Instrumental Activities of Daily Living after Critical Illness: A Systematic Review

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Abstract

Rationale: Poor functional status is common after critical illness, and can adversely impact the abilities of intensive care unit (ICU) survivors to live independently. Instrumental activities of daily living (IADL), which encompass complex tasks necessary for independent living, are a particularly important component of post-ICU functional outcome.

Objectives: To conduct a systematic review of studies evaluating IADLs in survivors of critical illness.

Methods: We searched PubMed, CINAHL, Cochrane Library, SCOPUS, and Web of Science for all relevant English-language studies published through December 31, 2016. Additional articles were identified from personal files and reference lists of eligible studies. Two trained researchers independently reviewed titles and abstracts, and potentially eligible full text studies. Eligible studies included those enrolling adult ICU survivors with IADL assessments, using a validated instrument. We excluded studies involving specific ICU patient populations, specialty ICUs, those enrolling fewer than 10 patients, and those that were not peer-reviewed. Variables related to IADLs were reported using the Patient Reported Outcomes Measurement Information System (PROMIS).

Results: Thirty of 991 articles from our literature search met inclusion criteria, and 23 additional articles were identified from review of reference lists and personal files. Sixteen studies (30%) published between 1999 and 2016 met eligibility criteria and were included in the review. Study definitions of impairment in IADLs were highly variable, as were reported rates of pre-ICU IADL dependencies (7–85% of patients). Eleven studies (69%) found that survivors of critical illness had new or worsening IADL dependencies. In three of four longitudinal studies, survivors with IADL dependencies decreased over the follow-up period. Across multiple studies, no risk factors were consistently associated with IADL dependency.

Conclusions: Survivors of critical illness commonly experience new or worsening IADL dependency that may improve over time. As part of ongoing efforts to understand and improve functional status in ICU survivors, future research must focus on risk factors for IADL dependencies and interventions to improve these cognitive and physical dependencies after critical illness.

Keywords: critical illness; critical care outcomes; functional outcomes; instrumental activities of daily living; patient-centered outcomes

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Each year, millions of patients survive critical illness (1–3) but often experience new and persistent physical, psychiatric, and cognitive impairments (4–10), collectively known as the “post-intensive care syndrome” (11, 12). Cognitive impairments after critical illness are often severe, and adversely affect complex cognitive functions (e.g., memory and executive function) that are essential for day-to-day functioning (13, 14). Physical impairments are also present in many patients (6, 15, 16), and include deficits such as neuromuscular weakness and impaired pulmonary function (6, 7). Psychiatric symptoms are wide-ranging, including depression (7, 17–21), anxiety (7, 9, 10, 19), and posttraumatic stress disorder (21–24). Many patients never return to their preillness functional baseline (7, 23, 25, 26). Each of these types of impairments is associated with long-lasting impairments in daily functioning.

Assessment of functional abilities after critical illness is crucial as functional impairments may interfere with the ability to live independently. Various approaches are available to assess functional outcomes after critical illness, including measures of strength and mobility, and assessment of activities of daily living (ADLs). Activities of daily living involve one’s ability to complete simple daily tasks such as bathing, dressing, and feeding, whereas instrumental activities of daily living (IADLs) involve more complex tasks such as financial and medication management, driving, shopping, house cleaning, and meal preparation. ADLs and IADLs are both essential to patient functioning and ability to live independently (27), and dependencies are associated with cognitive and physical impairments (28, 29). IADL dependencies reflect higher order functional impairments due to the cognitive demands required for successful task completion (30, 31). Further, IADL dependency is associated with a wide range of cognitive impairments (14, 28, 29), and new IADL dependency predicts future decline in cognitive function (30). Thus, IADLs represent a clinically meaningful postdischarge outcome in intensive care unit (ICU) survivors (30, 32, 33).

Impairments in IADL have been increasingly evaluated in ICU survivors (2, 34). Hence, our objectives were to synthesize existing data to (1) assess the prevalence of IADL impairments in

survivors of critical illness, (2) describe the type of IADL dependency and changes in IADL dependency over time, and (3) identify risk factors associated with IADL dependency after critical illness.

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (35) were followed for reporting this systematic review.

Search Strategy

We searched using PubMed, CINAHL, the Cochrane Library, SCOPUS, and the Web of Science through December 31, 2016 (*see* APPENDIX 1 in the online supplement). Our search strategy focused on articles that assessed IADLs in adult survivors of critical illness, using keywords associated with “critical illness/intensive care” and “IADL” and “functional outcomes” as per the eligibility criteria below. The initial search was limited to human studies and the English language, except for the Cochrane Library (which did not allow language limitation). Additional articles were identified from reference lists of eligible studies and personal files.

Article inclusion criteria were as follows: (1) study population of adult ICU survivors, and (2) assessment of IADLs (complex skills that support living independently), using a validated instrument designed specifically to evaluate IADLs. We excluded studies that (1) enrolled specific ICU populations, such as neurological (e.g., traumatic brain injury or subarachnoid hemorrhage) or cardiac surgery patients; (2) primarily specialty ICU; (3) had sample sizes less than 10 at follow-up; or (4) were not peer-reviewed, including published abstracts and dissertations.

Study Screening and Data Extraction

Each citation was independently reviewed for eligibility by two trained researchers (M.R.S. and R.O.H.) via review of titles and abstract, and then full text articles. Disagreement regarding eligibility was resolved by consensus. Relevant data were extracted for eligible articles by the same researchers and included study design, study setting, patient characteristics, instruments used, and relevant outcomes. Variables related to IADLs were coded and

categorized using the Patient Reported Outcomes Measurement Information System (PROMIS). The PROMIS system was developed by the National Institutes of Health and includes a structure to guide research about physical, mental, and social aspects of health and to identify which outcomes are important to patients (www.nihpromis.org) (36, 37).

Results

Study Selection

The search yielded 991 citations (Figure 1). After removal of duplicate records, screening of titles and abstracts, and identification of 23 additional studies from reference lists and personal files, 50 eligible full-text articles were evaluated for inclusion. Thirty-six articles were excluded as 29 did not include post-ICU IADL assessment using a validated measure and seven described nonadult ICU survivors. Of the 17 remaining articles, one study (38) was excluded as it reported identical data to a previous publication from the same cohort (6, 39), resulting in 16 studies of unique patient cohorts in this review (2, 17, 18, 39–50) (Figure 1 and Table 1).

Study Characteristics

Of the 16 included studies, 11 were conducted in the United States, four in Europe, and one in South America (Table 1). Fifteen studies (94%) involved a prospective cohort design and one was a randomized controlled trial. Eleven (69%) studies were conducted in a single institution and five studies were conducted in multiple institutions. Nine studies (56%) were published since 2010.

Participants and Follow-Up

The 16 studies enrolled 4,723 patients with a mean (SD) sample size of 315 (270) (range, 21–826) patients (Table 1). Sixty-five percent of enrolled patients completed the IADL assessment, with sample sizes ranging from 21 to 499 patients (mean [SD], 191 [176]). The mean (SD) time to follow-up was 12.9 (7.9) months (range, 2 to 24 mo) (Table 1), with eight studies (50%) having 2- or 3-month follow-up, six (38%) with 6-month follow-up, seven (44%) with 12-month follow-up, and five (31%) with 48-month follow-up. Ten studies assessed IADL at two or more time

Figure 1. Study flow diagram.

points (six studies with more than two follow-up times).

Instrumental Activities of Daily Living Measures

Three different IADL questionnaires were used: the Lawton IADL questionnaire (Lawton IADL) (31) in 11 studies (69%), the Pfeffer Functional Activities Questionnaire (FAQ) (51) in four studies (25%), and the 2012 Health and Retirement Study Core Interview Questionnaire Section G (52) in one study (6%) (Table 2). The Lawton IADL is an eight-item questionnaire that assesses the following eight tasks: using the telephone, shopping, housekeeping, washing laundry, food preparation, using public transportation, managing medications, and managing finances. Lawton IADL scores range from 0 to 8, with lower scores indicating greater dependence (31). The FAQ is a 10-item questionnaire that assesses tasks needed to live independently, including managing finances, assembling tax records or papers, playing a game or working on a hobby, preparing balanced meals, using the stove, shopping, remembering current events, paying attention to and understanding television or a book, remembering appointments, and traveling. Items are scored 0 (“independence”), 1 (“difficulty, but can complete without assistance”), 2

(“difficulty requiring assistance”), or 3 (“complete dependence”), with FAQ scores ranging from 0 to 30. A cut-point of 9 (dependent in three or more activities) indicates impaired function. The Health and Retirement Study Core Interview Questionnaire Section G assesses the total number dependences for six ADLs (bathing, dressing, walking, eating, getting in and out of bed, and toileting) and five IADLs (preparing a hot meal, shopping for groceries, making telephone calls, taking medications, and managing money) (52) with scores ranging from 0 (no assistance required) to 11 (assistance required in all areas).

Definitions of Instrumental Activities of Daily Living Dependency

Definitions of IADL dependency varied widely between studies, even when identical IADL measures were used (Table 2). Scores for defining IADL dependency varied from a single category of dependency to absolute numeric scores. This variability made cross-study comparisons difficult, despite use of similar measures. These differences in IADL instruments and dependency definitions precluded meta-analysis of these data.

Pre-ICU Instrumental Activities of Daily Living Dependency

Twelve studies (75%) reported data on pre-ICU IADL dependency (2, 17, 18, 40, 42, 43,

45–47, 48–50) (Table 2), with results ranging from 7 to 85%, but nine studies did not report percentage for either pre- or post-IADL dependency. Pre-ICU IADL dependency was significantly associated with post-IADL dependency in two of 12 studies (16%) (18, 43). One study reported that mild or moderate pre-ICU IADL dependency correlated with post-ICU IADL dependency; however, this was not the case for severe pre-ICU IADL dependency (2). Pre-ICU IADL dependency was also associated with an increased risk of early death post-ICU (43, 48, 49).

Post-ICU Instrumental Activities of Daily Living Dependency

Eleven studies (69%) reported that survivors of critical illness experience new or worsening IADL dependencies (Table 1). Post-ICU IADL dependencies ranged from 5 to 70% at the furthest time point measured (17, 18, 39, 40, 42, 43, 45, 47, 50) (Table 1). Most studies did not describe the specific type of IADL dependencies. Using the Lawton IADL questionnaire, Bienvenu and colleagues (17) reported that survivors were dependent in the following IADL areas: 70% for housekeeping, 60% for shopping, 51% for traveling, 49% for doing laundry, 43% for preparing food, 42% for managing finances, 30% for medication management, and 10% for using the telephone. Using the FAQ, Jackson and colleagues reported that the greatest IADL dependencies occurred in memory, financial management, making travel arrangements, and traveling.

Risk Factors for Instrumental Activities of Daily Living Dependency

There were few consistent associations between risk factors and IADL dependency (Table 3; and *see* Table E1 in the online supplement). For example, three of five studies showed a positive association between older age and IADL dependency (18, 34, 46). One of three studies showed a positive association with ICU delirium and post-ICU IADL dependency (40). Both studies evaluating mechanical ventilation demonstrated an association between longer duration of mechanical ventilation and increased IADL dependency (44, 47).

Change in Instrumental Activities of Daily Living Dependency over Time

All studies reported an increase in IADL dependency from the pre- to post-ICU

Table 1. Studies of instrumental activities of daily living in critically ill patients

Study [Author (Ref.) (place, yr)]	Study Design and Setting	Sample Characteristics and Follow-Up	Sample Size	IADL Instrument	Significant Findings
Abelha et al. (40) (Portugal, 2013)	Prospective cohort Surgical ICU Single institution	Surgical postoperative 6-mo follow-up	n = 562 enrolled n = 410 at 6 mo 6% died 21% lost to follow-up	Lawton IADL	19% had pre-ICU IADL dependencies 40% had post-ICU IADL dependencies
Bienvenu et al. (17) (USA, 2012)	Prospective cohort Medical-surgical ICU Four institutions	Mechanically ventilated patients with acute lung injury 3-, 6-, 12-, and 24-mo follow-up	n = 196 enrolled n = 146 at 24 mo 16% died 10% lost to follow-up	Lawton IADL	40% with pre-ICU IADL dependency 45% had post-ICU IADL dependency at 24-mo follow-up
Boumendil et al. (39) (France, 2004)	Prospective cohort Medical ICU Single institution	Age > 75 yr 24-mo follow-up	n = 192 enrolled 57% died before follow-up n = 45 with IADL scores at 2 yr 46% incomplete data	Lawton IADL	56% had IADL ≥ 1 10% unable to do self-care or perform IADLs
Broslawski et al. (41) (USA, 1995)	Prospective cohort Medical ICU Single institution	Age ≥ 65 yr 6-mo follow-up	n = 45 enrolled n = 27 at 6 mo 40% died 0% lost to follow-up	Lawton IADL	22% had increased IADL dependencies at 6 mo compared with pre-ICU [†]
Brummel et al. (42) (USA, 2014)	Prospective cohort Medical ICU Single institution	> 12 h of mechanical ventilation 3- and 12-mo follow-up	n = 126 enrolled n = 63 at 12 mo 50% died or lost to follow-up	FAQ	Surrogate baseline: 21% had IADL dependencies At 12-mo follow-up: 5% had IADL dependencies
Chelluri et al. (43) (USA, 2004)	Prospective cohort Medical, neurological, trauma, and surgical ICUs Single institution	≥ 48 h of mechanical ventilation 12-mo follow-up	n = 359 enrolled at 1 yr n = 296 completed 1 yr of follow-up 18% lost to follow-up	Lawton IADL	41% of survivors had 1 baseline IADL dependency 68% had >1 IADL dependency at 1 yr (7% dependent in all IADLs) [†]
Cox et al. (44) (USA, 2007)	Prospective cohort Medical and surgical ICUs Single institution	Prolonged mechanical ventilation (≥ 21 d or ≥ 96 h with tracheostomy) 2-, 6-, and 12-mo follow-up	n = 817 enrolled n = 114 eligible for 12-mo follow-up n = 42 completed follow-ups at 12 mo 57% died 6% lost to follow-up	Lawton IADL	More IADL dependencies associated with prolonged compared with short-term mechanical ventilation

(Continued)

Table 1. (Continued)

Study [Author (Ref.) (place, yr)]	Study Design and Setting	Sample Characteristics and Follow-Up	Sample Size	IADL Instrument	Significant Findings
Daubin <i>et al.</i> (45) (France, 2011)	Prospective cohort Medical ICU Single institution	Age ≥ 75 yr 3-mo follow-up	n = 100 enrolled n = 38 at 3 mo 61% died 1% lost to follow-up	Lawton IADL	No significant change at 3 mo from pre-ICU IADL ($P = 0.04$)
Haas <i>et al.</i> (46) (Brazil, 2013)	Prospective cohort Non-trauma ICUs Two institutions	≥ 24 h in ICU 48-mo follow-up	n = 506 enrolled at 24 mo n = 499 at 2 yr 1% missing data 0% died n = 516 enrolled	Lawton IADL	Significant decline in Lawton scores for certain subsets of patients at 24 mo compared with ICU discharge ($P < 0.001$)
Iwashyna <i>et al.</i> * (2) (USA, 2010)	Prospective cohort from Health and Retirement Study ICU admission	Severe sepsis and age > 50 yr Interviewed every 2 yr	n = 516 enrolled	Health and Retirement Core Interview Questionnaire Section G	Mean of 1.57 new functional limitations in patients without limitations before sepsis Mean of 1.5 new IADL dependencies in patients with mild to moderate limitations before sepsis
Jackson <i>et al.</i> (34) (USA, 2007)	Multicenter prospective longitudinal cohort Trauma ICU Single institution	Negative brain CT scan 12- to 24-mo follow-up	n = 58 enrolled 0% died 0% lost to follow-up	FAQ	22% had IADL dependencies in memory, managing finances, and making travel plans
Jackson <i>et al.</i> (47) (USA, 2012)	Randomized trial of home-based cognitive, physical, and functional rehabilitation vs. usual care Medical-surgical ICU Single institution	Enrolled in BRAIN-ICU Study 3-mo follow-up	n = 21 enrolled	FAQ	No difference in pre-IADL dependency between the two groups
Jackson <i>et al.</i> (18) (USA, 2014)	Prospective cohort Medical-surgical ICU Multicenter	Respiratory failure, cardiogenic or septic shock 3- and 12-mo follow-up	8, usual care; 13, intervention 0% died 0% lost to follow-up n = 826 enrolled n = 382 (46%) at 12 mo 38% died 16% lost to follow-up	FAQ	IADLs improved in the treatment group at 3 mo ($P = 0.04$) 23% had post-ICU IADL dependencies at 12 mo†
Quality of Life after Mechanized Ventilation in the Elderly Study Investigators (48) (USA, 2002)	Prospective cohort Medical, surgical, neurological, and trauma ICUs Single institution	> 48 h of mechanical ventilation 2-mo follow-up	n = 817 enrolled n = 232; complete data at 2 mo 43% died 29% lost to follow-up or incomplete data	Lawton IADL	Increased IADL dependency compared with pre-ICU at 2 mo

(Continued)

Table 1. (Continued)

Study [Author (Ref.) (place, yr)]	Study Design and Setting	Sample Characteristics and Follow-Up	Sample Size	IADL Instrument	Significant Findings
Sacanella et al. (49) (Spain, 2011)	Prospective cohort Medical ICU Single institution	Age ≥ 65 yr 12-mo follow-up	n = 230 enrolled n = 112 at 12 mo 51% died 0% lost to follow-up	Lawton IADL	IADLs decreased from baseline (6.7 vs. 5.3; $P < 0.001$) IADLs did not recover to baseline in 45% by study end IADL dependency increased ≥ 2 activities in 27% of patients
Van Pelt et al. (50) [†] (USA, 2007)	Prospective cohort Medical, surgical, and trauma ICUs Single institution	>48 h of mechanical ventilation 2-, 6-, and 12-mo follow-up	n = 169 enrolled 0% died 0% lost to follow-up	Lawton IADL	42% had pre-ICU functional dependency 70% had functional dependency at 12 mo Functional dependencies for problem solving, laundry, housekeeping, and managing finances

Definition of abbreviations: BRAIN-ICU = Bringing to Light the Risk Factors and Incidence of Neuropsychological Dysfunction in ICU Survivors; CT = computed tomography; FAQ = Functional Activities Questionnaire; IADL = instrumental activities of daily living; ICU = intensive care unit.

*Report only on sepsis survivors, not on patients with nonsepsis hospitalization.

[†]The percentage of pre-ICU IADL dependencies was not reported.

[‡]Data are a selected subset of the Quality of Life Study data (data from caregiver and matched patient) that report 1-yr outcome data. These patients are included in the total number of patients we reported, as it is not possible to know the overlap between Quality of Life and Cox studies.

period (Table 4). Only four studies assessed post-IADL dependencies over time (17, 18, 42, 50). Of the four studies that monitored patients longitudinally, three reported a decrease in IADL dependencies, among survivors, over 12-month follow-up (17, 42, 50), and one reported no significant change (18) (Figure 2). One of these studies reported that IADL dependencies did not change from 12 to 24 months (17), suggesting that maximum improvement was achieved at 12 months. No studies demonstrated a return in post-ICU IADL dependencies to pre-ICU levels.

Discussion

This systematic review demonstrates that a large number of ICU survivors (69%) experience new or worsening IADL dependencies after critical illness. The time to follow-up was variable, and most studies were single-center cohort studies. In 75% of longitudinal studies, IADL dependencies decreased over time but did not return to pre-ICU level (17, 18, 42, 50). Pre-IADL dependencies were present in 7–85% of patients and were associated with increased risk of post-ICU IADL dependency (18, 43, 44). Pre-ICU IADL dependency was also associated with an increased risk of early death post-ICU (43, 48, 49). Although a majority of studies report new post-ICU IADL dependencies there was significant variability in the incidence and definitions of IADL dependency despite use of the same instruments across studies. The wide range of definitions of IADL disability, variability in follow-up times, and lack of reporting actual scores, including domain scores, are problematic (53). There is little agreement on the quality of IADL instruments (54) and direct comparisons of IADL instruments in ICU populations have not been done. Uniformity in instruments and consistent reporting of data are essential for accurate interpretation and comparison of findings across studies. In other populations, variability in the incidence of IADL disability has been reported across instruments. For example, one study assessed functional status and mild cognitive impairment using three different IADL measures (Lawton and Brody IADL, Scales for Independent Behavior-Revised, and Everyday Problems Test) and found the results differed based on which IADL instrument was used (55).

Table 2. Definitions of instrumental activities of daily living dependencies

IADL Instrument	Study	Definitions of IADL Dependencies
Lawton IADL	Abelha <i>et al.</i> (40)	One or more dependencies: Total score 0 (completely dependent) to 7 (completely independent) for each of seven items
	Bienvenu <i>et al.</i> (17)	IADL dependencies: No baseline dependency with ≥ 2 IADL dependencies at follow-up Remission: ≤ 2 IADL dependencies at any follow-up time and a decrease in number of dependencies of greater than the Reliable Change Index for this measure (i.e., needed a difference of ≥ 2 dependencies)
	Boumendil <i>et al.</i> (39)	Total score from 0 (no limitation) to 4 (difficulties in all activities). Good functional status defined as ≤ 1 dependency
	Broslawski <i>et al.</i> (41)	Percentage of patients whose scores increased, showed no change, or decreased from pre-ICU to follow-up
	Chelluri <i>et al.</i> (43)	Total score: Scores range from 0 to 8. Higher score indicates more dependence
	Cox <i>et al.</i> (44)	Number of dependencies in IADL
	Daubin <i>et al.</i> (45)	Total scores: Scores range from 0 to 4. Scores of 0 (complete independence), 1 (dependent), and 4 (complete dependence)
	Haas <i>et al.</i> (46)	Decrease IADL score from pre-ICU function to follow-up
	Quality of Life after Mechanized Ventilation in the Elderly Study Investigators (48)	Total scores, with higher scores indicating more dependence
	Sacanella <i>et al.</i> (49)	Total score: Scores range from 0 to 8. A score of 8 denotes full autonomy in IADL
FAQ	Van Pelt <i>et al.</i> (50)	Total score: Scores range from 0 to 8
	Brummel <i>et al.</i> (42)	Total score: Range from 0 to 30. Scores ≥ 9 indicate impaired functioning
	Jackson <i>et al.</i> (34)	
	Jackson <i>et al.</i> (47)	
	Jackson <i>et al.</i> (18)	
Health and Retirement Study Care Questionnaire	Iwashyna <i>et al.</i> (2)	Total number of IADL and ADL deficiencies to create a total deficiency score (range, 0 to 11 [assistance in all categories])

Definition of abbreviations: ADL = activities of daily living; FAQ = Functional Activities Questionnaire; IADL = instrumental activities of daily living; ICU = intensive care unit.

Table 3. Risk factors for instrumental activities of daily living dependencies

Risk Factors	Total Studies (n)	Studies with No Association [n (%)]	Positive Association (Greater IADL Dependencies) [n (%)]
Pre-ICU factors			
Older age	5	2 (40%)	3 (60%)
Sex (male)	1	0 (0%)	1 (100%)
Baseline IADL dependency	4	0 (0%)	4 (100%)
Baseline depression	1	0 (0%)	1 (100%)
ICU factors			
ICU delirium	4	2 (50%)	2 (50%)
ICU length of stay	1	0 (0%)	1 (100%)
Illness severity	1	0 (0%)	1 (100%)
Duration of mechanical ventilation	2	0 (0%)	2 (100%)
Trauma admission	1	0 (0%)	1 (100%)
Unplanned surgical or medical ICU admission	1	0 (0%)	1 (100%)
Post-ICU factors			
Post-ICU cognitive impairment	1	0 (0%)	1 (100%)

Definition of abbreviations: IADL = instrumental activities of daily living; ICU = intensive care unit.

Table 4. Change in instrumental activities of daily living dependency over time

Study	IADL Instrument	Change in IADL Dependency over Time	Summary of Results
Abelha <i>et al.</i> (40)	Lawton IADL	Pre-ICU: 7% had at least 1 IADL dependency 6 mo: 19% had at least 1 IADL dependency	Increase in IADL dependencies compared with pre-ICU
Bienvenu <i>et al.</i> (17)	Lawton IADL	IADL, ≥ 2 dependencies: 3 mo: 64% 6 mo: 53% 12 mo: 43% 24 mo: 45% Remission vs. no remission: Remission in IADL dependency ~ 1 in follow-up No remission in IADL dependency ≥ 4 in follow-up	IADL dependencies decreased over time but are still present in many patients
Broslawski <i>et al.</i> (41)	Lawton IADL	Change from pre-ICU to 6 mo 6 patients, scores declined 21 patients, score stated the same or improved	Majority of patients had no change or decrease in IADL dependencies compared with pre-ICU; some patients had increased IADL dependencies over time
Brummel <i>et al.</i> (42)	FAQ	3 mo: 3 IADL deficiencies (range, 0–6); disability in IADL in 17% 12 mo: 1 IADL deficiency (range, 0–5); disability in IADL in 5%	Decrease in IADL dependence over 12 mo
Cox <i>et al.</i> (44)	Lawton IADL	Pre-ICU admission: mean, 2.1; SD, 2.7 2 mo: mean, 5.7; SD, 2.1 6 mo: mean, 5.2; SD, 2.4 12 mo: mean, 4.8; SD, 2.6	Increase in IADL dependencies initially post-ICU compared with pre-ICU: Slight, but not significant decrease over time
Daubin <i>et al.</i> (45)	Lawton IADL	No significant change from pre-ICU to 3-mo follow-up Pre-ICU: 40% completely independent and 7% completely dependent Number of IADL dependencies: Pre-ICU: mean, 1.1; SD, 1.3 vs. 3-mo follow-up: mean, 2.9; SD, 1.4 ($P = 0.62$)	Increase in IADL dependencies compared with pre-ICU early after ICU discharge, with no change over time
Iwashyna <i>et al.</i> * (2)	IADL using Health and Retirement Core Interview Questionnaire Section G	Pre-ICU: 43% with zero IADLs First survey postsepsis ($n = 623$): same as baseline Second survey postsepsis ($n = 288$): 14% with zero IADLs 32% with 0.5 IADLs 53% with 3 IADLs Third survey postsepsis ($n = 98$): 14% with zero IADLs 29% with 0.5 IADLs 57% with 3 IADLs	Increase in IADL dependencies early after ICU discharge compared with pre-ICU; no change over time
Jackson <i>et al.</i> (18)	FAQ	3 mo: 56% of patients with prior IADL disability had disability versus 23% with new IADL disability (9.5 vs. 2.2 IADLs) 12 mo: 62% of patients with prior IADL disability had disability versus 20% with new IADL disability (10.0 vs. 2.0 IADLs)	New disability in IADL compared with pre-ICU for some patients; no significant change over time
Quality of Life after Mechanized Ventilation in the Elderly Study Investigators (48)	Lawton IADL	Pre-ICU IADL scores: Median = 1 for overall group (survivors and nonsurvivors) Median = 4 for nonsurvivors Post-ICU IADL scores: Median = 4 for patient interview ($n = 132$) Median = 7 for proxy interview ($n = 98$)	Increase in IADL dependencies compared with pre-ICU

(Continued)

Table 4. (Continued)

Study	IADL Instrument	Change in IADL Dependency over Time	Summary of Results
Sacanella <i>et al.</i> (49)	Lawton IADL	IADL scores: Pre-ICU: mean, 6.7; SD, 1.7 3 mo: mean, 5.2; SD, 1.7 6 mo: mean, 5.6; SD, 1.6 12 mo: mean, 5.3; SD, 2.6	Slight decrease in IADL dependencies compared with pre-ICU; still significantly disabled in IADL dependencies; no change over time
Van Pelt <i>et al.</i> (50)	Lawton IADL	Pre-ICU functional dependency: 42% 2 mo: 91% with functional dependency 6 mo: 78% with functional dependency at 6 mo 12 mo: 70% had functional dependency at 12 mo	Increase in IADL dependency compared with pre-ICU with some decrease over time

Definition of abbreviations: FAQ = Functional Activities Questionnaire; IADL = instrumental activities of daily living; ICU = intensive care unit.

Only two studies reported data on the individual domains of IADL function. Data on the type and severity of specific functional impairments is required to develop appropriate interventions. Four studies longitudinally assessed IADL dependency, with all four demonstrating a decrease in dependencies over time in the majority of survivors (17, 18, 42, 50), but these studies did not report a standardized cutoff or minimal important difference, and little change was noted from 12 to 24 months in a single study (17). Studies to determine the minimal important clinical difference for IADL instruments in survivors of critical illness are needed.

Our review suggests that various risk factors may increase ICU survivors' risk of post-ICU IADL dependencies, but there were few consistent associations with any of the variables reported. For example, older age was associated with post-ICU IADL dependency in three studies (18, 43, 46), whereas two studies did not find a similar

relationship (41, 49). IADL dependency was not consistently associated with illness severity or other markers of critical illness. This lack of consistent association may be because some studies were underpowered to demonstrate significant associations with pre-ICU or ICU factors and IADL dependency. Finally, pre-IADL dependency was associated with an increased risk of death after ICU discharge (43, 48, 49).

We found that delirium, and post-ICU cognitive and functional impairments, are variably associated with post-ICU IADL dependency, as one study demonstrated increased IADL dependency (40) and two demonstrated no relationship (18, 42). Delirium is a reported risk factor for IADL dependency in other populations. For example, in a prospective cohort study of patients undergoing cardiac surgery, postoperative delirium was independently associated with IADL decline at 1- and 12-month follow-up after adjusting for age, comorbidity, baseline function, and

cognitive function (56). The lack of consistent association may relate to the limited number of small cohort studies that have evaluated the relationship between delirium and IADL dependency.

Cognitive impairment adversely affects independent performance of IADLs, especially in areas such as shopping, food preparation, use of public transportation, and management of medications and finances. Only one study assessed the relationship between cognitive impairments and post-ICU IADL dependency and found that 22% of ICU survivors had IADL dependencies that were associated with cognitive impairment (34). This finding parallels previous reports in non-ICU populations, particularly the elderly. For instance, in mild Alzheimer's disease, executive dysfunction is a key contributor to IADL dependence after accounting for memory impairment (57). In elderly community-dwelling individuals, cognitive impairment was associated with IADL dependence, and worse cognitive function was associated with higher dependence and had a greater impact on independence (58). Better cognitive function was associated with fewer IADL dependencies in 1,095 healthy nondemented community dwellers (59). Finally, a study of hospitalized patients found that a one-point worse score on a cognitive screening test was associated with a 1.5-fold increase in development of new IADL dependencies (60). Assessment of functional dependence should be a research priority given the large numbers of ICU survivors that develop cognitive impairments.

The association of physical, cognitive, and psychological deficits with a patient's ability to function independently and resume daily function has received little attention until recently. Including IADLs as

Figure 2. Change in instrumental activities of daily living (IADLs) over time. Summarized are the four studies that longitudinally evaluated IADL dependencies in intensive care unit survivors. Sample sizes at each available time point, respectively: Brummel *et al.* (42): 76, 55; Jackson *et al.* (18): 422, 372; Bienvenu *et al.* (17): 161, 169, 152, 142; and Van Pelt *et al.* (50): 169 at all three time points. ICU = intensive care unit.

an outcome may aid evaluating a person's ability to function independently. Instruments for IADL assessment are validated in other patient populations and easy to administer. The choice of instrument in the studies reviewed was variable, but we recommend the Lawton IADL instrument as it has good psychometric properties, is widely used in a variety of populations (e.g., healthy aging, dementia, chronic obstructive pulmonary disease), is easy to administer, can be administered by phone, and can be administered to proxies with good correlation with patient responses (30, 43, 61).

There are important limitations in the available literature. Some of the studies did not report both pre- and post-ICU IADL dependencies, which may be critical for evaluating recovery trajectories. Reporting of IADLs varied between the studies, and few studies reported individual IADL disabilities. That there were only a small number of studies that assessed IADL functioning (16, out of hundreds of studies that have explored post-ICU outcomes in the last 2 decades) is surprising and noteworthy, as from a patient and caregiver vantage point functional ability rivals cognitive or psychological ability in importance. Clinically oriented measures of strength, cognition, and psychiatric symptoms commonly evaluated by critical care investigators do not necessarily have a strong correlation with functional outcomes (62, 63). Needham and colleagues found that muscle strength impairments were

significantly less than impairments in 6-minute walk distance or the SF-36 Physical Function self-reported outcome, reinforcing that factors other than muscle weakness contribute to poor physical functioning (10). Restoration of function, rather than an increase in muscle strength, may be what matters most to patients.

Research on IADLs and other functional outcomes should include consistency in the following areas: methods of evaluating functional outcomes, follow-up times, and definitions of IADL dependency. IADL reporting often is patient-based reporting, which may have limitations. Other methods are feasible, including direct assessment and proxy-based reporting. Direct assessment of functional status is an approach used in more traditional rehabilitation contexts, in which IADLs are assessed via direct observation of task performance (e.g., cooking, managing finances, etc.) as opposed to patient self-report on their adeptness at these tasks, which is often limited by patient lack of awareness or cognitive impairment. Such an approach would require in-person assessment, and may not always be feasible. Alternatively, proxy-based reporting may provide additional information that assists in assessment of patient cognitive impairment and correlates with patient reports (43). Future studies should also assess cognitive and psychiatric functioning (depression, anxiety, posttraumatic stress disorder)

and their association with IADL dependency in ICU populations. As existing research (R24HL111895; see www.improvelto.com) progresses with development of a minimum "core outcome set" (64, 65, 66) of measures used for all important outcome domains in all research studies evaluating patients postdischarge, this type of future research may be more feasible.

Conclusions

We identified only 16 studies evaluating IADL dependency in survivors of critical illness. Even when the same widely used, reliable, and valid instrument was used, comparisons between studies were difficult because of variable definitions of IADL dependency. New or worsening IADL dependency was present and persisted months to years after ICU discharge for most survivors. There was little evidence supporting any consistent association of risk factors with IADL dependency. Longitudinal data are sparse; hence, trajectories of IADL recovery are difficult to interpret. The relationship between cognitive impairment and IADL dependencies, which has been consistently reported in other populations, is lacking in studies of ICU survivors. Studies with rigorous methods are necessary to assess whether interventions will alter IADL dependency in ICU survivors. ■

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