly if some of the risk factors are at all modifiable.

A number of research articles have addressed the issue of risk factors by looking at patients already diagnosed with COVID-19 and examining the course of their disease. Initially these were based on the Chinese experience, however a wider representation of cases is now available. A systematic review (November 2020) and meta-analysis reviewed 88 such articles that examined indicators associated with 5311 COVID-19 deaths in 69,762 COVID-19 positive people (predominantly from China, Europe, the United Kingdom and the United States).[1] They reviewed co-morbidities and symptoms in patients with COVID-19 and used information from survivors and non-survivors to determine Odds Ratios for mortality (see detailed results later).

Factors that were consistently associated with poor outcomes were advanced age, a range of co-morbidities, and frailty. These factors are very common in residents of aged care facilities and an assessment of the relative importance of these factors would assist in developing a tool for assessing the risk of poor outcomes in such people should they become infected with COVID-19.

FACTORS ASSOCIATED WITH POOR OUTCOMES WITH COVID-19

Age

Over 75% of the deaths that have occurred in Australia to date have been in people 80 years or older, and over 90% of the deaths were in people over 70 years of age (**Figure 1**).

When the number of cases is considered, the case fatality rate for COVID-19 (deaths per 100 cases) is over 40% for males over 80 years of age and almost 30% for females of the same age. This case fatality rate is approximately 3.5 times higher than that in people 70-79 years of age and 20 fold higher than that for people 60-69 years of age. Further, if the total population of people in each age bracket is considered (deaths per 100,000 population), the risk of death from COVID-19 in people over 80 years old is over 6-fold higher than in those 70-79 years old and over 40-fold higher than in those 60-69 years old (see **Figure 1**).

Thus, while the Australian Government Department of Health states that people aged 70 or older are at high risk of severe illness with COVID-19[2], people aged 80 or more are at significantly higher risk of mortality with COVID-19 than those aged between 70 and 80.

While chronological age is a factor, many older people have chronic diseases, and a number of chronic conditions have also been associated with increased severity of COVID-19.
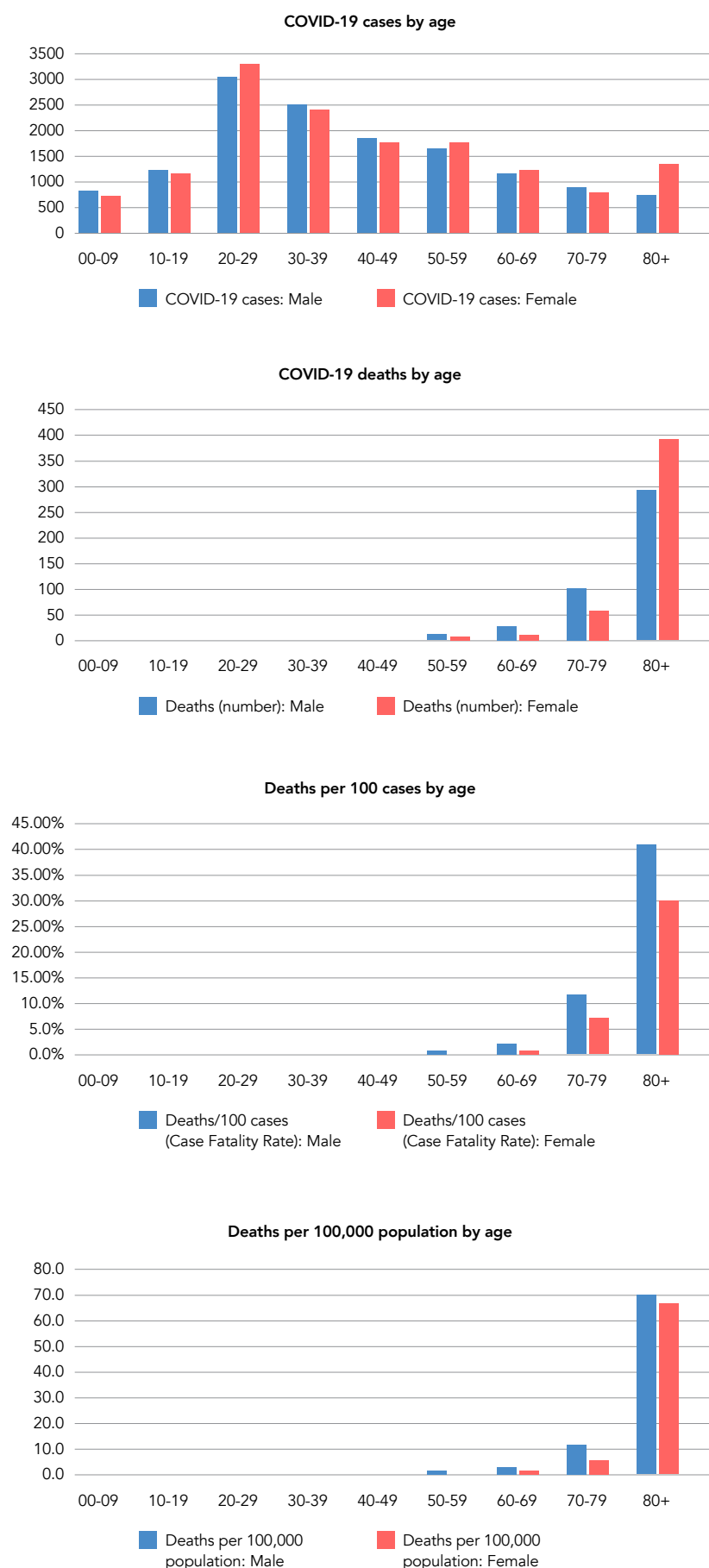
COVID-19 cases by age

COVID-19 deaths by age

Deaths per 100 cases by age

Deaths per 100,000 population by age

Figure 1: COVID-19 cases and deaths in Australia by age and sex

Co-morbidities

Studies of co-morbidities and COVID-19 outcomes are almost exclusively retrospective cohorts examining associations of the particular condition(s) with COVID-19 outcomes in patients already diagnosed with COVID-19. Despite attempts to clarify these associations by correcting for known influencing or confounding factors, the causality of the particular conditions remains unclear and this should be borne in mind when assessing the available information.

The systematic review and meta-analysis referred to earlier[1] is the most comprehensive review of co-morbidities. This confirmed that cardiovascular disease (and specifically hypertension), chronic kidney disease, diabetes, chronic lung disease (and specifically chronic obstructive lung disease), cerebrovascular disease and malignancy all had a greater than two-fold increase in odds of death with COVID-19. Smoking was also associated with an increase in mortality (see **Figure 2**).

Of importance, these authors found several studies that indicated that immunosuppressive therapy, asthma, and liver disease were not associated with an increase in mortality.

Frailty

A number of articles from various countries have identified that frailty predicts poor or fatal outcomes from COVID-19 in older patients.[3,4,5,6,7,8] The combination of frailty with multi-morbidity seems associated with an especially high risk of death from COVID-19. In an Italian study, less than 2% of patients with COVID-19 without frailty died, while 28% of those with multi-morbidity only and 75% of those with both multi-morbidity and frailty died (see **Figure 3**).[5]
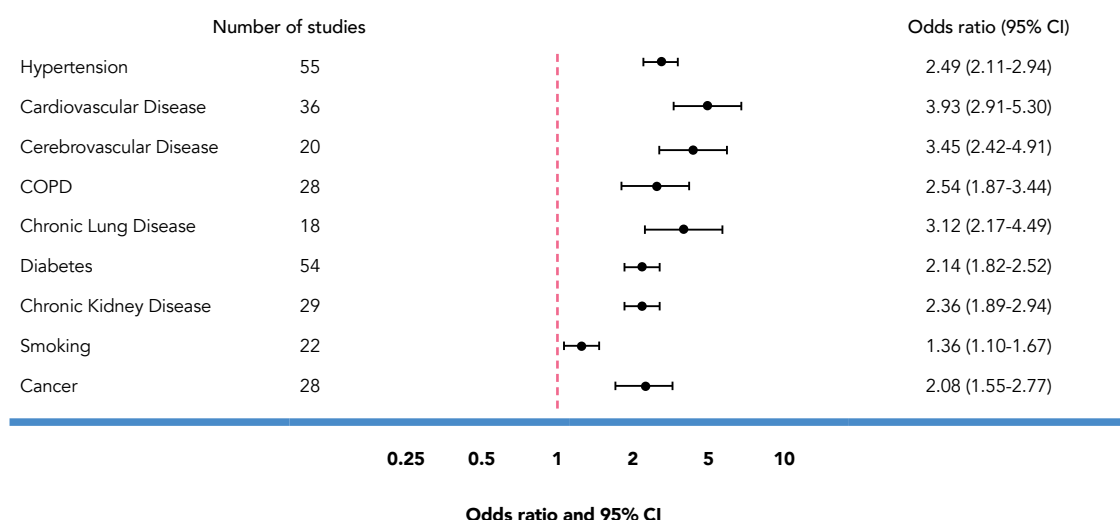
	Number of studies		Odds ratio (95% CI)
Hypertension	55		2.49 (2.11-2.94)
Cardiovascular Disease	36		3.93 (2.91-5.30)
Cerebrovascular Disease	20		3.45 (2.42-4.91)
COPD	28		2.54 (1.87-3.44)
Chronic Lung Disease	18		3.12 (2.17-4.49)
Diabetes	54		2.14 (1.82-2.52)
Chronic Kidney Disease	29		2.36 (1.89-2.94)
Smoking	22		1.36 (1.10-1.67)
Cancer	28		2.08 (1.55-2.77)

0.25　0.5　1　2　5　10

Odds ratio and 95% CI

Figure 2: Odds ratio for mortality with COVID-19 (COPD = chronic obstructive pulmonary disease, OR = odds ratio, CI = confidence interval, N = number of studies) (modified from Reference 1)
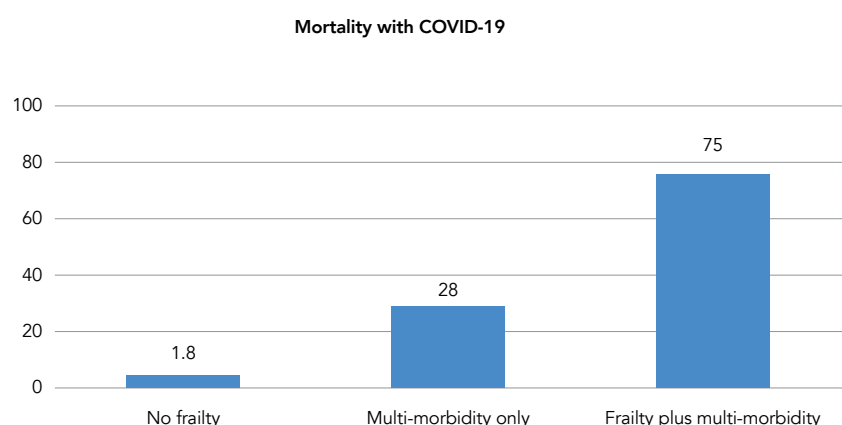
Mortality with COVID-19

No frailty: 1.8
Multi-morbidity only: 28
Frailty plus multi-morbidity: 75

Figure 3: Risk of mortality for no frailty, multi-morbidity or the combination of frailty and multi-morbidity (adapted from Reference 5)

A variety of assessment tools were used in the studies of frailty and COVID-19 outcomes. In the largest of these studies,[3] the Clinical Frailty Scale (CFS), a simple 9-point scoring system was used[9,10] (see **Figure 4**).

The study found that higher frailty (CFS 5-9) was associated with both earlier death and longer time in hospital when adjusted for age, sex, smoking status and co-morbidities (see **Table 1**).

Clinical Frailty Scale	Time to mortality HR (95%CI)*	Time to discharge from hospital HR (95%CI)*
1-2	1.00 (ref)	1.00 (ref)
3-4	1.55 (1.00-2.41)	0.94 (0.77-1.16)**
5-6	1.83 (1.15-2.91)	0.70 (0.54-0.91)
7-9	2.39 (1.50-3.81)	0.66 (0.50-0.87)

*HR= Adjusted Hazard Ratio (adjusted for age, sex, smoking status, increased C reactive protein, diabetes, coronary artery disease, hypertension, impaired renal function) 95%CI= 95% confidence interval
** not significant

Table 1: Hazard ratio for mortality and discharge from hospital with COVID-19 for different Clinical Frailty Scale scores (from Reference 3)

CLINICAL FRAILTY SCALE

	1	VERY FIT	People who are robust, active, energetic and motivated. They tend to exercise regularly and are among the fittest for their age.
	2	FIT	People who have no active disease symptoms but are less fit than category 1. Often, they exercise or are very active occasionally, e.g., seasonally.
	3	MANAGING WELL	People whose medical problems are well controlled, even if occasionally symptomatic, but often are not regularly active beyond routine walking.
	4	LIVING WITH VERY MILD FRAILTY	Previously "vulnerable", this category marks early transition from complete independence. While not dependent on others for daily help, often symptoms limit activities. A common complaint is being "slowed up" and/or being tired during the day.
	5	LIVING WITH MILD FRAILTY	People who often have more evident slowing, and need help with high order instrumental activities of daily living (finances, transportation, heavy housework). Typically, mild frailty progressively impairs shopping and walking outside alone, meal preparation, medications, and begins to restrict light housework.
	6	LIVING WITH MODERATE FRAILTY	People who need help with all outside activities and with keeping house. Inside, they often have problems with stairs and need help with bathing and might need minimal assistance (cuing, standby) with dressing.
	7	LIVING WITH SEVERE FRAILTY	Completely dependent for personal care, from whatever cause (physical or cognitive). Even so, they seem stable and not at high risk of dying (within 6 months).
	8	LIVING WITH VERY SEVERE FRAILTY	Completely dependent for personal care and approaching end of life. Typically, they could not recover even from a minor illness.
	9	TERMINALLY ILL	Approaching the end of life. This category applies to people with a life expectancy <6 months, who are not otherwise living with severe frailty. (Many terminally ill people can still exercise until very close to death.)

Figure 4: Clinical Frailty Scale[9,10]

DEVELOPING A RISK ASSESSMENT TOOL

The factors above (older age, co-morbidities and frailty) all occur commonly in residential aged care and in patients with chronic disease in the community. While any of these factors may increase the risk of poor outcomes, it is clear that people with multiple of these factors would be at higher risk of poor outcomes.

It is possible to collate the factors that have been associated and develop a rudimentary tool for determining relative risk of poor outcomes in COVID-19. In **Table 2** below, a scaled score for age and degree of frailty and a score for each co-morbidity is listed. A greater score is attached to age over 80 (compared to age over 70) and to a clinical frailty score of 7 or 8 (compared to a lower frailty score) as the risk of poor outcomes is significantly higher for people with these features.

Age
70-80 **(1 point)**
Over 80 **(2 points)**
Co-morbidities
Chronic lung disease (COPD, emphysema, bronchitis - excludes mild or moderate asthma) **(1 point)**
Cardiovascular disease (coronary heart disease, heart failure, or hypertension) **(1 point)**
Cerebrovascular disease (stroke, TIAs) **(1 point)**
Diabetes **(1 point)**
Chronic renal failure (CKD Stage 4 or greater – eGFR<30ml/min/sqm) **(1 point)**
Non-haematological malignancy **(1 point)**
Frailty
Clinical Frailty Scale score of 5 or 6 **(1 point)**
Clinical Frailty Scale score of 7 or more **(2 points)**

Table 2: Factors associated with poor outcomes with COVID-19

This assessment tool was tested at five facilities in Tasmania (a total of 405 residents) and the results are shown in **Table 3** and **Figure 5**.

Close to 75% of residents were over 80 years old (average age of all residents was 85), and had cardiovascular disease or a clinical frailty score of 7 or 8.

While all residents in aged care are at high risk of poor outcomes with COVID-19, those that score higher on this scale will necessarily have a significantly higher risk because of a combination of advanced age, frailty, and one or more co-morbidities. Approximately one third of patients score 6 or more and over two thirds score 5 or more. Targetting such patients, particularly if they are taking multiple medications, to have a close review of their medications with a view to making pre-emptive changes, may reduce their risk. The pre-emptive changes would include optimisation of management of modifiable risk factors (e.g. diabetes, hypertension, COPD) and simplification/rationalisation of each medication regimen.

COVID-19 risk factor		Number	Percentage of residents
Age	under 70	20	4.9
	70-80	77	19.0
	over 80	308	76.0
Co-morbidities	Chronic lung disease	72	17.8
	Cardiovascular disease	302	74.6
	Cerebrovascular disease	101	24.9
	Diabetes	94	23.2
	Chronic renal failure	29	7.2
	Non-haematological malignancy	63	15.6
Clinical Frailty Score	4 or less	6	1.5
	5 to 6	92	22.7
	7 or 8	307	75.8

Table 3: Elements of COVID-19 severity screening score - Results in 405 aged care facility residents in Tasmania

COVID-19 risk score **Cumulative risk score**

1	1 (0.2%)	400 (100%) 1 or more
2	10 (2.5%)	404 (99.8%) 2 or more
3	29 (7.2%)	394 (97.3%) 3 or more
4	74 (18.3%)	365 (90.1%) 4 or more
5	139 (34.3%)	291 (71.8%) 5 or more
6	105 (25.9%)	152 (37.5%) 6 or more
7	37 (9.1%)	47 (11.6%) 7 or more
8	10 (2.5%)	10 (2.5%) 8 or more

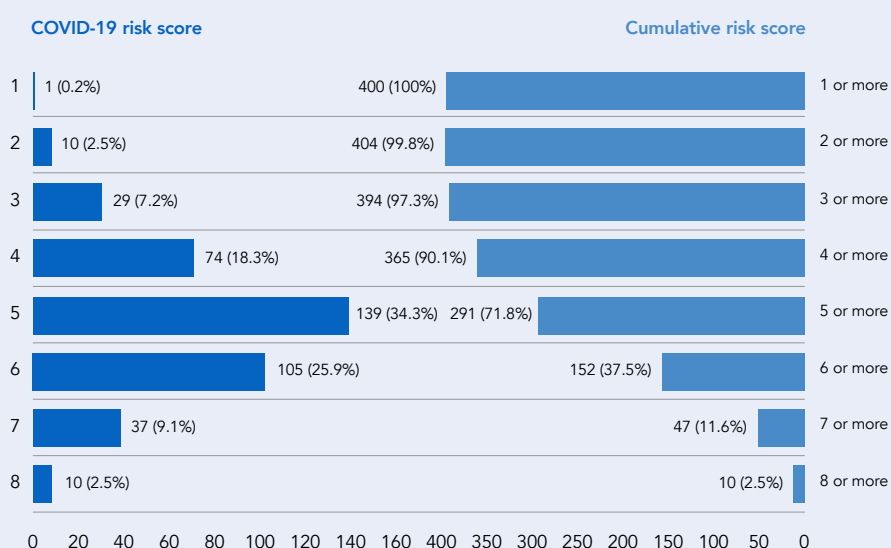0 20 40 60 80 100 120 140 160   400 350 300 250 200 150 100 50   0

Figure 5: COVID-19 severity risk score in Tasmanian nursing homes

[1] Katzenschlager S, Zimmer AJ, Gottschalk C, Grafeneder J, Seitel A, Maier-Hein L, Benedetti A, Larmann J, Weigand MA, McGrath S, Denkinger CM. Can we predict the severe course of COVID-19 - a systematic review and meta-analysis of indicators of clinical outcome? medRxiv [Preprint]. 2020 Nov 12:2020.11.09.20228858. doi: 10.1101/2020.11.09.20228858. PMID: 33200148; PMCID: PMC7668761.

[2] https://www.health.gov.au/health-alerts/covid-19/advice-for-groups-at-risk

[3] Hewitt J, Carter B, Vilches-Moraga A, Quinn TJ, Braude P, Verduri A, Pearce L, Stechman M, Short R, Price A, Collins JT, Bruce E, Einarsson A, Rickard F, Mitchell E, Holloway M, Hesford J, Barlow-Pay F, Clini E, Myint PK, Moug SJ, McCarthy K; COPE Study Collaborators. The effect of frailty on survival in patients with COVID-19 (COPE): a multicentre, European, observational cohort study. Lancet Public Health. 2020 Aug;5(8):e444-e451. doi: 10.1016/S2468-2667(20)30146-8. Epub 2020 Jun 30. PMID: 32619408; PMCID: PMC7326416.

[4] Kundi H, Çetin EHÖ, Canpolat U, Aras S, Celik O, Ata N, Birinci S, Çay S, Özeke Ö, Tanboğa IH, Topaloğlu S. The role of Frailty on Adverse Outcomes Among Older Patients with COVID-19. J Infect. 2020 Dec;81(6):944-951. doi: 10.1016/j.jinf.2020.09.029. Epub 2020 Sep 28. PMID: 33002560; PMCID: PMC7521439.

[5] Marengoni A, Zucchelli A, Vetrano DL, Armellini A, Botteri E, Nicosia F, Romanelli G, Beindorf EA, Giansiracusa P, Garrafa E, Ferrucci L, Fratiglioni L, Bernabei R, Onder G. Beyond chronological age: Frailty and multimorbidity predict in-hospital mortality in patients with coronavirus disease 2019. J Gerontol A Biol Sci Med Sci. 2020 Nov 20:glaa291. doi: 10.1093/gerona/glaa291. Epub ahead of print. PMID: 33216846; PMCID: PMC7717138.

[6] Aliberti MJR, Covinsky KE, Garcez FB, Smith AK, Curiati PK, Lee SJ, Dias MB, Melo VJD, Rego-Júnior OFD, Richinho VP, Jacob-Filho W, Avelino-Silva TJ. A fuller picture of COVID-19 prognosis: the added value of vulnerability measures to predict mortality in hospitalised older adults. Age Ageing. 2021 Jan 8;50(1):32-39. doi: 10.1093/ageing/afaa240. PMID: 33068099; PMCID: PMC7665299.

[7] Mendes A, Serratrice C, Herrmann FR, Genton L, Périvier S, Scheffler M, Fassier T, Huber P, Jacques MC, Prendki V, Roux X, Di Silvestro K, Trombert V, Harbarth S, Gold G, Graf CE, Zekry D. Predictors of In-Hospital Mortality in Older Patients With COVID-19: The COVIDAge Study. J Am Med Dir Assoc. 2020 Nov;21(11):1546-1554.e3. doi: 10.1016/j.jamda.2020.09.014. Epub 2020 Sep 15. PMID: 33138936; PMCID: PMC7491997.

[8] Tehrani S, Killander A, Åstrand P, Jakobsson J, Gille-Johnson P. Risk factors for death in adult COVID-19 patients: Frailty predicts fatal outcome in older patients. Int J Infect Dis. 2021 Jan;102:415-421. doi: 10.1016/j.ijid.2020.10.071. Epub 2020 Oct 30. PMID: 33130213.

[9] Rockwood, K., X. Song, C. MacKnight, H. Bergman, D.B. Hogan, I. McDowell, and A. Mitnitski, A global clinical measure of fitness and frailty in elderly people. CMAJ, 2005. 173: p. 489-195

[10] Available from Dalhousie University, Canada at https://www.dal.ca/sites/gmr/our-tools/clinical-frailty-scale.html