

Cancer Care Coordination: a Systematic Review and Meta-Analysis of Over 30 Years of Empirical Studies

Sherri Sheinfeld Gorin, PhD^{1,2} · David Haggstrom, MD, MAS³ · Paul K. J. Han, MD, MA, MPH⁴ · Kathleen M. Fairfield, MD⁴ · Paul Krebs, PhD⁵ · Steven B. Clauser, PhD⁶

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Abstract

Background According to a landmark study by the Institute of Medicine, patients with cancer often receive poorly coordinated care in multiple settings from many providers. Lack of coordination is associated with poor symptom control, medical errors, and higher costs.

Purpose The aims of this systematic review and meta-analysis were to (1) synthesize the findings of studies addressing cancer care coordination, (2) describe study outcomes across the cancer continuum, and (3) obtain a quantitative estimate of the effect of interventions in cancer care coordination on service system processes and patient health outcomes.

Methods Of 1241 abstracts identified through MEDLINE, EMBASE, CINAHL, and the Cochrane Library, 52 studies met the inclusion criteria. Each study had US or Canadian participants, comparison or control groups, measures, times, samples,

and/or interventions. Two researchers independently applied a standardized search strategy, coding scheme, and online coding program to each study. Eleven studies met the additional criteria for the meta-analysis; a random effects estimation model was used for data analysis.

Results Cancer care coordination approaches led to improvements in 81 % of outcomes, including screening, measures of patient experience with care, and quality of end-of-life care. Across the continuum of cancer care, patient navigation was the most frequent care coordination intervention, followed by home telehealth; nurse case management was third in frequency. The meta-analysis of a subset of the reviewed studies showed that the odds of appropriate health care utilization in cancer care coordination interventions were almost twice (OR = 1.9, 95 % CI = 1.5–3.5) that of comparison interventions.

Conclusions This review offers promising findings on the impact of cancer care coordination on increasing value and reducing healthcare costs in the USA.

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✉ Sherri Sheinfeld Gorin
sherri.gorin@gmail.com

¹ National Cancer Institute (NCI; Leidos Biomedical Research, Inc.), Bethesda, MD, USA

² New York Physicians Against Cancer (NYPAC), New York, NY, USA

³ VA HSR&D Center for Health Information and Communication, Regenstrief Institute, Inc., Indiana University School of Medicine, Indianapolis, USA

⁴ Maine Medical Center Research Institute, Scarborough, ME, USA

⁵ VA Medical Center, New York University, New York, NY, USA

⁶ Patient-Centered Outcomes Research Institute (PCORI), Washington, DC, USA

Keywords Care coordination · Health care coordination · Cancer · Neoplasms · Continuity of patient care · Patient navigation · Interdisciplinary communication

Background

Coordinating cancer care is especially challenging because of its complexity [1]. The care of many cancer patients involves multimodal cancer therapies, treatment of other health conditions in addition to the cancer, and multiple organizational levels, health services, providers, and sites of care [1, 2]. The complexity of cancer care is exacerbated by a delivery system that is neither integrated nor organized in its design. The Institute of Medicine has reported that patients with cancer often receive poorly

coordinated care. Poor care coordination is associated with poor symptom control, medical errors, and high costs [3–6].

A recent systematic review sponsored by the Agency for Healthcare Research and Quality (AHRQ) identified more than 40 definitions of care coordination [4]. The authors concluded with the following general definition: “Care coordination is the deliberate organization of patient care activities between two or more participants (including the patient) involved in a patient’s care to facilitate the appropriate delivery of health care services. Organizing care involves the marshaling of personnel and other resources needed to carry out all required patient care activities and is often managed by the exchange of information among participants responsible for different aspects of care.” According to the National Quality Forum, “Care coordination is about what happens in the space between providers” [5].

As cited in the AHRQ review, coordination of cancer care depends upon effective information exchange and regular communication between patients and physicians, family members, support staff and services, and even community organizations [4, 6–9]. Some patients are able to manage this complex care environment, alone or with the help of family or social supports, but others become lost, with direct negative impact on the quality of care they receive [1]. According to a recent *BMJ* (formerly, *British Medical Journal*) study [10], fragmented care—including communication breakdowns—are considered medical errors; medical errors are the third cause of death in the USA.

Many models of care coordination have relied heavily on constructs and empirical findings from behavioral medicine (e.g., patient navigation systems), and behavioral medicine investigators and clinicians have been involved in developing and implementing innovative models of care coordination. For example, while the most common form of care coordination, patient navigation, was designed to address structural barriers to continuous care (financial impediments, and transportation), it has grown to address the psychological, social, and physical support systems that are mainly directed at improving the quality of life of patients with cancer [11].

Further, a growing number of government agencies, medical organizations, payers, and consumers have become engaged in efforts to improve care coordination, including, in 2002, the Centers for Medicare & Medicaid Services’ (CMS) Medicare Coordinated Care Demonstration (MCCD) [5–7, 11–13]. The results of this study across 15 participating sites (25.1 % of whom were diagnosed with cancer) highlighted both the important opportunities for implementing care coordination on a broad scale across diverse health systems and the difficulty of measuring its benefits. As of 2015, CMS offered coverage of care coordination for Medicare recipients with

chronic illnesses, including cancer, under the Oncology Care Model, however [14].

Little is known about the extent to which coordination occurs in cancer care across the USA and whether approaches to increase the effectiveness of care coordination result in greater health care quality and improved patient experiences. The current study was undertaken to address this need.

We conducted a systematic review and meta-analysis among studies of cancer care coordination published between 1980 and 2015. The primary aims were to (1) synthesize the findings of studies evaluating cancer care coordination, (2) describe the study outcomes across the cancer continuum, from detection to end-of-life, and (3) estimate the magnitude of the effect of interventions in cancer care coordination on service system processes and patient health outcomes. To our knowledge, the current study is the first systematic review and meta-analysis of the empirical literature on the effectiveness of interventions aimed at cancer care coordination across the continuum.

Methods

Search Strategy

The databases MEDLINE (Dialog/ProQuest), *Embase*, CINAHL, and the Cochrane Library were searched with database-specific controlled vocabulary terms for cancer and keywords (with some adjacency operators) for integrated or coordinated healthcare. Other relevant keywords (e.g., measure*, outcome*, model*, scale*, questionnaire*, process*, instrument) were included in the search strategies to enhance retrieval. In addition, QUOSA (Elsevier) software was used to search the full text of articles retrieved from initial *PubMed* and *Embase* searches. To increase reliability of the definition of cancer, the search used the same subject terms for specific neoplasms as Yabroff et al. [15]. The full list of search terms is available in an online Appendix A1.

Selection Strategy

Selection of abstracts for full review was divided among two pairs of raters. After each person in each pair reviewed the abstracts independently, the project leader reviewed findings from rater pairs, resolved any discrepancies, and produced a final list of studies for full-text examination. To represent the extant literature that included both randomized clinical trials and observational studies and to compare similar medical practices, the following inclusion criteria were used: US or Canadian study populations consisting of patients diagnosed with cancer or undergoing procedures for the diagnosis of cancer, empirical (vs. conceptual) studies, and clearly

specified outcome measures. To include only rigorous studies, all research used control or comparator groups consisting of time (e.g., baseline and follow-up [16]), defined patient samples (e.g., women in gatekeeper health plans [17]), or interventions (e.g., those receiving patient navigation [PN] vs. historical controls [18]). For the meta-analysis, additional inclusion criteria consisted of the presence of both baseline and follow-up sample sizes and quantitative outcome measures. Other systematic reviews and summaries of lessons learned or programs of research were excluded.

Review Strategy The list of studies identified for full-text review was divided among the two pairs of raters, who independently reviewed each using a standardized online rating instrument designed for this project. After each rater entered data abstracted from the articles, the project leader (SSG) or an additional independent rater identified discrepancies, which were then systematically resolved by consensus among the entire research team, and final data were entered for each study. When full text could not be located or when published articles did not present sufficient data, we contacted authors for additional information.

Studies included in the meta-analysis were assessed for quality using a modified seven-item version of the Physiotherapy Evidence Database (PEDro) coding scheme, which was developed using a Delphi expert consensus technique. Generally applied to randomized clinical trials, the scheme was designed to identify studies that are generalizable, internally valid, and contain interpretable data. [19].

Statistical Analysis for the Meta-Analysis

According to the Cochrane Collaboration, a meta-analysis assesses those studies that meet a higher threshold for rigor and will improve the precision of the findings by assessing the statistical association of the intervention with specific outcomes (<http://handbook.cochrane.org/>). This may increase the potential use of the review by providers and policy makers.

For a subset of the studies that met additional inclusion criteria, we conducted a meta-analysis using Hedges g as the effect size (ES) statistic. Hedges g , as defined by Borenstein et al. [20], is the difference between intervention and control group means (d), divided by their pooled standard deviation multiplied by a factor (J) that corrects for underestimation of the population standard deviation. The effect size statistic standardizes outcomes across studies and facilitates comparison among disparate outcome measures.

Each effect size was weighted by its inverse variance weight in calculating mean effect sizes. Heterogeneity was examined using the I^2 statistic, which represents the approximate proportion of total variability (0 to 100 %) in point

estimates that can be attributed to systematic differences across studies (larger percentages reflect greater heterogeneity). All effect size calculations employed a random effects estimation model. A random effects estimate assumes additional variance beyond the set of studies and facilitates generalizability of results.

When studies reported outcomes at more than one follow-up time point, the final assessment reported was used to calculate the effect size. Individual effect sizes were examined to identify outliers for possible correction, and the trim and fill technique was used to evaluate the influence of publication bias. Trim and fill assesses the extent of asymmetry in the funnel plot and imputes an adjusted intervention effect to correct for potential publication bias. We used the *Comprehensive Meta-Analysis* software package (<http://www.meta-analysis.com/>) to conduct all statistical analyses. All p values are two-sided.

Results

Study Selection

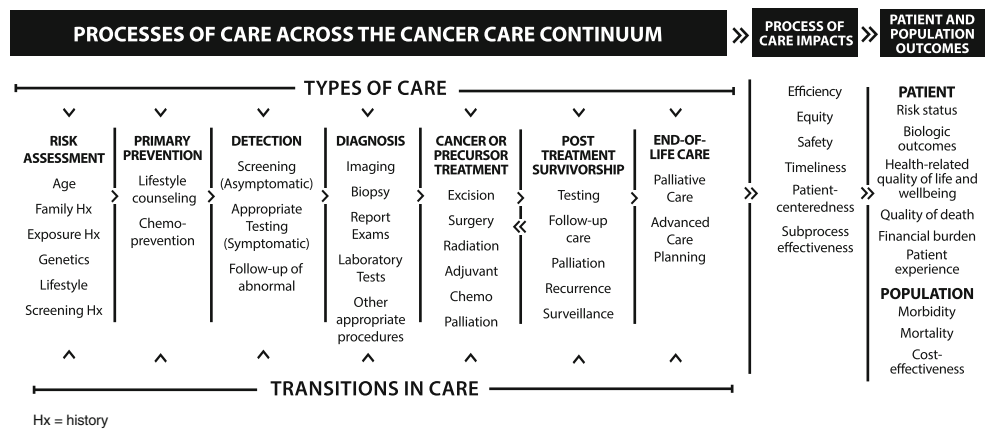
We covered the full continuum of cancer care across the disease trajectory, from risk assessment through primary prevention, screening, detection, diagnosis, treatment, and survivorship to end-of-life care (see Fig. 1). A total of 1241 study abstracts were identified through online databases. Full text was retrieved for 137 studies. On review of these studies, 85 were eliminated because they did not meet inclusion criteria for the systematic review, yielding 52 studies for analysis (see Fig. 2) [17–73]. Of these, 11 studies met additional inclusion criteria for the meta-analysis [16, 21–30].

Characteristics of Included Studies The characteristics of the 52 studies, including the participants, treatment settings, tumor types, perspectives, location along the care continuum, and cancer treatment approaches ($N = 598,683$ participants), are summarized in Table 1. As expected, we did not find any studies of cancer care coordination in risk assessment or primary prevention along the cancer continuum. The characteristics of all of the included studies are described more fully in Appendix Table A2 (online). The characteristics of the subset of studies that were included in the meta-analysis are described in Appendix Tables A3 and A4 (online).

Research Methods

The cross-sectional survey, using original or secondary data [31, 33, 35, 36, 41, 42, 45, 46, 48, 52, 55, 56, 61, 65, 66, 68],

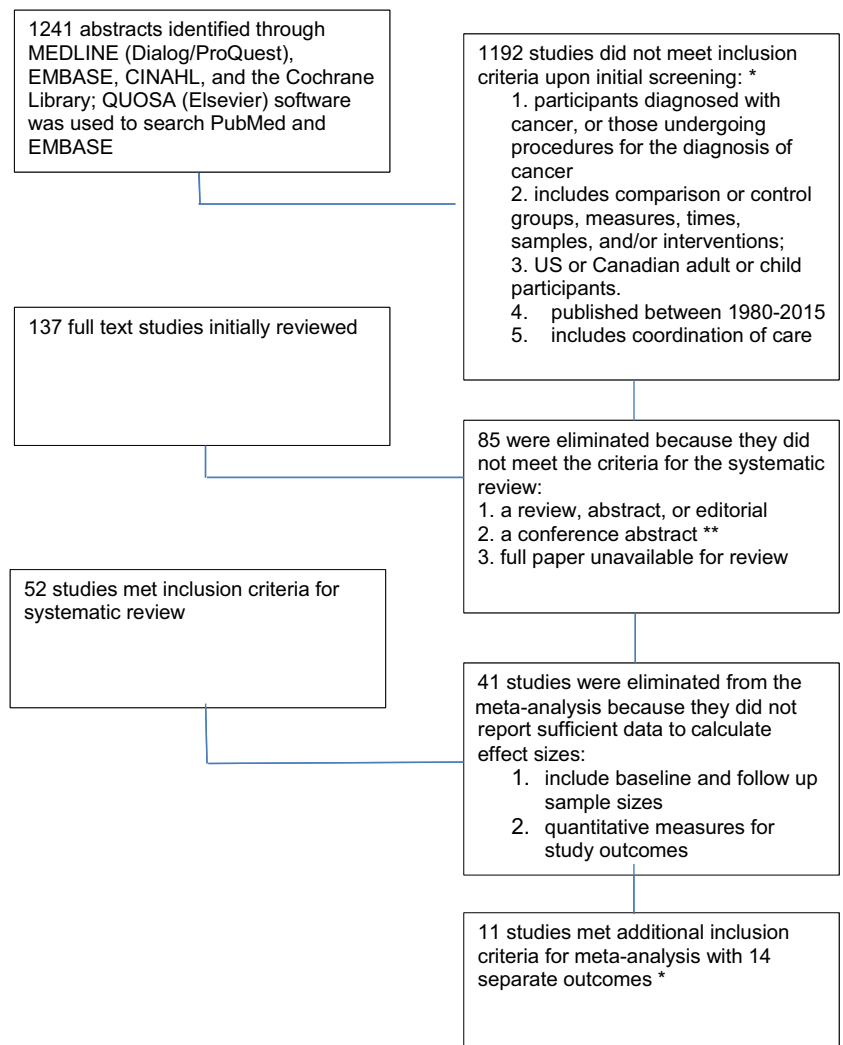
Fig. 1 The cancer continuum. Adapted from [97]



or the retrospective cohort analyses [17, 32, 34, 39, 51, 53, 54, 57, 62–64, 67, 69, 71–73] were the most commonly cited study designs ($N = 16$ each; e.g., medical record review) [39], randomized controlled trial (RCT, $N = 10$) [16, 22–25, 27–30, 43] followed by the pre–post questionnaire ($N = 4$)

[21, 37, 49, 50], secondary analyses of RCT data ($N = 2$) [26, 40], and prospective comparative trials ($N = 2$) [18, 47] designs. Mixed method studies ($N = 1$; 39) and comparative multiple case studies ($N = 1$; 45) were the least common designs in this sample (see Table 1).

Fig. 2 Selection of included studies



*Updated to 2015. N excluded cancer, N=148; control/comparison, N=346; non-US/Canadian participants, N=277; date, N=0; care coordination, N=421. **One conference abstract was included with clinical trial data.

Table 1 Summary of study intervention characteristics ($N = 52$ studies, 598,683 participants)

Sociodemographic and treatment characteristics	N
Country	
USA	43
Canada	9
Minorities ($N = 30$)	26.2 %
Women ($N = 37$)	61.4 %
Uninsured ($N = 8$)	12.6 %
Tumor type ($N = 52$)	
Breast	13
Lung	7
Colorectal	3
Prostate	2
Mixed	27
Type of cancer treatment ($N = 52$)	
Chemotherapy	4
Radiotherapy	2
Palliation	5
Chemotherapy and radiotherapy	1
Mixed	23
Other treatments	1
No active treatment	7
Unknown	9
Perspective on care coordination ($N = 45$)	
Patient/family	29
Health care professional	10
System representative	5
Multiple	1
Cancer care coordination focus ($N = 49$)	
Primary	5
Specialty	20
Primary/specialty interface	12
Other	12
Cancer continuum ($N = 62$) ^a	
Screening	5
Diagnosis	9
Treatment	24
Survivorship	17
End of life	7
Study setting ($N = 52$)	
Outpatient specialty	20
Outpatient primary	6
Inpatient general medicine	1
Multiple	22
Missing	3
Study design ($N = 52$)	
Cross-sectional survey	16
Retrospective cohort analysis	16
Randomized clinical trial (RCT)	10
Pre–post questionnaire	4

Table 1 (continued)

Sociodemographic and treatment characteristics	N
Secondary analysis of RCT	2
Prospective comparative trial	2
Mixed methods	1
Comparative multiple case study	1

^a Several studies described more than one point along the cancer care continuum, including these five: [33, 38, 54, 62, 68]

Types of Cancer Care Coordination Interventions

Twenty-one studies (40 %; 16, 18, 21–30, 37, 43, 45–51) included an intervention, among an average 3784 participants (see Table 2). Across the continuum of cancer care, patient navigation (generally by a trained community member) was the most frequent care coordination intervention ($N = 5$) [16, 18, 24, 29, 45]. Home telehealth (with an automated message delivery by an interactive telehealth informatics infrastructure and a care coordinator) was second most common ($N = 3$) [21, 37, 46] and nurse case management ($N = 3$) was third in frequency [25, 28, 47].

Less common ($N = 2$) were comprehensive healthcare system or community-based educational approaches [43, 51] and, with one study each, were survivorship care plans [27], psychiatric collaborative care interventions [30], or education about depression and cancer [23].

In palliative care programs, a comprehensive team was most common ($N = 4$) [22, 26, 49, 50]. One study assessed coordination by a palliative cancer care physician or nurse [48].

Findings on Cancer Care Coordination Models

Only three studies [18, 25, 28] cited an underlying model or cross-cutting concepts for the intervention; none applied a fully elaborated behavioral theory as an intervention guide. These models included Bower's model for case management [25], Donabedian's model to evaluate the quality of medical care [28], and community participatory research [18].

Findings on Cancer Care Coordination Processes and Structures

Overall, 30 studies evaluated the processes and structures of cancer care coordination across the cancer continuum. [16, 18, 25, 26, 31, 33, 35, 37–45, 47, 48, 50–53, 55–57, 64–66, 72]. These measures included the extent, fidelity, timeliness, and/or quality of cancer care coordination (see Table 3 online only and online Appendix A2).

Table 2 Summary of the study intervention characteristics at baseline ($N = 52$ studies)

Intervention participants	N
<i>Intervention types ($N = 21$)^a</i>	
Patient navigation	5
Home telehealth	3
Nurse case manager, care coordinator	3
Palliative care programs	5
Education about depression and cancer, treatment options and follow-up	1
Psychiatric collaborative care	1
Survivorship care plan	1
Comprehensive approach within a healthcare system or multi-community (e.g., with cancer care coordinator, computerized reminder/tracking system, multidisciplinary pulmonary nodule conference, new thoracic surgeon)	2
<i>Intervention format ($N = 20$)</i>	
Individual	17
Group	2
Family	1
<i>Intervention mode ($N = 19$)</i>	
In-person	8
Phone	6
Multiple (in-person, telephone, email)	5
<i>Type of provider ($N = 21$)</i>	
Nurse	5
Patient navigator	5
Social worker	1
Psychologist	1
Mixed	9
<i>Intervention levels ($N = 21$)</i>	
Healthcare system	3
Provider	1
Patient and family	17
<i>Comparison group ($N = 52$)</i>	
Yes	24
No	25
Not reported	3
<i>Control participants</i>	
<i>Type of control groups ($N = 9$)</i>	
Usual care	8
Component controls ^b	1

^aTwo sets of studies administered the same intervention [24, 21, 37]

^bComponent controls exclude the “active ingredients” of treatment, while generally including nonspecific therapeutic factors such as expectations of improvement (for example, therapist-led intervention group without supportive-expressive therapy vs. therapist-led intervention group with supportive-expressive therapy [103])

Cancer Care Coordination Outcomes

Among 55 cancer care coordination outcomes measured across 26 separate studies, favorably increased outcomes were observed across 10 studies [17, 23, 25, 26, 29, 37, 46, 47, 49, 68], appropriately decreased outcomes were reported in 11 studies [23, 28, 30, 34, 36, 37, 49, 50, 69, 71, 73], and 5 remained unchanged [16, 17, 22, 24, 43] relative to the comparison or control groups, measures, times, samples, and/or interventions (see Table 4 and online Appendix A2). The types of outcomes varied across the continuum, as expected.

Detection and Diagnosis Only one study measured mortality outcomes among patients undergoing cancer diagnosis. It found that treatment timeliness was not associated with increased survival among hospital patients diagnosed with non-small cell lung cancer (NSCLC) stages I to III [58].

Treatment A pilot study of a collaborative care depression intervention, which included education about depression and cancer, treatment options, and follow-up, led to increased emotional well-being and decreased depression among Latinas [23]. A stepped collaborative care intervention did not significantly reduce depression [30], pain, and fatigue among cancer survivors, however.

Two studies systematically examined the impact of patient navigation [16, 24] on health outcomes. No differences in satisfaction with cancer-related care [24], psychologic distress, emotional well-being, or quality of life [17] were observed.

In contrast, a population-based telephone health survey of women ages 50 years and older reported that patient ratings of care quality (using six items from the Consumer Assessment of Health Plans Study [CAHPS] hospital survey; 70) increased after their medical oncologists began to share management. Shared (or co-) management included joint participation in the planning, decision-making, and delivery of care [68].

Telehealth between a care coordinator and patients increased health-related quality of life in two trials among newly diagnosed patients who were receiving chemotherapy [37, 46]. In a randomized clinical trial of a nurse intervention focused on symptom management among women diagnosed with ovarian cancer, hospitalizations and oncology outpatient visits were unaffected while emergency department (ED) visits increased [28].

A prospective longitudinal cohort study among patients referred to a community-based oncology nursing program found improvements in patient-reported outcomes in key supportive health domains, including psychological needs, health system and information needs, physical and daily living needs, patient care, and support needs [47].

Table 3 Processes and structures of cancer care coordination across the cancer care continuum ($N = 30$ studies with measures)*Detection and diagnosis*

Time to follow-up [64]

Multidisciplinary cancer conference (MCC) benefits for coordinating and improving plans among physicians and surgeons vs. administrators [33]

Timeliness of care: navigation with reduced time to treatment [39]; combined medical/surgical breast health program reduced time to appointment [55]; reduced image to treatment interval associated with hospital aegis [57]; reduced time between first abnormal image and the initiation of treatment for lung cancer [51]

Reduced stage of diagnosis: with continuity of care from internist rather than general or family physician [72]; comparable stage of diagnosis in integrated health care system [54]

Primary care responsible for 47 % of healthcare of prostate cancer patients [62]

Treatment

Oncologist primarily responsible for care throughout treatment to survivorship [31]

Shared care of oncologist with primary care physician (PCP) increased across treatment to survivorship [31]

Navigators can predict treatment intensity and navigation time [45]

Most patients cooperate with home messaging device collecting symptoms [37]

Patient travel reduced with provider-directed education [43]

Delayed radiation treatment (RT) in integrated healthcare system [53]

Case management associated with more breast-conserving surgery, RT [25]

Case management associated with normal arm function [25]

Case management associated with perceived patient treatment choice [25]

Early palliative care, less chemotherapy, longer timing of chemotherapy, and death [26]

Navigation associated with less treatment interruption (days) [18]

Navigation associated with enrollment in clinical trial or cancer control protocol [18]

Perceived low care coordination by patients, particularly those of low literacy [65]

Reported low satisfaction with care coordination by patients, particularly those of low literacy [65]

Multidisciplinary cancer conference benefits for coordinating and improving plans among physicians and surgeons vs. administrators [33]

Nurse-led models of supportive care (teaching/coaching for symptom management, counseling, support, system resource navigation, promise improvements in coordination of care [38]

Low surgeon use of patient and practice management process measures [42]

Integrated system and comparable rates of curative colon cancer surgery [54]

Integrated system comparable rates of treatment for Non-Hodgkin's lymphoma (NHL), multiple myeloma [54]

Integrated system less 3-D conformal or intensity-modulated RT for prostate cancer [54]

≥50 % PCP involvement relative to specialists in discussion of treatment preferences and use of surgery [35]

Specialists (urologists) provide most (prostate) cancer care (45.2 %) [62]

Patients followed by specialists more often followed American Society of Clinical Oncology (ASCO) guidelines for breast cancer surveillance than PCPs; documentation was inconsistent [32]

Paired perspective of navigator and patient identified struggles of investment imbalance and relational amelioration during navigation [40]

Survivorship

Shared care of oncologist with PCP increased across treatment to survivorship [31]

Reasonable support for survivorship care [52]

Least developed were information technology system for survivorship care planning [52]

Lack of a survivorship care plan related to low confidence in managing survivorship among young adults [56]

Patient self-management tools and interventions limited in survivor centers of excellence [52]

Guidelines for surveillance met for most (70 %) of post-colorectal cancer clinic visits [66]

Most young adult cancer patients (71 %) attended survivorship clinic [56]

Low confidence in managing survivorship care among young adults related to non-white ethnicity [56]

More patients (89 %) identified primary care physician as responsible for follow-up throughout care [27]

Nurse-led models of supportive care (teaching/coaching for symptom management, counseling, support, system resource navigation, promise improvements in coordination of care [38]

Decline in annual visits to oncologists over time vs. no annual decrease in visits to primary care providers [67]; most frequent primary care visits [61]

Radiation oncologist care declined in survivorship; medical oncology and primary care increased [62]

Table 3 (continued)

Higher fragmentation in care associated with repeat Prostate-specific antigen (PSA) testing [73]
Less than one-half to two-thirds of Institute of Medicine (IoM) content found in treatment summaries and survivorship care plans [41]
Patients followed by specialists more often followed ASCO guidelines for breast cancer surveillance than PCPs; documentation was inconsistent [32]
Cancer patients seeing specialists more than noncancer patients, no more likely to receive preventive influenza vaccine or to stop smoking [36]
Patients who saw oncologist and PCP most likely to receive preventive services over time [71]
<i>End-of-life</i>
Durations from referral to palliative care team to death were similar across the inpatient consultation team and inpatient units and longest in outpatient clinics [48]
Radiation oncologist care declined in end-of-life; medical oncology and primary care increased [62]

The same study showed no differences among the programs in global health or physical functioning, however, as measured by the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core 30 (EORTC-QLC-30; v3; 47).

Survivorship In the only reviewed study that explored the economics of cancer using the linked SEER-Medicare database, Skolarus et al. [73] found that costs increased among prostate cancer survivors with fragmented care (i.e., care by a greater average number of providers over time). Those receiving more fragmented care were more likely to receive repeat prostate-specific antigen (PSA) testing than were those receiving more coordinated care [73]. Importantly, fragmented prostate cancer survivorship care was more than three times as costly as the least fragmented care, particularly among those not treated with androgen-dependent therapy.

Colorectal cancer survivors who saw a primary care provider and a specialist were more likely to receive preventive services than those who saw either alone, according to the Surveillance, Epidemiology and End Results (SEER)-Medicare data [63, 71]. A retrospective record review among breast cancer survivors participating in a multisite clinical trial showed that specialists were more likely to follow the American Society of Clinical Oncology (ASCO) guidelines for surveillance than were primary care providers, however [32]. Few studies focused on patient self-management [52].

End-of-Life Care Among patients at the end of life, a palliative care program increased hospice care less than 1 week before death and increased home death (vs. hospital) [49]. Using a pre–post design, Dudgeon et al. [50] found that the implementation of common assessment tools, collaborative care plans, and symptom management guidelines across multiple Canadian health sectors resulted in reduced ED visits, acute care visits, and deaths in acute care settings. The intensity of symptoms, caregiver burden, or caregiver satisfaction with care did not differ between participants compared pre- and post-implementation.

In a randomized controlled trial of 151 patients with newly diagnosed metastatic NSCLC, participants received either early palliative care integrated with standard oncology care or standard oncology care alone. The palliative care intervention increased enrollment in hospice before death [26].

One study examined the effect of a comprehensive and interdisciplinary cancer support team implemented over 15 months among late stage lung, gastrointestinal, or gynecologic cancer patients. The study found no statistically significant differences between intervention and usual care groups on health-related quality of life (using the Functional Assessment of Cancer Therapy, FACT-General), aggressiveness of end-of-life care, or functional assessment of cancer therapy. [22].

Meta-Analytic Outcomes

A subset of studies was systematically examined through meta-analysis ($N = 11$; see Fig. 3). Data were sufficient to examine four general categories of outcomes (1), appropriate use of care (2), healthcare utilization (3), patient quality of life, and (4) mental health. In terms of appropriate use of care, studies reported outcomes related to treatment adherence [23, 29], cancer-related hospitalizations [21], receipt of recommended treatment [25], referrals to hospice [22], and days in hospice [26]. Healthcare utilization was measured by reductions in preventable visits [21], receipt of unnecessary chemotherapy [26], primary care visits [28], and hospital days [22]. Quality of life was measured by the FACT [16, 22, 23, 30] and SF-36 [27]. Mental health outcomes reported were measured by the CES-D [30] PHQ-9 [23], and Impact of Event Scale [24, 27].

Cancer care coordination significantly reduced hospitalization rates and ED visits and led to more timely treatments. Meta-analyses of the six studies that aimed to increase appropriate use of healthcare yielded $g = 0.37$ (95 % CI = 0.29 to 0.45, $p < 0.001$, $I^2 = 0.00$, fail-safe $N = 62$). Trim and fill imputed no studies. Four studies reported outcomes in which the goal was to reduce healthcare utilization, where $g = 0.22$ (95 % CI = -0.05 to 0.49, $p = 0.11$, $I^2 = 56.6$), with trim and fill imputing one negative study resulting in an ES of $g = 0.12$. Five studies reported quality of life outcomes $g = 0.12$ (95 % CI = -0.01 to 0.26,

Table 4 Study outcomes for cancer care coordination across the cancer care continuum ($N = 26$ studies with measured outcomes)

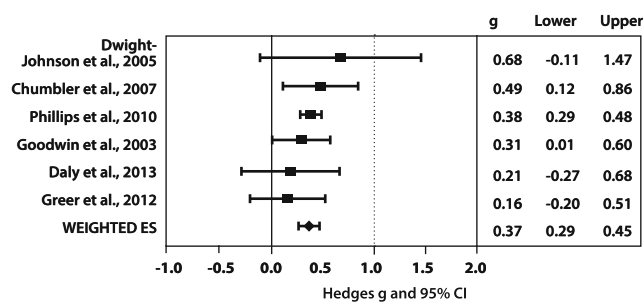
<i>Outcomes increased</i>	
<i>Detection and diagnosis</i>	
Mammogram adherence [17, 29]	
Papillomavirus smear test (Pap smear), Clinical Breast Examination (CBE) [17]	
Patient ratings of care [68]	
<i>Treatment</i>	
Emotional well-being [23]	
Reduction in inappropriate treatment [25]	
Health-related quality of life (HRQoL) [46, 37]	
Patient ratings of care [68]	
Patient-reported outcomes in key supportive health domains [47] ^a	
<i>End-of-life</i>	
Enrollment in hospice care <1 week before death, home death [49]	
Enrollment in hospice before death [26]	
<i>Outcomes decreased</i>	
<i>Treatment</i>	
Clinic visits, including primary care, acute, and preventive [21]	
Depression [23]	
<i>Survivorship</i>	
Primary care visits and for acute conditions [34]	
Per capita expenditures on prostate cancer care [73]	
<i>End-of-life</i>	
Death in acute care hospitals [50]	
Use of chemotherapy at end of life [26]	
Emergency Department (ED) visits, acute care visits, Intensive Care Unit (ICU) visits [50, 69]	
<i>No difference</i>	
<i>Detection and diagnosis</i>	
Prostate-specific antigen (PSA) [17]	
Global health or physical functioning [47]	
Image treatment timeliness and survival [57]	
<i>Treatment</i>	
Satisfaction with cancer-related care [24]	
Psychologic distress, emotional well-being [30, 24, 27, 16]	
Health-related quality of life [30, 23, 16, 27]	
Hospitalizations and oncology outpatient visits [28] ^b	
<i>Survivorship</i>	
Visits for chronic conditions [34]	
Fatigue [30]	
Pain [30]	
Depression [30]	
<i>End-of-life</i>	
Intensity of symptoms, caregiver burden, caregiver satisfaction with care [51]	
Referral to hospice [26]	
HRQoL, aggressiveness of End of Life (EoL) care, functional assessment of cancer therapy [22]	

Three studies contributed more than three outcomes each [28, 36, 49]

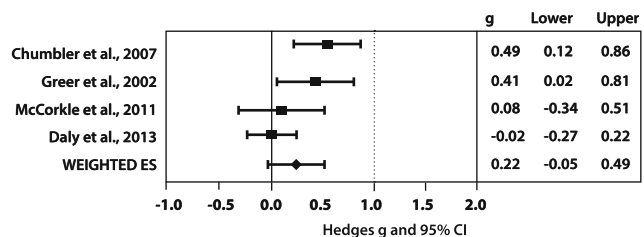
^a No reviewed studies of survivorship measured increased outcomes

^b As directed by the nurse

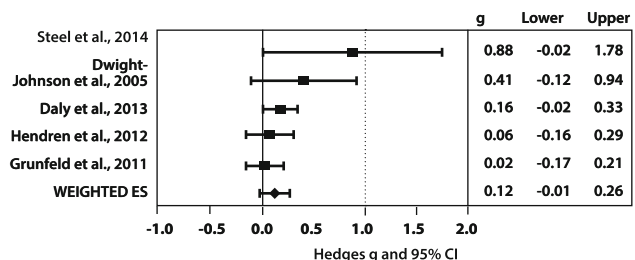
Effect Sizes and 95% CI: Appropriate Use of Care



Effect Sizes and 95% CI: Utilization Reduced



Effect Sizes and 95% CI: Quality of Life



Effect Sizes and 95% CI: Mental Health

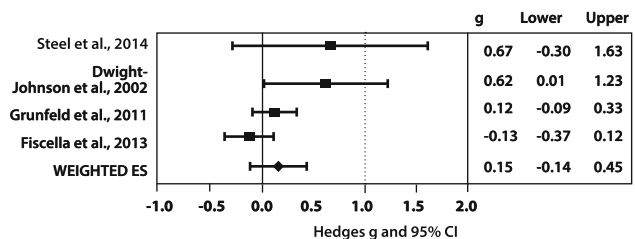


Fig. 3 Forest plots of effect sizes and 95 % CIs across four outcomes

$p = 0.08$, $I^2 = 25.0$). Trim and fill imputed two studies with negative results bringing the ES to $g = 0.08$. Four studies reported mental health outcomes, $g = 0.15$ (95 % CI = -0.14 to 0.45 , $p = 0.31$, $I^2 = 59.1$), with no studies imputed. Moderator analysis could not be conducted due to an insufficient number of studies in each outcome group.

Quality of Studies

We evaluated the 11 studies that were included in the meta-analysis based on whether they did or did not meet a PEDro

[19] criterion. As is common across studies in behavioral medicine, none of the studies concealed allocation or blinded assessors, but fewer than one-third of all studies reported monitoring treatment implementation (see Appendix, Table A5, online).

Discussion

The totality of findings from this systematic review of studies from 1980 to 2015 suggests that a variety of cancer care coordination interventions were effective across more than four fifths (81 %) of the studies that measured patient outcomes. Improvement in cancer care outcomes was greater for cancer detection and diagnosis, treatment, and end-of-life care than for cancer survivorship. Meta-analysis of a homogeneous subset of these studies showed that cancer care coordination interventions were almost twice as efficacious (OR = 1.9, 95 % CI = 1.5–3.5) in improving appropriate use of healthcare than was usual care. Cancer care coordination also improved care processes and outcomes in the majority of studies that were included. Across the continuum of cancer care, patient navigation was the most frequent care coordination intervention, followed by home telehealth; nurse case management was third in frequency.

Overall, care coordination interventions increased appropriate health care utilization in primary, acute, and hospice care settings, the ED, and the ICU. Importantly, coordinated care decreased costs markedly among survivors. Looking at health-related quality of life and mental health outcomes, however, the findings were equivocal. Two older studies with care coordinators (as adjuncts to oncologists) and telehealth increased health-related quality of life among newly diagnosed patients who were receiving chemotherapy [37, 46], but both used pre–post designs, limiting the strength of their conclusions. No other studies found similar effects. Two smaller studies reported improved mental health outcomes (e.g., increased emotional well-being, decreased depression, and increased supportive care) [23, 47]. The findings from an RCT of a collaborative care intervention described a positive—albeit nonsignificant—trend toward reduced psychologic distress, including depression. In the meta-analysis, none of the combined effect sizes from these studies reached statistical significance, however [30].

Effective Types of Cancer Care Coordination

Primary care providers and oncologists, along with nurses, are key across the cancer care continuum. Increased communication across multidisciplinary teams could improve cancer care coordination. Effective interventions were generally led by nurses [25, 28, 47], navigators [18, 30], or social workers [23]. In two studies, interventions were led by clinical opinion leaders or project-wide clinician and administrative teams and committees [43, 50]. Only one of the interventions was led by a psychologist [30]. Compliance with cancer-specific professional guidelines

seems to be associated with specialist care [32]; compliance with preventive care guidelines is inconsistent, however [36, 63, 71]. Structural interventions in palliative care (for example, with dedicated palliative physicians, nurses, or units) [26, 49] demonstrated some effectiveness. No studies have yet examined the impact of physician-led interventions. Cancer care coordination using a combination of work routines (telehealth) and care coordinators [21], or multidisciplinary coordination [26, 74, 75], reduced hospital visits, particularly during treatment [21] and end-of-life.

Disparities in Cancer Care Coordination

Sociodemographic characteristics of participants in the studies we reviewed were frequently homogeneous. One quarter of the reviewed studies included minority participants, and few (12 %) of the studies that reported this finding included the uninsured; only one study focused on patients living in rural areas [43]. Since individuals diagnosed with cancer who also have few resources, as well as members of racial and ethnic minority groups, experience poorer health outcomes in general, in part due to less coordinated care, more diverse patient enrollment in future research is necessary [5, 6]. Further, subgroup analyses of sociodemographic subgroups (i.e., uninsured, low English proficiency, and non-English primary language) [16, 24, 45] may yield important findings on how and why cancer care coordination varies in effectiveness across diverse populations and how interventions may be modified to enhance care coordination and improve health outcomes across the population.

Measurement of Cancer Care Coordination Remains a Challenge

There is a lack of conceptual clarity about the definition of care coordination. Very few empirical studies even made explicit reference to a specific definition of the construct of “coordination.” The studies that did include explicit definitions varied substantially, similar to the findings of a recent AHRQ review [4]. The measures of cancer care coordination applied across the 52 studies vary considerably by validity and reliability, as do findings on their implementation in US clinical settings. Some novel measures were applied, including the Herfindahl-Hirschman Index (HHI; [86–89] to measure the degree of fragmentation of care within providers and a measure of outpatient to inpatient continuity of care using the SEER-Medicare database [69]. These require replication.

Studies to date have focused on a limited subset of potentially meaningful outcomes related to care coordination. The relation of many other outcomes to coordination—such as technical (related to morbidity and mortality), patient-centered (related to patient experiences with care), and system-centered (related to the costs and efficiency of health care)—should be considered in expanded study designs.

Multilevel Intervention Studies Are Rare

The National Quality Forum [5], for example, has focused attention on system-wide approaches to care coordination. None of the studies reviewed assessed care from all potential intervention levels—policy/community, organization/health system, provider/provider teams, to the family, and individual patients—however. Most of the reviewed studies used patient-level interventions and outcomes only. The few system-level interventions that were studied need to be replicated to determine whether they are feasible and scalable, while yielding similar outcomes.

Theory as a Guide

Less than 6 % of the studies that were reviewed relied on theory, despite a number of well-established models of organizational coordination in the management and health service literature [76–86]. Given the relative recency of care coordination as a field of study, and the short history of interventions to coordinate care, this study evaluated the fundamental question of overall effectiveness. And, given the small number of studies that were rigorous enough to meet the criteria for meta-analysis, moderator analyses (to determine the influence of interventions, study designs, and sociodemographic characteristics on health outcomes) were not possible [90].

Yet, behavioral medicine offers a rich set of theoretical models and frameworks with which to understand patient, family, and provider decision-making about cancer care coordination that could enrich understanding of current effective interventions and maximize their usefulness in practice. Individual, cognitive-based models such as the Health Belief Model, Theory of Reasoned Action, and the Transtheoretical Model emphasize the importance of beliefs and values of outcomes as key variables that predict whether individuals engage in desired cancer prevention and control behaviors [91–95]. While patient barriers to coordination are described in a number of the papers that were reviewed [16, 24, 45], the concept of decisional balance (or the perceived benefits and barriers of engaging in a behavior) was not explored as an essential process of decision-making. The cue to action, which is included in the Health Belief Model, is a potentially valuable decision-making point for cancer care coordinators and patient navigators, as well as with the Electronic Medical Record. Interventions—including online interventions [96, 97] to move individuals along the stages of change toward action—may target shifting the pros and cons of changing [98].

Other models such as Motivational Interviewing [99] provide a structure for how—mechanistically—decision-making should take place, with a priority placed on solidifying the commitment to action as the most important decision made

prior to determining a course of action to take. For example, Motivational Interviewing might be useful in helping an individual to formulate an action plan for end-of-life care alongside a set of providers, with recording in the electronic medical record (EHR) [26, 49]. As this systematic review has reported that varied cancer care coordination intervention approaches are effective in improving health outcomes, management and behavioral science models and theories could help to explain how and why these interventions best work, when, and for whom.

Study Strengths and Limitations

This review offers promising findings on the impact of care coordination on increasing the quality of cancer care for patients. The strengths of this systematic review and meta-analysis include substantial rigor in the independent application of the inclusion criteria and the scoring of studies, a multidisciplinary team, and a systematic, iterative review approach with pairs of independent, multiple reviewers. The review also has some limitations. Selection criteria necessarily limited the studies included for review, and our search strategies could have influenced the set of articles located. This review identified potentially significant limitations in the methodological quality of the cancer care coordination literature; studies had considerable heterogeneity in the measured outcomes and intervention protocols and the psychometric quality of their measures. Raters were rarely blinded to the randomization protocol. Most studies used single interventions, and no replications were reported. Studies did not always explicitly identify the specific patient care activities involved or which members of the care delivery team were involved in care coordination.

Suggestions for Future Research

This review has identified several areas that should be addressed in future research:

- Sample diverse populations and conduct subgroup analyses of sociodemographic subgroups to assess any differential impact of care coordination interventions on health outcomes.
- Develop, implement, and test a set of conceptually and psychometrically sound, evidence-based, comprehensive, clinically relevant measures of cancer care coordination processes, structures, and outcomes.
- Measure the full economic costs of care coordination.
- Increase the scientific rigor of care coordination studies, particularly by mounting randomized clinical and pragmatic trials.
- Apply multiple levels of observation and intervention to cancer care coordination, from policy/community,

organization/health system, provider/provider teams, to the family and individual patients.

- Examine the differential use of cancer care coordination intervention approaches—including those facilitated by interoperable electronic health records—across systems of care and the cancer care continuum.
- Develop new theoretical models of and interventions to enhance patient self-management.

The findings from this comprehensive systematic review could contribute to the growth of evidence about strategies that can improve care coordination across major US healthcare systems, particularly for patients with multiple chronic conditions [100, 101]. The results have potential synergies with health reform goals, across public and private healthcare providers, to support primary care [102], develop meaningful use standards for electronic health records, and build Patient-Centered Medical Homes or Accountable Care Organizations (ACOs). This review offers promising findings on the impact of cancer care coordination on increasing value and reducing costs in health care in the USA.

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and meta-analysis adhere to the PRISMA guidelines. The meta-analysis is based upon patient-level data. All authors have agreed to abide by the relevant ethical standards.

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