Measuring functional status of older adults with cancer with patient and performance-based measures, a how-to guide: A young society of geriatric oncology and nursing and allied health initiative

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Functional status is an indicator of quality of life, cancer-related outcomes, chemotherapy toxicity, increased health care use, and even mortality [1–4]. Measurement of functional status, is strongly recommended by The International Society of Geriatric Oncology (SIOG) and the American Society of Clinical Oncology (ASCO) as a core domain of the geriatric assessment (GA) [5] to optimize treatment, and to inform interventions and supportive care for older adults with cancer [6,7]. Performance status, historically measured by crude measures such as Karnofsky Performance Status and Eastern Cooperative Oncology Group (ECOG), are not sensitive or specific enough for patient-centered, precision-based care [8]. Recommended assessment of functional status is a combination of patient- or proxy-reported and physical performance-based measures [9]. This paper provides the "how-to" guide to implement both forms of measurement.

1. Patient- or Proxy-Reported Measures of Function

Patient- or proxy-reported functional status can be assessed using widely used indicators such as: Activities of daily living (ADL), instrumental activities of daily living (IADL), health related quality of life (HRQOL), and prior falls. ADL and IADL measures, (e.g. Katz, Older Adult Resources and Services (OARS)) and HRQOL measures consist of 5–14 questions that can be answered easily, and take less than 5 min to complete. For example, assessing for prior falls can be assessed by just asking patients whether they have had a fall in the past 6 months or since the last clinic appointment. All instruments can be patient, or proxy (observer) reported [10–13]. All measures are described in more detail in Table 1.

1.1. Activities of Daily Living (ADL)

Basic activities of daily living includes dressing, grooming, bathing, toileting, feeding oneself and basic mobility. Some anticancer treatments have side effects that can directly impact ones ability to take care of themselves. In general, about one third of adults with cancer report ADL difficulty [14]. Limitations in ADL can impact mortality, morbidity, health care use and overall quality of life [4,15].

1.2. Instrumental Activities of Daily Living (IADL)

IADL concerns the patient's ability in accomplishing tasks that are necessary for independence in the community; such as, shopping, food preparation, housekeeping, doing laundry, use of transportation, use of medicine, telephoning, and financial behaviour. All domains require some degree of both physical and cognitive function. The skills covered are more complex compared to ADL and, therefore, are more sensitive for subtle functional deficiencies ADL [14]. Half of adults with cancer report difficultly in at least one domain of IADL [14]. Decline in IADL is an indicator of "slowing down" that can be a factor in future falls risk, and even chemotherapy tolerance [16,17].

1.3. Health-Related Quality of Life

Patients' self-rated level of activities and functional ability has been found to be significantly associated with HRQOL [4,18]. HRQOL is associated with frailty [19], cancer recurrence [20], and survival [21]. Older adults with cancer are at a significant risk of decreased HRQOL after diagnosis of cancer, with up to 25% reporting poor physical QOL, and 10% reporting poor mental QOL compared to those without cancer [22,23]. A widely used measurement of HRQOL is the EuroQol - five dimensions, five level, (EQ-5D-5L) [24]. Another common measure is the PROMIS Global Health Short Form which measures perceptions of global health across domains including physical function, pain, fatigue emotional distress, and social health [25]. These tools take less than 2 min to complete, and have been used in the geriatric oncology setting [26].

1.4. Special Considerations when Measuring ADL, IADL and HRQOL

One in five older patients develop new ADL impairment between the 1st and 2nd cycle of chemotherapy [27] and over half report an decline in IADL [14]. Given that older patients' functional status can change dramatically within a short window of time and the impact on other oncology based outcomes, routine assessment of ADL, IADL and HRQOL may be beneficial especially during active anticancer treatment.

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Table 1

Patient (and proxy) reported measures: a how-to guide.

What the tool measures	Time	Resource required	How to score	Challenges/special considerations
Katz Index [47] The Katz index ranks ability to carry out functions of bathing, dressing, toileting, transferring, continence, and feeding. Yes/no are scored for independence in each of the six functions.	2 mins	Pen/Paper Or computer	6 signifies full function 4 indicates moderate impairment, ≤ 2 indicates severe functional impairment	The Katz Index has a floor and ceiling effect as it is not sensitive to variations in low and higher levels of impairment.
Older Adult Resources and Services: ADL and IADL [13] 14 items: seven items assess basic ADL (eating, dressing and undressing, grooming, walking, getting in and out of bed, bathing, and continence), and seven items assess IADL (using the telephone, travel, shopping, meal preparation, housework, taking medicine, and management of money.	3–5 mins	Pen/Paper Or computer	Each item is rated on a 3-point scale: without help (2), with some help (1), or completely (0). Sum score of all 14 items (range 0–28). They can also be scored separately as ADL and IADL score. A higher score on each of these three scales indicates greater independence [48].	The reliance on self- or proxy-report rather than direct observation may lead to overestimation or underestimation of abilities. However, the patient's perspective provides a unique data point and remains their objective measurement of ability. This instrument may not be sensitive to small, incremental changes in functional ability [49].
PROMIS® Global Health [25] The PROMIS global Health short form measures perceptions of global health across domains including physical function, pain, fatigue emotional distress, and social health [25]. This tool has been used in the geriatric oncology setting [50].	2 mins	Pen/Paper Or computer	The PROMIS global is a 10 item measure that scores into two subscores of global physical and mental health. This measure, developed by the NIH, is a valid and reliable measure of functional health, and can also be used to compare to general population. Furthermore, this assessment can be used as subscores as well as each. The total raw score needs to be converted using a conversion (www.healthmeasures.net)	In addition to subscores, there are items that ask about fatigue and pain – considering each item can stand alone if needed, there are multiple ways to use this measure.
EQ-5D-5 L [24] The EQ-5D-5L consists of 2 pages: the EQ-5D descriptive system and the EQ visual analogue scale (EQ VAS).The descriptive system encompasses five components, with 5 levels (no problems to extreme) in mobility, self-care, usual activities, pain/discomfort and anxiety/depression. The EQ VAS reports the patient's self-rated health by asking visually 'The best health you can imagine' to 'The worst health you can imagine'.	>1 min	Pen/Paper Or computer	An EQ-5D summary index is derived by applying a formula that attaches weights to each of the levels in each component. The index is calculated by deducting the appropriate weights from 1, the value for full health (i.e. 12,345). The collection of index values (weights) for all possible EQ-5D health states is called a value set- a score of 11,111 indicates no problems. See for more details: https://euroqol.org/eq-5d-instruments/eq-5d-5l-about/	This tool is available in self-report, interviewer-based, and proxy versions.

*ADL – activities of daily living; IADL – instrumental activities of daily living; PROMIS - Patient-Reported Outcomes Measurement Information System; EQ-5D-5L – the 5-level EQ-5D version

2. Physical Performance Measures

Commonly used physical performance measures include gait speed, functional mobility, and grip strength, and can be assessed by healthcare professionals (e.g., nurses, occupational therapists, physical therapists, or physicians). All measures are described in detail in Table 2.

2.1. Functional Mobility

Measures of functional mobility, balance and endurance are closely linked to frailty [28,29] and falls which, in turn, can predict hospitalization frequency and long-term care use [30]. Commonly used functional mobility tests include the gait speed, Time Up and Go (TUG) test, the 30-s sit to stand and the Short Physical Performance Battery (SPPB) test. These tests take 1–10 min to administer.

Gait speed – "the functional vital sign" [31] - is an important measure of frailty that strongly predicts mortality [32,33], treatment related complications [34], healthcare utilization [33], and functional decline [35] in older adults with cancer. Assessing this 'vital sign' in clinics may substantially improve prognostication and individualization of care [33]. To administer this test, instruct the patient to walk at their normal pace and not to slow down before the end of the 4-m mark. Assistive device may be used if needed.

The 30-s sit to stand test assesses patients' balance, lower extremity strength, and functional mobility. In older adults, this test predicts falls [36] and is associated with physical health status, functional decline, and frailty [37]. 30-s sit to stand entails having the patient place hands on opposite shoulders, crossed at the wrists. Keeping feet flat and back straight, complete as many full stands as possible in 30 s. A variation of this test is the 5-times chair stand [38] which requires the person to complete 5 sets of standing and sitting.

The TUG entails having the patient to stand up from a sitting position, walk forward at normal pace for a designated distance, then turn around and return to the chair. SPPB is a group of performance measures combining the results of the gait speed, chair stand and balance tests [39,40] and has been used to predict possible disability and can be useful in monitoring of function in older adults. More detail on all tests suggested here are in Table 2.

2.2. Hand-Grip Strength

Hand-grip strength is a useful test to identify patients with increased risk for mobility limitation [41], and is independently associated with survival and functional characteristics in patients with advanced cancer and hematologic cancers [42]. This test entails having the patient squeeze a hand dynamometer while in a seated position and takes less than 5 mins [43].

3. Case

A 70 year old male (LM) with stage three localized muscle invasive urothelial cancer, presents in clinic. He is post surgical removal of

Table 2
Recommended Physical Performance Measures: A how-to guide.

What the tool measures	Time	Resource required	How to administer	How to score	Challenges/special considerations
Gait Speed [51] Balance, coordination and functional mobility	< 5 mins	• Measuring tape, • Masking tape/duct tape, • Distance of 4 m • Stopwatch	• Instruct the patient to walk at their normal pace and not to slow down before the end of the 4-m mark. • Assistive device may be used if needed.	The gait speed is recorded for 2 trials. Using the faster of the two trials. Record the time taken for the patient to walk the 4 m, then calculate gait speed by dividing the 4 m by the time taken to walk, to yield the gait speed in meters per second (m/s). A gait speed <0.8 m/s (taking more than 5 s to walk 4 m) suggests an increased risk of frailty and need for further assessment.	It is normal to observe faster walking at the second trial than the first trial due to practice effects [51].While longer courses (e.g. 10-m course) may provide more valid assessment of walking speed, the literature suggests that shorter course are also valid as well as more feasible in busy clinic settings. [52]
Timed Up and Go (TUG) [49] Balance, gait, and functional mobility	< 3 mins	• Standard armchair, • Measuring tape, • Masking tape/duct tape, • Distance of 10 m • Stopwatch	• Begin the test by having the patient sit back in the chair. • Instruct patient: When I say "Go" I want you to: Stand-up, walk to and around the tape, then return to the chair and sit down at your normal pace • Start stopwatch when patient begins to stand, and stop when patient's buttocks touch chair. • Assistive device may be used if needed.	A score of >9–10 s patient is at risk for falling and slow gait [38].	As with other walking tests, be sure to stay within an arm's length with the patient during the test in the event that the patient may suddenly lose balance.
30 s sit to stand [36] Balance, lower extremity strength, and functional mobility	< 3 mins	• Standard armchair, • Stopwatch	• Explain "We would like to see how long it takes you to stand up and sit down as quickly as possible within 30 min without stopping. After you stand up each time, sit down and then stand up again. Please keep your arms folded across your chest. I will be timing you with a stopwatch" • Demonstrate the maneuver to the patient, then ask is they are ready. If so, begin timing as soon as the patient bends forward at the hips. • Count out loud the number of sits the patient has performed. • Stop the stop watch as soon as they sit down at the end of the 30 s. • During the test, also stop if the patient starts to use their arms. • Record the number of sets the patient was able to do. Also record any presence of imbalance.	Chair Stand below average scores based on sex and age: Age Men Women 60–64 <14 <12 65–69 <12 <11 70–74 <12 <10 75–79 <11 <10 80–84 <10 <9 85–89 <8 <8 90–94 <7 <4	The patient should be seated in middle of chair, hands on opposite shoulders, crossed at the wrists. Keeping feet flat and back straight, complete as many full stands as possible Stop the test if the patient cannot execute the maneuvers or if you are concerned about the patient's safety
Hand Grip Strength [41] Muscle strength, function	>5 mins	Handheld dynamometer	• Ask the patient to remove any watches or bracelets. • Record the patient's hand dominance. Start with the dominant hand and then the non--dominant hand. • Demonstrate how to hold the dynamometer. Explain to patient that how the dial registers the best result by squeezing as tightly as possible. • Sit patient comfortably in a chair with a back support • Shoulder is close to side, elbow flexed at 90 degrees • Arm is not supported on arm rest. • Instruct patient not to allow feet to rise from the floor while squeezing the dynamometer	Maximal strength is average of three trials. Optimal hand-grip cut-points for increased likelihood for mobility limitation: Men (normal weight: 33 kg; overweight: 39 kg; obese: 40 kg), women (normal weight: 20 kg; overweight: 21 kg; obese: 23 kg) For more information: https://www.uhs.nhs.uk/Media/	The position of the handle can be adjusted as needed for different sized hands. For example, if you notice the patient's finger nails are digging in to the palm, it means that the handle should be moved further away from the mechanism. Or, if it looks as though the fingers are not close enough to the palm and it feels to the patient as if their hand may slip off the handle when squeezing, then the handled should be adjusted to bring it closer to the mechanism. When recording the reading, the outside dial registers the result in kg and the inner dial in lb.

(continued on next page)

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Table 2 (*continued*)

What the tool measures	Time	Resource required	How to administer	How to score	Challenges/special considerations
			• Ask patient to grip dynamometer • Turn the dial on the dynamometer to set the red needle to the "0" position or start test if digital. • Remind the patient the hand dynamometer is not built to move during assessment. • Encourage squeezing as long and as tightly as possible until the needle stops rising. E.g. Use a standard phrase: "Squeeze……harder, harder…and. stop squeezing" • Record the result to the nearest kg. • After measurement on one hand is completed, repeat test on the other hand. Record three measurements for each hand, alternating sides.	Southampton-Clinical-Research/ Procedures/BRCProcedures/ Procedure-for-measuring-gripstrength-using-the-JAMAR-dynamometer.pdf	Disregard recording and repeat the test if the patient's arm rises above the arm of the chair, or if their feet lift off the floor during squeezing.
Short physical performance battery (SPPB) [40]					
Gait speed, balance, and lower limb strength	10 mins	• Chair with arms 18–19″ in height • Stopwatch • Tape measure • 2 cones to mark 2.44 m	Repeated chair stand: See above section on 30-min chair-stand. Balance items: Proceed to demonstrate the positions 1, 2 and 3, and provide explanation. *Stand next to the patient to help them into the positions. *Allow patient to hold onto your arms for balance at the beginning. *Begin timing when patient has feet together and stands without support. *If they are able to complete 10 s progress to next step. 1- Side-by-side stand:Explain: "Begin with your feet together beside each other. Try to stand with your feet together, side by side. You may use your arms, bend your knees, or move your body to maintain your balance, but try not to move your feet. Try to hold this position for 10 s. I will tell you to stop". 2- Semi-tandem stand: (The instep of one foot touching the big toe of the other foot.). Explain: "Now I would like you to try to stand with the instep of one foot touching the big toe of the other foot for 10 s. You may put either foot in front, whichever is more comfortable for you." *Stop the test when patient moves their feet, grasps you for support, or when 10 s has	Scores range 0–10; Higher scores indicative of higher functioning There are 3 components: 1- Ability to stand for 10 s or longer on balance items*side by side (1 point is able to; 0 if not); *semi-tandem (1 point is able to; 0 if not); *and tandem (2 points is able to for 10, 1 point for 3–9.99 s; 0 if less than 3 s or unable) **with a combine total of 4 points 2- Gait speed- See link for instructions with faster speeds indicating higher points allotted (scored 0–4 with 4 points indicating less than 4.82 s) 3- Sit to stand- See link for instructions. Higher points allotted for less time. With 4 points given to those able to complete 5 stands in less than 11.19 s; and 0 points in unable to complete 5 in 60 s. For more information on	Prior to start of the test, assess the safety and suitability of the patient to perform the tests. If you feel that the patient is too weak or too unsteady, do not perform the SPPB measures A variation of the 30 s sit to stand test is the 5-times Chair-stand, in which the patient is timed while carrying out 5 sets of the sit-to-stand maneuver, instead of given 30 s to carry out as many as possible. Remain within an arm's length of the patient during the entire test in case patient loses balance

kidney and ureter and awaits further treatment. He is a married male, working prior to diagnosis as a semi-truck driver. He has no other medical conditions beside high cholesterol controlled with statins. Prior to diagnosis he was robust, fully independent, active, played golf and walked for exercise.

In the initial clinic visit patient was given the routine functional measure screens: Katz ADL and IADL and PROMIS global forms to fill out while sitting the waiting area. He was able to complete instruments by himself and returned the surveys to the front desk staff in under 5 min. As per usual care, gait speed was administered by the clinic nurse in the back hallway and was performed en route while patient was being ushered to the examination room. The time it took to provide patient with instructions and to execute and complete the test took less than 2 min. Hand grip strength was then performed by the nurse once patient was seated in the examination room and it was completed in 2 min.

LM reported independence in basic activities of daily living (via Katz), yet reported only "moderately" (scored a 3/5) able to "to carry out your everyday physical activities such as walking, climbing stairs, carrying groceries, or moving a chair" on the PROMIS global, and

reported his physical health as (3/5, "good"), overall measured with PROMIS global scores: physical health = 46; mental health 52). He was considered at risk for falls based on gait speed (0.6 m/s), and his hand grip strength (34 kg) (measured with dynamometer) is within normal limits for his sex/age. He was then referred for specialized cancer rehabilitation services: occupational therapy to address his ADL/IADL/ and global health needs, and PT for his physical activities, endurance and concerns regarding gait speed.

LM went to cancer rehabilitation. At discharge he was independent in ADL, IADL and his global HRQOL improved to pre- cancer status. He also started a physical activity program including walking, driving range, and exercised that was supervised by his physical therapist. His gait speed has returned to normal and has returned to pre-diagnosis robust status.

4. Discussion

The incidence of cancer is expected to continue to rise, with the aging of the population and improvement in early cancer detection

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programs [44]. Cancer treatment can lead to decrease in functional status [14]. The decision-making process for vulnerable older patients requires clinical parameters that can help guide treatment decisions [34]. Although the comprehensive geriatric assessment is useful for providing a holistic overview of the patient's health status and to unearth potential concerns [45], it may not be feasible for screening and to implement in daily practice. Performance status as measured historically through measures like Karnosfsky Performance Scale, and ECOG, are insufficient for older adults with cancer. Similar to the crude measure of chronological age, as opposed to the more optimal functional age, the evidence positions functional status as a more efficient and effective measure of patient-centered and cancer related outcomes.

Screening of physical performance and functional status, although less elaborate compared to a full assessment, is still useful for assessing patient's health status, and can be used as a prognostic tool in the older cancer population and to help optimize treatment decision-making [34,46].

In combination, patient reported and physical performance based measures offer the most comprehensive picture for decision making and also intervention. Cancer rehabilitation, specialized occupational and physical therapy, directly screen, assess and intervene to address and optimize function, HRQOL and physical performance-based outcomes. Functional status is not a static event only for predicting the future, but an indicator to refer to other cancer care team members to intervene.

5. Conclusion

This paper presents useful several patient performance measures to assess patient-reported function and physical performance. These tools can provide important information regarding patient's health and functional status and can be easily implemented in routine clinical practice to help optimize treatment and inform interventions.

Author contributions

Conceptualization, writing-original draft; writing review and editing were completed by both authors Drs. Pergolotti and Sattar (all others N/A).

Declaration of Competing Interest

Dr. Pergolotti receives a salary from ReVital Cancer Rehabilitation, Select Medical. Dr. Sattar has no conflicts of interest to declare.

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