Effects of Interdisciplinary Team Care Interventions on General Medical Wards
A Systematic Review

Samuel Pannick, MA, MBBS, MRCP; Rachel Davis, PhD; Hutan Ashrafian, PhD, MRCS; Ben E. Byrne, MB, BChir; Iain Beveridge, MB, BChir, FRCP; Thanos Athanasiou, MD, PhD; Robert M. Wachter, MD; Nick Sevdalis, PhD

Importance Improving the quality of health care for general medical patients is a priority, but the organization of general medical ward care receives less scrutiny than the management of specific diseases. Optimizing teams’ performance improves patient outcomes in other settings, and interdisciplinary practice is a major target for improvement efforts. However, the effect of interdisciplinary team interventions on general medical ward care has not been systematically reviewed.

Objectives To describe the range of objective patient outcomes used in studies of general medical ward interdisciplinary team care, and to evaluate the performance of interdisciplinary interventions against them.

Evidence Review We searched EMBASE, MEDLINE, and PsycINFO from January 1, 1998, through December 31, 2013, for interdisciplinary team care interventions in adult general medical wards using an objective patient outcome measure. Reference lists of included articles were also searched. The last search was conducted on January 29, 2014, and the narrative and statistical analysis was conducted through December 1, 2014. Study quality was assessed using the Cochrane Effective Practice and Organization of Care group’s tool.

FINDINGS Thirty of 6934 articles met the selection criteria. The studies included 66,548 patients, with a mean age of 63 years. Nineteen of 30 (63%) studies reported length of stay, readmission, or mortality rate as their primary outcome, or did not specify the primacy of their outcomes. The most commonly reported objective patient outcomes were length of stay (23 of 30 [77%]), complications of care (10 of 30 [33%]), in-hospital mortality rate (8 of 30 [27%]), and 30-day readmission rate (8 of 30 [27%]). Of 23 interventions, 16 (70%) had no effect on length of stay, 12 of 15 (80%) did not reduce readmissions, and 14 of 15 (93%) did not affect mortality. Five of 10 (50%) interventions reduced complications of care. In an exploratory quantitative analysis, the interventions did not consistently reduce the relative risk of early readmission or early mortality, or the weighted mean difference in length of stay. All studies had a medium or high risk of bias.

Conclusions and Relevance Current evidence suggests that interdisciplinary team care interventions on general medical wards have little effect on traditional measures of health care quality. Complications of care or preventable adverse events may merit inclusion as quality indicators for general medical wards. Future study should clarify how best to implement interdisciplinary team care interventions and establish quality metrics that are credible to both health care professionals and patients in this setting.
Understanding how to better organize health care for general medical patients is an international priority for safety improvement.\(^1\,\!^2\) \(^3\) Despite this need, we know relatively little about how to improve processes and outcomes for these patients. Missed opportunities to provide necessary health care are more common\(^4\) than technical procedural failings.\(^4\) More than any other health care setting, general medical ward processes generate the errors that lead to preventable deaths\(^5\); yet, the fundamental organization of ward-based care receives less attention than the management of specific diseases. Systems of general medical ward care are usually unchanged across successive generations of health care professionals, in contrast to the dynamic developments in the treatment of individual pathological conditions.

We identified 5 paths by which organizations may seek to improve the quality and safety of health care on the general medical ward: staffing levels and team composition; staff communication and collaboration; standardization of the processes of care; early treatment of deteriorating patients; and changes in the local safety climate.\(^5\) We focus here on interdisciplinary communication and collaboration. Physicians are increasingly required to formalize their interdisciplinary practice, which is a measure widely believed to improve efficiency; yet, to our knowledge, a systematic assessment of interdisciplinary care specific to the general medical ward setting has not been published.

Defining the measures on which to base that assessment is difficult; there is no consensus as to the metrics that best reflect the quality of general medical ward care. Quality can relate to structures, processes, or outcomes.\(^6\) Interpretation of outcome data can be contentious, although debate largely focuses on the inappropriate use of outcomes (rather than processes) to rank institutions’ comparative performance.\(^7\) In research, outcome data are of more use;\(^8\) they are also directly meaningful for patients and potentially influenced by interdisciplinary interventions. Interdisciplinary operating room safety checklists, for example, reduce surgical morbidity and possibly mortality,\(^8\,\!^9\,\!^10\) and complex cultural interventions in the intensive care unit (ICU) reduce catheter-associated bloodstream infections.\(^11\,\!^12\) We therefore conducted a systematic review to describe the range of objective patient outcomes used in studies of the general medical ward environment, and to evaluate the performance of interdisciplinary team care interventions against them. Interdisciplinary team care can be defined as the structured working practices that dictate which different health care practitioners interact together to contribute to patient care, as well as when and how they do so. This definition incorporates staff who are routinely expected to attend to the patient (eg, nurses and ward physicians) as well as those who intermittently provide specialist review and advice.

### Methods

#### Data Sources and Searches

We searched the EMBASE, MEDLINE, and PsycINFO databases for English-language studies published from January 1, 1998, through December 31, 2013 (see eMethods in the Supplement for the full search strategy). We also manually searched the reference lists of included studies. Ethics approval was not required because the study was conducted using existing published data.

**Eligibility Criteria**

We included primary reports of interdisciplinary team care interventions on adult general medical wards in which the interventions were evaluated against an objective patient outcome (eTable 1 in the Supplement). Interventions that relied solely on a staff member taking on a dedicated coordinating or facilitating role (eg, case management) were excluded, as were interventions that targeted the continuation of care by a similar group during the following shift (eg, handoff processes). Interventions focused on the period of inpatient hospitalization. Randomized controlled trials (RCTs), studies with an appropriate comparison group, and interrupted time series were included. We used the criteria and terminology of the Cochrane Effective Practice and Organization of Care\(^13\) review group to define study type.

**Study Selection**

One investigator (S.P.) reviewed each title and abstract to determine the study’s eligibility. A second reviewer (R.D.) independently screened 15% of the titles and abstracts to assess the reliability of the inclusion and exclusion criteria. Studies that met the criteria were examined in full by both reviewers, and the final set of studies was confirmed after discussion with a third reviewer (N.S.).

**Data Extraction and Risk of Bias Assessment**

Two reviewers (H.A. and S.P.) extracted data from each study. When required information was not initially available, authors were contacted for further data or clarification. Two reviewers (B.E.B. and S.P.) independently assessed the risk of bias for each study, with disagreements resolved by consensus. We used predefined criteria based on the Cochrane Effective Practice and Organization of Care group’s guidance,\(^14\) to rate studies as having low, medium, or high risk of bias. Other systematic reviews of heterogeneous health care interventions use a similar approach.\(^15\) Interventions were classified as low, medium, or high intensity. No single measure of intensity could adequately be applied to such heterogeneous studies, but factors taken into account included the frequency of the mandated use of the intervention; autonomy of the individuals on the interdisciplinary team to enact recommendations; resource provision; and follow-up.

**Statistical Analysis**

We categorized interventions based on their focus on interdisciplinary team composition or practice, and subcategorized interdisciplinary composition interventions by the type of specialist input they delineated. We describe the studies’ outcome measures and the adjustment methods used to account for their patient case mix. For meaningful analysis, outcomes were grouped into early (occurring within 30 days of receiving the intervention) or late outcomes (31 days to 12
Effects of Interdisciplinary Team Care Interventions on Medical Wards

Results

Study Characteristics

Trial Designs

A total of 6934 potentially relevant citations were identified. After excluding abstracts from conferences, there was 100% agreement between 2 reviewers (S.P. and R.D.) on the initial inclusion of a 15% sample of abstracts (1040 citations). After full text review, 30 studies met the inclusion criteria,16-45 26 of which were identified from the initial database search and 4 from hand-searching reference lists (eFigure in the Supplement). These studies comprised 8 RCTs,16,17,36-39,41,43 9 cluster RCTs,* 8 nonrandomized cluster trials,22,23,26,30,31,33,35,40 4 controlled before-after studies,18,20,28,32 and 1 interrupted time series.27

Types of Intervention and Context

Study characteristics are summarized in the Table, with more complete descriptions in eTable 2 in the Supplement. Other than 1 example,29 studies compared an interdisciplinary team care intervention with usual care. Interventions were grouped into 2 categories. The first group of interventions altered the composition of the interdisciplinary team who routinely attended the patient, such as by requiring additional specialists or professionals to provide advice. The second group

*References 19, 21, 24, 25, 29, 34, 42, 44, 45

Methods

Interdisciplinary team care interventions (ITC-C) tend to increase early mortality (weighted RR, 0.925; 95% CI, 0.816-1.049). The 2 interdisciplinary team practice interventions (ITC-P) tended to reduce early mortality (weighted RR, 0.665; 95% CI, 0.449-0.986). The data marker with arrow for the study by Webster et al33 indicates that the 95% CI for the RR (2.167) was out of the range of the plot.

The figure's exploratory analysis indicates no significant reduction in early mortality with interdisciplinary team composition interventions (ITC-C; weighted risk ratio [RR], 0.925; 95% CI, 0.816-1.049). The 2 interdisciplinary team practice interventions (ITC-P) tended to reduce early mortality (weighted RR, 0.665; 95% CI, 0.449-0.986). The data marker with arrow for the study by Webster et al33 indicates that the 95% CI for the RR (2.167) was out of the range of the plot.

The figure's exploratory analysis indicates no significant effect of interdisciplinary team care interventions on early readmissions. This was the case for each of the 2 subcategories: interventions altering interdisciplinary team composition (ITC-C; weighted mean difference, 0.087; 95% CI, −0.083 to 0.257) and interventions altering interdisciplinary team practice (ITC-P; weighted mean difference, 0.001; 95% CI, −0.035 to 0.037).

The figure's exploratory analysis indicates no consistent effect of interdisciplinary team care interventions on length of stay. Interdisciplinary team composition interventions (ITC-C) tended to increase length of stay (weighted mean difference, 0.087; 95% CI, 0.037 to 0.137), and interventions altering interdisciplinary team practice (ITC-P) did not significantly reduce early readmissions (weighted RR, 0.995; 95% CI, 0.992 to 1.000).

The relative risk of outcomes or weighted mean difference (for length-of-stay data) was calculated with DerSimonian and Laird random-effects modeling. Between-study and within-study variances contributed to study weighting. Analyses were performed using Stata, version 12 (StataCorp LP).

Table

<table>
<thead>
<tr>
<th>Study Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Types of Intervention</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Context</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

The analysis was performed using Stata, version 12 (StataCorp LP).
### Table. Characteristics of Included Studies

<table>
<thead>
<tr>
<th>Source (Country)</th>
<th>Intervention</th>
<th>Objective Patient Outcomes (Primary or Secondary)</th>
<th>Trial Design</th>
<th>Changes in Outcomes With Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Geriatrics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Webster et al.13</td>
<td>Geriatric delirium care team (physician and nurse) proactively identify patients with delirium and guide staff in its management</td>
<td>LOS, in-hospital death, discharge disposition (not specified)</td>
<td>Nonrandomized cluster trial</td>
<td>Reduced LOS; no difference in discharge disposition or mortality</td>
</tr>
<tr>
<td>Korbkitjaroen</td>
<td>Systematic delirium detection, followed by geriatrician review and specialist nurse follow-up.</td>
<td>LOS, discharge to the community, death within 8 wk of enrollment (all secondary outcomes)</td>
<td>RCT</td>
<td>No differences in LOS, discharge to the community, or survival</td>
</tr>
<tr>
<td>Pitkälä et al.17</td>
<td>Systematic delirium detection followed by geriatrician review and specialist nurse follow-up; no definitive description of who delivered the intervention, or how</td>
<td>Patients discharged to permanent institutional care or deceased at 1 y (combined end point, primary outcome)</td>
<td>RCT</td>
<td>No difference in primary end point or any secondary end point</td>
</tr>
<tr>
<td>Kircher et al.37</td>
<td>Geriatrician, social worker and nurse consultation service; geriatrician summarized recommendations in a structured format; input from nurse and social worker as required</td>
<td>Living location, proportion of patients with a 1 readmission, and days of readmission at 12 mo (all described as primary outcomes); 12-mo Survival, Timed-Up-and-Go-Test, hand grip (secondary outcomes)</td>
<td>RCT</td>
<td>No difference in any end point</td>
</tr>
<tr>
<td><strong>Hepatology</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lai et al.18</td>
<td>Multidisciplinary hepatology team; direct supervision of a specialized housestaff team structure</td>
<td>LOS (primary outcome)</td>
<td>Controlled before-after study</td>
<td>Adjusted LOS reduced with intervention (when adjusted for CMI and MELD score); concurrent control group’s LOS increased over the study period</td>
</tr>
<tr>
<td><strong>Infectious disease</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solomon et al.19</td>
<td>Multidisciplinary AUT (clinician-educator/infectious disease physician/clinical pharmacist); Systematic screening for unnecessary antibiotic prescriptions, followed by educational intervention to prescriber; “Academic detailing”—one-on-one interactive educational outreach, delivered by a professional trained to discuss prescribing decisions in a manner likely to induce evidence-based practice change; (NB: restrictive intervention)</td>
<td>LOS, 30-d readmissions, in-hospital deaths, transfer to the ICU (all secondary outcomes)</td>
<td>Cluster randomized trial</td>
<td>No change in these end points; NB: these end points were documented to show that intervention had no measurable negative clinical effects; intervention not designed to affect them per se</td>
</tr>
<tr>
<td>Fine et al.29</td>
<td>Specialist nurse input to facilitate antibiotic management; Screening for patient stability sufficient to allow conversion from IV to oral antibiotic therapy, or discharge; Direct communication with primary team to discuss recommendations (NB restrictive intervention)</td>
<td>LOS (primary outcome); 30-d Mortality, medical complications, 30-d readmission (secondary outcomes)</td>
<td>Cluster randomized trial</td>
<td>No change in LOS overall, although intervention appeared effective at 1 of 7 study sites; fewer medical complications in intervention group; no differences in mortality or readmission</td>
</tr>
<tr>
<td>Canins et al.34</td>
<td>Multidisciplinary AUT (infectious disease physician and specialist pharmacist); Systematic screening for unnecessary antibiotic prescriptions, followed by educational intervention; (academic detailing) to prescriber (NB restrictive intervention)</td>
<td>LOS, in-hospital mortality (secondary outcomes)</td>
<td>Cluster randomized trial</td>
<td>Patients treated by intervention group had shorter median LOS; no differences in mortality</td>
</tr>
<tr>
<td>Manuel et al.35</td>
<td>Infectious disease specialist; Systematic assessment of antibiotic prescription with regard to need for antibiotic, choice of drug, route and dose, with feedback to treating physician</td>
<td>LOS, in-hospital mortality (secondary outcomes)</td>
<td>Nonrandomized cluster trial (with crossover)</td>
<td>No difference in end points</td>
</tr>
<tr>
<td>Korbkitjaroen et al.21</td>
<td>Multidisciplinary infection control team (infectious disease physician and infection control nurse) identifying risk factors for hospital-acquired infection, with feedback to the treating team; feedback included observations regarding adherence to infection control measures</td>
<td>LOS, in-hospital mortality, hospital-acquired infection rates (not specified; mortality and LOS reported in “Patient Characteristics” table)</td>
<td>Cluster randomized trial</td>
<td>Intervention associated with reduced hospital-acquired infection rate (driven by reduced pneumonia and catheter-associated urinary tract infections); no change in LOS or mortality</td>
</tr>
</tbody>
</table>

(continued)
<table>
<thead>
<tr>
<th>Source (Country)</th>
<th>Intervention</th>
<th>Objective Patient Outcomes (Primary or Secondary)</th>
<th>Trial Design</th>
<th>Changes in Outcomes With Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesprit et al.38 2013 (France)</td>
<td>Infectious disease physician; Systematic assessment of antibiotic prescription, with feedback to treating physician; (NB: restrictive intervention)</td>
<td>LOS (primary outcome); ICU admission, in-hospital mortality, 60-d readmission for relapsing infection (secondary outcomes)</td>
<td>RCT</td>
<td>No change in LOS, in-hospital mortality, or ICU admission; fewer 60-d readmissions for relapsing infection in intervention group</td>
</tr>
<tr>
<td>IV therapy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soifer et al. 1998 (USA)</td>
<td>Intravenous therapy (nursing) team; Insertion and/or management of peripheral IV catheters</td>
<td>Intravenous line-related bacteremia, local complications from catheter insertion (unspecified)</td>
<td>RCT</td>
<td>Reduced catheter-related bacteremias and local complications in intervention group</td>
</tr>
<tr>
<td>Medical librarian</td>
<td>Clinical medical librarian embedded in medical rounds to answer specific questions posed by team members; Detailed answers supplied via email after rounds</td>
<td>LOS, 30-d readmissions (not specified)</td>
<td>Nonrandomized cluster trial</td>
<td>Higher readmission rates and LOS in intervention group</td>
</tr>
<tr>
<td>Pharmacotherapy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kucukarslan et al. 2003 (USA)</td>
<td>Clinical pharmacist; Participation in rounding and prospective evaluation of patient medications</td>
<td>Preventable adverse drug events (primary outcome); LOS, time to respond to therapy, readmission rate (secondary outcomes)</td>
<td>Nonrandomized cluster trial</td>
<td>Fewer preventable adverse drug events per 1000 patient-days in intervention group (36.2% vs 45.2%; adjusted odds ratio, 0.63); no effect on 6-mo readmission; median LOS increased in intervention group (adjusted median ratio, 1.16)</td>
</tr>
<tr>
<td>Mannheimer et al. 2006 (Sweden)</td>
<td>Clinical pharmacologist and specialist nurse; Systematic screening for potential drug interactions contributing to patient symptoms, with feedback to the treating physician</td>
<td>Readmission and/or death at 6 mo (primary outcome); Number of patients readmitted to hospital at 6 mo, deaths at 6 mo (secondary outcomes)</td>
<td>RCT</td>
<td>No difference in any outcome</td>
</tr>
<tr>
<td>Makowsky et al. 2009 (Canada)</td>
<td>Clinical pharmacist; Participation in rounding and provision of proactive clinical services</td>
<td>3- and 6-mo Readmissions, LOS (all secondary outcomes)</td>
<td>Cluster randomized trial (with crossover)</td>
<td>Lower rate of 3-mo hospital readmissions in both the crude and adjusted analysis (36.2% vs 45.2%; adjusted odds ratio, 0.63); no effect on 6-mo readmission; median LOS increased in intervention group (adjusted median ratio, 1.16)</td>
</tr>
<tr>
<td>Lisby et al. 2010 (Denmark)</td>
<td>Clinical pharmacist and clinical pharmacist; Systematic medication review, with advisory feedback to treating physician</td>
<td>LOS (primary outcome); 3-mo Readmissions, 3-mo mortality, time to first readmission, number of readmissions, number of emergency department visits at 3 mo, number of visits to outpatient care at 3 mo (secondary outcomes)</td>
<td>RCT</td>
<td>No difference in any outcome</td>
</tr>
<tr>
<td>Schillig et al. 2011 (USA)39</td>
<td>Pharmacist-directed anticoagulation service; Initial warfarin dose selection, daily dose adjustments, and daily laboratory monitoring; Education standardized between inpatient and outpatient settings, and plan for outpatient follow-up confirmed</td>
<td>Composite end point of INR &gt;5, major bleeding, or development of new thrombosis in-hospital or within 30 d of discharge (primary safety end point)</td>
<td>Cluster randomized trial</td>
<td>No change in primary end point or the components of the primary end point</td>
</tr>
<tr>
<td>Psychiatry</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desai et al. 2011 (USA)</td>
<td>Psychiatrist; Proactive identification of patients with mental health issues, early psychiatric consultation, and coordination with primary team</td>
<td>LOS (primary outcome)</td>
<td>Controlled before-after study</td>
<td>Reduced LOS (2.9 vs 3.8 d); reduced proportion of cases with LOS &gt;4 d (14.5% vs 27.9%)</td>
</tr>
<tr>
<td>Stroke</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dey et al. 2005 (UK)</td>
<td>Multidisciplinary stroke team (attending and senior therapist); Advised primary team on acute stroke management, and coordinated early input from therapy groups</td>
<td>6-wk and 12-mo Mortality (primary outcomes); Death or institutionalized care (secondary outcome)</td>
<td>RCT</td>
<td>No difference in any outcome</td>
</tr>
<tr>
<td>Interdisciplinary Team Practice</td>
<td>Interdisciplinary rounds including physician, nurse, pharmacist, nutritionist, and social worker; Orders written during rounds</td>
<td>LOS, in-hospital mortality (not specified)</td>
<td>Nonrandomized cluster trial</td>
<td>Reduced LOS (5 vs 6 d); no difference in in-hospital mortality</td>
</tr>
</tbody>
</table>

(continued)
Table. Characteristics of Included Studies (continued)

<table>
<thead>
<tr>
<th>Source (Country)</th>
<th>Intervention</th>
<th>Objective Patient Outcomes (Primary or Secondary)</th>
<th>Trial Design</th>
<th>Changes in Outcomes With Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mudge et al.23</td>
<td>Consistent multidisciplinary teams aligned with admitting medical units;</td>
<td>LOS, in-hospital mortality, 6-mo mortality (primary outcomes); 6-mo Readmissions, discharge to residential care (secondary outcomes)</td>
<td>Nonrandomized cluster trial</td>
<td>Reduced in-hospital mortality (3.9% vs 6.4%); no change in 6-mo mortality, LOS, or 6-mo readmissions; no effect on new residential care discharge</td>
</tr>
<tr>
<td></td>
<td>Expanded senior clinical nurse role, incorporating structured detailed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>assessment of preadmission functional and social patient data;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Investment in allied health professional staffing to allow a consistent staff member</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>from each discipline in each intervention unit; Early discharge planning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O'Leary et al.24</td>
<td>Structured IDR s and structured communication tool for newly admitted</td>
<td>LOS (primary outcome)</td>
<td>Cluster randomized trial</td>
<td>No effect on LOS</td>
</tr>
<tr>
<td>2010 (USA)</td>
<td>patients; Attended by nurses, resident physicians, pharmacist, social worker, and case manager</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O'Leary et al.45</td>
<td>Structured IDR s and structured communication tool for newly admitted</td>
<td>Adverse events (primary outcome)</td>
<td>Cluster randomized trial</td>
<td>Fewer patients experienced adverse events (16.2% vs 24.5%); lower adjusted total adverse events (3.9 vs 7.2 per 100 patient-days); lower adjusted preventable adverse events (0.9 vs 2.8 per 100 patient-days)</td>
</tr>
<tr>
<td>2011 (USA)</td>
<td>patients; Attended by nurses, resident physicians, pharmacist, social worker, and case manager</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O'Leary et al.25</td>
<td>Structured IDR s and structured communication tool for newly admitted</td>
<td>LOS (secondary outcome)</td>
<td>Cluster randomized trial</td>
<td>No difference in adjusted LOS</td>
</tr>
<tr>
<td>2011 (USA)</td>
<td>patients; Attended by nurses, resident physicians, pharmacist, social worker, and case manager</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wald et al.26</td>
<td>Interdisciplinary rounds, standardized geriatric assessment; focus on safety</td>
<td>LOS, falls, 30-d readmissions, discharge location</td>
<td>Nonrandomized cluster trial</td>
<td>No difference in any outcome</td>
</tr>
<tr>
<td>2011 (USA)</td>
<td>and early discharge planning; educational curriculum; IDR attended by nurses, physicians, social workers, case managers, physical/occupational therapists, pharmacists, and volunteers; IDR led by attending/resident physician</td>
<td>(secondary outcomes)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auerbach et al.27</td>
<td>Multidisciplinary teamwork training</td>
<td>LOS, 30-d readmissions</td>
<td>Interrupted time series study</td>
<td>No difference in any outcome</td>
</tr>
<tr>
<td>2012 (USA)</td>
<td>curriculum and STs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Singh et al.11</td>
<td>Localization of each medical team's patients to a single nursing unit</td>
<td>LOS, 30-d readmission rates (not specified); Inpatient deaths described as a patient characteristic rather than an outcome</td>
<td>Nonrandomized cluster trial</td>
<td>No difference in any outcome</td>
</tr>
<tr>
<td>2012 (USA)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thanarajasingam et al.34</td>
<td>Localization of each medical team's patients to a single nursing unit; Census cap of 14 patients per service</td>
<td>30-d Readmission rates, cardiac arrests, rapid response team events, ICU transfers, adverse events as defined by AHRQ patient safety indicators (not specified)</td>
<td>Controlled before-after study</td>
<td>Reduced 30-d readmission rate, but not meeting the predefined P &lt; .01 threshold for multiple comparisons; no change in rapid response team/cardiac arrest events/ICU transfers or complications of care</td>
</tr>
<tr>
<td>2012 (USA)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saint et al.28</td>
<td>Interdisciplinary rounds, modified attending rounds, regular attending team</td>
<td>LOS, 7-d readmission rate, 30-d readmission rate (unspecified)</td>
<td>Interrupted time series study with control cohort</td>
<td>No difference in any end point (after accounting for secular trends)</td>
</tr>
<tr>
<td>2013 (USA)</td>
<td>meetings, and increased attending commitment to inpatient service provision; IDR attended by doctors, nurses, pharmacist, and clinical care coordinator; Educational curriculum for attendings and residents</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: AHRQ, Agency for Healthcare Research and Quality; AR, allied health professions investment; AUT, antimicrobial utilization team; CC, clinical coordinator; CGA, comprehensive geriatric assessment; CMI, Case Mix Index; ES, embedded specialist; ICU, intensive care unit; IDR, interdisciplinary rounds; IV, intravenous; LOS, length of stay; MELD, Model for End Stage Liver Disease; NB, note well; RCT, randomized controlled trial; STs, safety teams composed of ward staff.

* Interventions to alter the composition of the interdisciplinary team routinely attending the patient, through proactive and/or unsolicited involvement of medical specialists or allied health care professionals.

† Results from phase 2 of the study relating to interdisciplinary team care intervention.

‡ Length of stay excluded from analysis owing to changes over the course of the intervention (expansion of an advanced heart failure service).

§ Interventions to alter the practice of the established interdisciplinary team in terms of where, when, and how staff work together.

¶ Authors argue that their intervention is not a typical acute care of the elderly unit but a hybrid general medical service (NB: no environmental changes or separate nursing training or protocols).

∫ Results from phases 1 and 2 of the study, excluding the patient-targeted interventions of phase 3.
Risk of Bias and Intervention Intensity

No study had a low risk of bias; 7 (23%) had a medium risk of bias, 18,19,21,23,24,27,28,30-36,39-43, and 23 (77%) had a high risk of bias.8 Eight studies (27%) involved low-intensity interventions, 17,30,33-36,39,41,43. The remainder were of medium or high intensity.

Outcome Risk Adjustment and Analysis

Of the 30 studies, 16 (53%) did not adjust their results for their patient case mix. || Eleven of 30 studies (37%) used patient characteristics as independent variables in a multivariate analysis to isolate the effect of their intervention. # Two of 30 studies (7%) adjusted results for predicted outcomes based on diagnosis-related groups, 22,33 and 1 of 30 studies (3%) used a disease-specific severity index. 29 Only 7 of 30 studies (23%) accounted for autocorrelated outcomes, in which patients treated by the same physician (or team) are more likely to have similar results than those who are not.

Complications of Care and Discharge Location

Of 10 interdisciplinary team care interventions, 5 (50%) reduced complications of care, 21,29,38,40,45 Three of those 5 harnessed input from infectious diseases specialists,21,29 or specialist nurses in reducing infective complications of peripheral intravenous catheters. 58 Both studies that reported preventable adverse events suggested improvement, either through embedding pharmacists in the clinical team40 or formalizing interdisciplinary rounds. 45 Four of the 5 interventions that showed reduced complications of care were rated high intensity, 21,38,40,45 but there was no apparent relationship between high-intensity categorization and reduced complications (χ² = 0.476; P = .49). Zero of 7 interventions successfully reduced the need for institutional care after discharge; 4 of those 7 were rated high intensity, 16,21,26,33.

Length of Stay

Saint et al29 documented significant secular reductions in length of stay. In this context, 16 of 23 interventions (70%) had no effect on the length of stay**; 5 of 23 (22%) reduced the length of stay18,26,22,33,34, and 1 (4%) may have increased the length of stay. 42 A study by Espana et al29 that associated clinical librarian input with increased length of stay was too heavily confounded by patient group differences to support this conclusion, as acknowledged by its authors. Four of 5 effective interventions (80%) incorporated subspecialist input to the primary general medical ward team. 18,20,33,34 Again, 4 of 5 effective interventions were of high intensity, 18,20,22,33 without a significant overall correlation between intensity and effect on length of stay (χ² = 1.433; P = .49).

Of the studies that failed to demonstrate a statistically significant change in length of stay, 9 of 16 (56%) reported increased length of stay with their intervention,16,17,24-26,28,31,35,43 Singh et al31 explained how this result could be an unintended consequence of localization interventions. However, the exploratory quantitative summary did not detect a signifi-

†References 16, 17, 19-21, 29, 33-38, 41, 43, 44
‡References 18, 17, 20-24, 28-33, 36-39, 41, 43
§References 18-26, 29-35, 37, 38, 40-42, 44, 45
# References 16, 17, 19-21, 23, 26, 30, 34-36, 39-41, 43, 44
| References 18, 12, 24, 25, 27, 28, 31, 37, 38, 42, 45
**References 16, 17, 19, 21, 23-29, 31, 35, 36, 40, 43
cant change in length of stay overall. The weighted mean difference in length of stay for interdisciplinary team composition interventions was 0.087 (95% CI, −0.083 to 0.257). For interdisciplinary team practice interventions, the weighted mean difference in length of stay was 0.001 (95% CI, −0.035 to 0.037) (Figure 1).

Readmissions and Use of Outpatient Care
Twelve of 15 interventions (80%) did not reduce readmissions. One study (7%) reported readmissions at 7 days, 28 8 studies (53%) reported readmissions at 30 days, 19-23-25 5 studies (33%) reported readmissions at points between 60 days and 6 months, 23,26-28,31-33 and 1 study (7%) reported readmissions at 1 year. 37 One study reported both 3- and 6-month readmissions. 42

One of 3 infectious disease interventions (33%) reduced 60-day readmissions related to relapsing infection 36; the other 2 similar interventions did not affect readmissions, albeit when measured at 30 days. 19-23 One of 4 40-43 pharmacy interventions reduced admissions (at 3 months), although the effect had dissipated by 6 months. 42 Zero of 6 interdisciplinary team practice interventions reduced readmissions. 23,26-28,31,32 One study suggested reduced readmissions after localizing teams and introducing service census limits, but the results did not meet the predefined statistical threshold allowing for multiple comparisons. 23 Increased readmissions in the study by Esparza et al 39 were again attributed to confounding factors. Of the 2 interventions that reduced readmissions, one was of low intensity 36 and the other was of high intensity. 32 An exploratory analysis showed interdisciplinary team care interventions had an inconsistent effect on early readmissions. Team composition interventions tended to increase early readmissions, albeit with important confounding factors in the included studies: weighted risk ratio (RR), 1.341 (95% CI, 1.120-1.607). Team practice interventions did not significantly reduce early readmissions: weighted RR, 0.995 (95% CI, 0.912-1.085) (Figure 2).

Last, 1 study reported contact with primary health care (ambulatory visits to medical specialists, family physicians, and the emergency department) 43 and 1 reported objective functional measures at 12 months. 37 The interdisciplinary team interventions had no effect on these outcomes.

Mortality Rates
Only 1 of 15 (7%) studies that reported mortality rate showed a significant effect at any time point 23 (Figure 3). Mudge et al 23 were the only group, to our knowledge, to describe a sustained increase in allied health care professional resourcing (physiotherapy, occupational therapy, social work, dietetics, and speech therapy) alongside an interdisciplinary structure to make use of those staff. The intervention was rated high intensity. However, the observed reduction in in-hospital mortality did not persist at 6 months. 23 Team practice interventions tended to reduce early mortality, although only 2 studies contributed data: weighted RR, 0.665 (95% CI, 0.449-0.986). Interdisciplinary team composition interventions did not significantly reduce early mortality: weighted RR, 0.925 (95% CI, 0.816-1.049) (Figure 3).

Discussion
Studies of interdisciplinary team care interventions on general medical wards most commonly choose length of stay, complications, readmission, or mortality rates as their primary outcome measures. In this setting, we found that most interdisciplinary interventions do not affect these outcomes, although there is some evidence that improvements in interdisciplinary collaboration may reduce complications of care. Significant contemporaneous secular reductions in length of stay are reported, 28 which these interventions did not reduce further. Interdisciplinary interventions confined to the inpatient setting are unlikely to reduce readmissions, the need for institutional care after discharge, or mortality rates—although simultaneous investments in staffing and team structures may reduce mortality rates in the short term. Limited reports of success suggest that high-intensity delivery is necessary, but not sufficient, for an intervention to have the desired effect on any of these outcomes.

The included studies took place in a variety of settings, from safety-net hospitals to large academic facilities, and across numerous countries with disparate health care systems. In contrast to many trials, the studies included here had relatively few exclusion criteria. These findings are therefore generally applicable to a broad range of medical inpatients internationally, although the evidence on which they draw is limited in both quantity and quality.

Our results broadly correlate with earlier work evaluating nontechnical interventions. A Cochrane review 46 of RCTs could only label collaborative interprofessional interventions as “promising” rather than “proven.” Multidisciplinary team training in obstetrics does not improve clinical outcomes, 47,48 nor did an interdisciplinary safety program for surgical ward teams. 49 Similarly, interventions with the primary aim of promoting a culture of patient safety do not have a clear effect on patient outcomes. 50 The evidence that interdisciplinary interventions can improve patient outcomes appears limited to the operating room and the ICU. 51,52 Outside these structured units, we may need a more considered approach to the assessment and improvement of interdisciplinary team care.

Every medical discipline now requires an updated set of core trial outcomes—a key data set to which each new study should contribute—in addition to its specific findings. 54 Interdisciplinary care in internal medicine may need this set of outcomes more than most; it is striking that both the systems of care, and our favored parameters for evaluating them, have gone unchanged for decades. 28,53 Meaningful collaboration is increasingly seen as the bellwether for a high-performing ward, but our findings suggest that changes in interdisciplinary team care are not well captured by the objective patient measures currently used in this setting. There is little apparent consensus on the essential outcomes that general medical ward interventions should report, nor how to adjust them to reflect the ward’s case mix. Other authors have also suggested that the focus on length of stay, readmissions, and mortality rate misses the point. 52-54 Good interdisciplinary team care may pro-
long admissions, perhaps by fostering an environment in which the patient’s medical and social needs before discharge are better identified. Thirty-day readmission rates may be largely determined by the provision of services in the community, and mortality rates correlate poorly with quality of care. 

In contrast, a Delphi expert consensus identified the 72-hour readmission rate as a valid quality indicator for hospitalized patients with complex needs. This rate was the only preferred patient outcome among several process measures; other consensus panels addressing complexity have focused solely on processes as quality indicators. Our analysis suggests that complications of care or preventable adverse events may also have promise as clinically meaningful outcomes reflecting the quality of general medical ward care. These outcomes, together with selected process data, merit consideration in a core data set. Too few studies reported postdischarge use of outpatient services or objective measures of patients’ functional performance to judge whether these too may be useful. We believe that patients themselves should also be invited to tell health care professionals which objective outcomes they hold most important. Whether their individual experiences of health care correlate with its technical quality remains unclear; nonetheless, as a group, patients are too rarely asked to participate in defining what matters.

With relevant outcomes better established, future studies should evaluate how best to implement interdisciplinary team care interventions. Interdisciplinary care is not a panacea; understanding the preconditions for its success (eg, adequate staffing levels or strong leadership support) and whether it potentiates other safety initiatives should be a priority. New interventions should also capitalize on 3 important phenomena. First, interdisciplinary teams become more effective as their members develop personal autonomy to enact recommendations. Second, practical changes that facilitate better teamwork may be more effective than simply investing in teamwork training per se. Third, clinical and managerial engagement are crucial if successful changes are to persist after a study, and authors should describe the implementation model accompanying any intervention alongside its objective evaluation.

To our knowledge, this review is the first systematic attempt to assess interventions targeted specifically at the organization of care on general medical wards. Our definition of interdisciplinary team care establishes a meaningful class of intervention. We identified a focused collection of work that is relevant to modern practice. Previous reviews of interdisciplinary interventions brought together distinctly different contexts—for example, internal medicine and orthopedic surgery or psychiatry and the ICU. However, general medical wards face different challenges than other areas of the hospital, including more frequent transitions of care, geographic team dispersion, and heterogeneous patient populations for whom there is no single best pathway for diagnosis or treatment. We believe these differences argue for a specific analysis of general medical wards rather than extrapolating from other clinical departments to this unique setting. Including a range of study designs, as we have done here, facilitates a deeper understanding of context-specific improvement strategies than reviews that rely on RCTs alone. Last, our definition of intervention intensity mirrored an updated conceptual framework for understanding implementation fidelity.

Nonetheless, the heterogeneous studies described here could be categorized differently. We were unable to search for unpublished trials, precluding assessment of publication bias or selective reporting. Included studies used a variety of different designs; even allowing for this fact, most have severe methodological limitations that constrain the strength of our conclusions. The absence of any studies with a low risk of bias is noteworthy, and we included controlled before-after studies with only 1 intervention or control site, which are particularly prone to confounding. We aggregated results reported at different times; our distinction between early and late outcomes is arbitrary but mimics that used in clinical practice. Although we sought to contact study authors for clarification or additional data, only some replied. The heterogeneity of the included studies limited quantitative analysis, and the search strategy may not have been fully sensitive to all relevant articles. Our search identified only the articles with objective patient outcomes, so we have not described process measures, subjective outcomes, or patient-reported outcomes; these too are valuable.

Conclusions

To date, most general medical ward interdisciplinary team care interventions have not improved the objective patient outcomes used to assess them. Outside the operating room and ICU, more sensitive measures are required to evaluate interdisciplinary care. In 1995, Campion argued that “bedside consultations are not a form of technology, and we should not be as severe in judging them as we are in evaluating a surgical procedure.” We propose that equally careful consideration of interdisciplinary care is merited, although we need new objective measures of its effectiveness.
Green Cross Medical Ltd for the development of training materials for cancer tumor boards. Dr Wachter had a role in writing as the immediate past-chair of the American Board of Internal Medicine (ABIM) for which he received a stipend and is a current member of the ABIM Foundation board; receiving a contract to UCSI from the Agency for Healthcare Research and Quality for editing 2 patient-safety websites; receiving compensation from John Wiley and Sons for writing a blog; receiving royalties from Lippincott Williams & Wilkins and McGraw-Hill for writing/editing several books; receiving a stipend and stock options for serving on the Board of Directors of IPC Healthcare; serving on the scientific advisory boards for Amino.com, PatientSafe Solutions, CRISI, QPID, and EarlySense (for which he receives stock options); and holding the Benoiff endowed chair in hospital medicine from Marc and Lynne Benoiff. No other disclosures were reported.

Funding/Support: This study was supported by the National Institute for Health Research via the Imperial Patient Safety Translational Research Center (http://www.cpssq.org) (Drs Pannick, Davis, Byrne, and Sevdalis); from January 2015, the National Institute for Health Research Collaboration for Leadership in Applied Health Research and Care South London at King's College Hospital National Health Service Foundation Trust (Dr Sevdalis); the West Midlands University Hospital National Health Service Trust (Drs Pannick and Beveridge); and the Department of Surgery and Cancer at Imperial College London (Dr Asratha and Athanasiau).

Role of the Funder/Sponsor: The authors were fully independent of their funding institutions, which took no part in the design or conduct of the study; the collection, management, analysis, and interpretation of the data; the preparation, review, or approval of the manuscript; or the decision to submit the manuscript for publication.

Disclaimer: The views expressed are those of the authors and not necessarily those of the National Health Service, National Institute for Health Research, or Department of Health.

REFERENCES


**Invited Commentary**

**Inpatient Interdisciplinary Care**

**Can the Goose Lay Some Golden Eggs?**

Hilary J. Mosher, MFA, MD; Peter J. Kaboli, MD, MS

**For some years, medical students** at our institution have started orientation with a team-building exercise. Using paper, rubber bands, paper clips, popsicle sticks, and drinking straws, groups of 5 students are instructed to build a contraption to safely transport a raw egg from an atrium balcony to the floor below. The teams hatch their plans, negotiate their ideas, divvy up work, and test their vessels. Few eggs land intact, but the broader objectives—bringing together students with diverse life experiences and talents and communicating teamwork as a valued aspect in health care—are achieved.

Despite the assumption that teamwork creates value, health care professionals receive little formal interdisciplinary training. Teams form, evolve, and reform in fluid and dynamic fashions as they coalesce around shared goals. In medical inpatient units, we have assembled interdisciplinary teams to help our patients (the eggs) navigate the dangerous health care setting with the hopes of landing them safely home, to postacute care, or to a peaceful death. The provision of this care with high quality, efficiency, and satisfaction for everyone is the ultimate common goal.

In their systematic review, Pannick et al1 sought to evaluate the effect of hospital-based interdisciplinary team