The emerging informationist specialty: a systematic review of the literature

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Purpose: A systematic literature review was conducted to synthesize what is known about informationists, highlight program models, and suggest areas for future research.

Methods: Articles retrieved through database searching were reviewed for relevance. Informationist case reports were identified and coded according to an attributes checklist. Data from other retained publications were synthesized under broad themes. The few research studies found were reviewed for level of evidence.

Results: Of 113 papers reviewed, the study identified 7 classic and 8 emerging informationist programs. Two major models are apparent, clinical and research, with priorities differing according to program maturity. The literature synthesis also brought together current thinking about informationist qualifications; practice roles; setting characteristics; education and training; organizational, programmatic, and service provider success factors; and challenges and barriers. Program outcomes to date are reported, and future research topics suggested. Specific findings will assist informationist program planners.

Conclusions: While the informationist concept remains in the early adopter stage, it appears that domain knowledge, continuous learning, and embedding (working in context) are essential to success. The need for librarians to transition to greater specialization and libraries to emphasize customized service was underscored. A research agenda focused on information management, dissemination, behaviors, and economics is proposed.

INTRODUCTION

It has been seven years since Davidoff and Florance [1] proposed a new professional, an informationist with responsibility for providing highly specialized information services in the clinical setting. Davidoff and Florance characterized these new professionals as knowledge workers formally trained in both the information and clinical sciences so they can retrieve, synthesize, and present medical information routinely for clinical health care teams. They called for a national program to credential these professionals and advocated for their financial support to come directly from clinical funds.

In recognition of the broad scope of information needs in health care and the variability among health care institutions, discussion of this information specialty has encouraged multiple perspectives. Model programs (Tables 1 and 2) have sprung up in health policy and public health, biomedical research, and other related domains as well in clinical settings, where an expanded concept of clinical librarianship had been developing for some time. The original term, informationist, prevails although information specialist in context (ISIC) [2] is also used to emphasize the importance of the setting in framing the informationist’s role. Internationally, the label of informaticist is sometimes applied [3, 4].

The objective of this literature review is to synthesize and share the literature related to the informationist in order to assist new and developing programs in planning and setting future directions. Related objectives are to identify model programs and suggest future directions for research. Davidoff pointed out that a way to understand the state of the informationist is to apply Rogers’ diffusion of innovations model [5]. Under this model, the informationist innovation still falls in the early adopter category (stage two of five), which follows immediately after the innovator category and is characterized by local applications and involvement of opinion leaders. (Stages three to five include the early majority, the late majority, and laggards [6].) As Light observed [7], given the formative nature of the specialty, this study can only be an exploratory and descriptive attempt to look broadly at what is known to date and suggest directions for further research.

The paper will:
- assess how broadly the concept has been discussed in the literature
- identify and characterize model programs
- report commonalities in various definitions and roles
- identify education and training approaches
- summarize success factors
- report challenges and barriers to implementation
- summarize reported outcomes
- provide an overview of suggested further research

BACKGROUND

The overarching rationale for the informationist profession is the growing amount of biomedical...
After years of emphasizing the generalist librarian, health sciences librarians must become more specialized, parallelizing the health care environment in which they work. An embedded informationist is more likely to achieve credibility, acceptance, and sustainability than an impersonal information service provided at a distance. Subject expertise is essential for the informationist. Model informationist programs with the greatest stability are library funded. Because informationist programs are inherently targeted to small groups, multisite studies are necessary to achieve robust evaluation.

**Implications**

- A library starting an informationist program should review existing models, identify local needs, set program objectives, and then select the most appropriate approaches for its users.
- Programmatic emphasis should be placed on both technical and service excellence.
- Organizational commitment is needed for knowledge integration into practice and for the informationists’ lifelong learning.

Information that challenges health care practitioners to stay current. As justification for their proposal, Davidoff and Florance pointed out that this information resides in scattered formats with inconsistent indexing and accessibility and requires time, domain knowledge, retrieval, and critical appraisal skills to convey the best of it to the point of care [1]. Changes in scholarly publishing [8, 9]; inconsistent and slow translation of research into practice [10]; lack of readily available (prepackaged) syntheses of evidence [11]; pressures on physicians to practice evidence-based medicine (EBM), reduce risks, ensure patient safety, and deliver cost-effective care [12]; lack of nursing staff time [13]; and a more informed patient population [14–16] are some of the compelling reasons for an informationist in hospital settings.

The literature is filled with justification for this concept in other settings as well. In the United Kingdom, the National Health Service (NHS) clinical governance policy mandates routine EBM practice in general practice settings [17]. In public health emergencies, public trust requires rapid, informed responses to health threats that are often of unknown origin and that continually unfold over hours and days [18]. Researchers in the fields of molecular biology and genetics now must master new tools to manage and mine large data sets, the results of an information explosion made possible by advances in technology and large scale international collaborative research efforts [19]. Major demographic population shifts and the resulting budgetary challenges also require difficult decisions in health care policy that must be informed by accurate data and information [20].

Both the Medical Library Association (MLA) and the National Library of Medicine (NLM) have supported the idea of the informationist. Following Davidoff and Florance’s editorial, the MLA Board of Directors convened a special conference at NLM to discuss the concept with library professionals, informaticians, academicians, health care practitioners, and accreditation bodies. Topics included training requirements, funding models, concept marketing, programmatic models, and evaluation strategies [21]. Subsequent MLA annual meetings featured an open forum, chapter sharing roundtables, and numerous paper presentations on the informationist [22–25]. The MLA Task Force on the Informationist Specialist in Context engaged the Eskind Biomedical Library at Vanderbilt University to investigate and report on the concept and perceptions of the informationist [26]. NLM meanwhile stepped forward with a new grant program for informationist training fellowships [27], with the first awards given in 2004.

The concept has roots in well-established library outreach practices, notably the library liaison and clinical medical librarian (CML) programs. Although Europeans have been familiar with subject specialists in libraries for centuries, widespread adoption of the academic library liaison program in the United States dates from World War II [28]. In the early 1970s, Lamb introduced the idea of a CML program to link literature with patient care by having librarians participate on hospital rounds and supply case-related information [29]. Lamb’s CML programs were emulated by other similar efforts across the country and more recently internationally [30, 31]. Both the CML and liaison responsibilities are now seen as the basis for maturation into informationist roles [32, 33]. The EBM movement also stimulated libraries to take on informationist roles [34–36].

In the last twenty-five years, technology has also been a major factor driving integration of librarians into various health care settings. Matheson and Cooper’s 1982 seminal report challenged health sciences centers to better position themselves to leverage new technologies. It anticipated cross-disciplinary library roles that spanned the professional boundaries of information science, technology, and the health sciences [37]. Picking up this thread, Davidoff and Florance suggested the informationist serve as a critical intermediary with developing technology such as gathering meta-information about clinical questions [1]. Looking forward to 2015, Lindberg and Humphreys’s futuristic vision of medical libraries proposed a marked increase in electronic information but also more in-context work by librarians “to improve quality, to reduce the risks associated with inefficient or incomplete retrieval of the available evidence, and to do community outreach” [38].
See Figure 1 for program attribute definitions.

| Table 1 | Classic informationist models: published reports that contained all defining attributes of an informationist program |
|---------|---------------------------------------------------------------------------------------------------------------|
| Author, year [reference] | Article type | Program attributes | Setting | Description | Funding | Outcomes |
| Bioscience | | | | | | |
| Chattopadhyay, 2006 [111] | Case report | A, B, C, D, E, F, G | University of Pittsburgh, Pittsburgh PA | Molecular biology/genetics expert with formal training in information science provides workshops, consultations, web portal, specialized licensed resources, presentations for faculty and scientific meetings, coauthoring, and co-instruction. | Institution | Expanding role led to adding staff and resources. |
| Minie, 2006 [61]; Yarfitz, 2000 [19]; Florance, 2002 [70] | Case report | A, B, C, D, E, F, G | University of Washington, Seattle, WA | Bioinformatics service includes bioinformatics classes, consultations, software support, and advanced tool development. By 2005, a team approach enabled support of university researchers, regional business, and not-for-profit community. | Shared grant/ institution | 85% of questions required specialized subject knowledge. Class evaluations and web surveys point to customer satisfaction. |
| Clinical | | | | | | |
| Whitmore [74] | Case report | A, B, C, D, E, F, G | US National Institutes of Health, Bethesda, MD | 14 informationists work with 40+ scientific groups. Roles include expert searching and literature syntheses, participation in team research projects, and specialized activities such as gene data analysis. | Institution | Evaluation (surveys and key informant interviews) shows strong acceptance and uptake. |
| Florance, 2002 [70]; Giuse, 2005 [12] | Case report | A, B, C, D, E, F | Vanderbilt University, Nashville, TN | Clinical Informatics Consult Service (CICS) informationists answer questions on rounds, with evidence-based medicine (EBM) literature synthesis. They also train health care team to manage routine queries, provide consultation, engage in continuous learning. They support outpatient care through medical record messaging button for “evidence consult.” | Institution | Formal evaluation underway; authors believe CICS saves clinician time. Combining literature synthesis with knowledge tools in the practice workflow may be more effective than either one alone. |
| Greenhalgh, 2002 [3]; Martin, 2001 [77]; Swinglehurst, 2005 [15] | Case report | A, B, D, F | Imperial College London and Basildon, Essex, UK | Study compared 2 primary care informaticist projects, 1 in an academic department, the second in a general practice (GP) setting supported by GP informaticists with formal EBM/search training. The academic program emphasized rigorous research guidelines whereas the practice setting was more service oriented. Both tried to promote questioning and offered training. | Grant | Study demonstrated that evaluation of an informaticist service should include both technical and service dimensions. |
| Sladek, 2004 [109] | Case report | A, B, C, D | Repatriation General Hospital, Daw Park, Australia | Pilot project of informationist program in acute tertiary care hospital. The informationist attended rounds and clinical meetings for 23 weeks, provided literature searches per a search protocol, and developed evidence summaries. | Grant | Pilot study showed that doctors will use an informationist service. The service contributed/probably contributed to their professional development, and influenced clinical outcomes. |
| Education and Research | | | | | | |
| McKibson, 2004 [34] | Case report | A, B, C, D, F, G | McMaster University, ON, Canada | 2 librarians on informatics research team perform administrative and writing responsibilities for evidence-based practice journals, tutoring and preceptoring, training, conducting systematic reviews, and critical appraisal. | Institution | Librarians showed personal growth and earned clinical faculty appointment. |

METHODS

The informationist concept has been discussed through electronic mailing lists, blogs, conference presentations, newsletters, and the published literature. This review was limited to English-language literature published primarily from 2000 to 2006. Newsletters and unpublished works were excluded with the exception of grant abstracts [39–44]. The start year of 2000 corresponds with publication of the Davidoff and Florance article.

Databases were searched in both the biomedical and library literature as follows: CINAHL; Computer Retrieval of Information on Scientific Programs (CRISP); EMBASE; ERIC; Google Scholar; Library, Information Science & Technology Abstracts (LISTA); Library Literature; PubMed; Scopus; and Web of Knowledge. Search terms were “informationist,” “information specialist,” “ISIC,” and “informaticist.” Additionally, article bibliographies were hand-searched and a citation search of Davidoff and Florance’s article was performed in Web of Science. Basic inclusion criteria therefore were English-language publications dating from 2000 using informationist terms. The de-duplicated results set meeting these basic criteria numbered 198 publications. Papers were further excluded if they did not offer a perspective or program description related to the informationist. The retained publications (n = 113) included case reports, grant abstracts, editorials,
letters to the editor, commentaries, literature reviews, and research studies. The retained publications formed the basis of the literature review.

Prior to coding case reports, the three authors identified four essential program attributes and three secondary attributes (Figure 1) of an informationist service based on their reading and understanding of the literature. The case reports were then coded by these attributes. To increase the reliability of coding, the papers were coded independently by the authors, followed by a discussion to achieve consensus. All cases with defining attributes were further divided by customer group (Tables 1 and 2).

All 113 articles were analyzed for content related to definitions of the informationist, education and training requirements, success factors, challenges and barriers, outcomes, and areas for further research.

Articles that described training programs for informationists are listed in Table 3 (online), while those that addressed the informationist concept in a more general manner are in Table 4 (online).*

Due to the variation in methods and the preponderance of opinion papers, it was not possible to do a meta-analysis. However, the 11 studies among the full set that reported research findings were selected for in-depth review using the Critical Skills Training in Appraisal for Librarians (CriSTAL) appraisal tool [45]. Excluding grant abstracts (n=6), 107 articles underwent a literature analysis.

* Three references [15, 60, 79] appear twice in one or more tables and one reference [70] appears three times in 2 tables for a total of 118 citations on the 4 tables.

### Table 2
Emerging and variant informationist models: published reports that contain some but not all defining attributes of an informationist program

| Author, year [reference] | Article type | Setting | Program components | Funding | Outcomes |
|--------------------------|--------------|---------|---------------------|---------|----------|
| Verhoeven, 2004 [100] | Case report | University of Groningen, The Netherlands | A GP informationist trained in EBM and medical libraries provided an evidence-based service. All project participants first received training in framing EBM questions. During the project, 61 questions were answered from 26 GPs. | Grant/institution | The majority of answers had an effect on GPs; half had an effect on patients. The time commitment was greater than anticipated. |
| Bioscience | | | | | |
| Lyon, 2006 [60] | Case reports | Harvard University, University of Florida, University of Minnesota, Vanderbilt University | 4 bioinformatics services developed in the context and needs of their institutions are described with emphasis on collaborations and partnerships. | Institution | While programs differ, partnerships can be categorized as knowledge management, instruction, and e-resource support. |
| Oliver, 2005 [33] | Case report | John Hopkins University, Baltimore, MD | Project developed lab software for collecting and analyzing lab data. The bioscience informationist identifies literature needs and assists with technical development of information resource discovery software. | Grant | Evaluation is planned. |
| Rein, 2006 [62] | Case report | Purdue University, West Lafayette, IN | Bioinformatician performs needs assessment and environmental scan and develops instructional programs. Reference, consultations, new technologies, and services are planned. | Institution | Faculty and students from 31 departments participated in bioinformatics instruction event. |
| Tennant, 2005 [89]; Lyon, 2006 [60] | Case report | University of Florida, Gainesville, FL | Bioinformatics information specialist for genetics research and graduate education provides classes, course-integrated instruction, traditional collection development and reference, website support, information summaries and synthesis, and in-depth consultations. Promotes service through multiple channels. | Institution | Program has received positive informal feedback, led to increased participation in classes and requests for services, and led to support for similar program for nursing. |
| Education and research | | | | | |
| Detlefsen, 2004 [54] | Case report | University of Pittsburgh, Pittsburgh, PA | Informationist with a clinical mental health research center team provides information dissemination for team and consumers, reference services, teaching, lead in systematic review (pending grant funding), and is a member of the Executive Committee. | Grant | Professional growth noted. |
| Public health | | | | | |
| Rook, 2001 [124] | Case report | St. George’s Hospital Medical School London, UK | Information specialist program for public health (PH) postgraduate trainees evolved from liaison into team member providing consultations, evidence-based PH training, promotion of e-resources, establishment of e-network, and participation in PH curriculum. | Fee | Evaluation includes quantitative and focus groups. Response has been positive. |
| Swain, 2004 [18] | Case report | US Centers for Disease Control and Prevention, Atlanta, GA | As a team member in week-long Federal Emergency Management Agency (FEMA) bioterrorism exercise, the informationist provided information services and field-tested an information tool for investigative teams. | Institution | Both the librarian role and information tool were rated highly in post-exercise evaluations. |
RESULTS

Literature analysis

The informationist discussion has occurred largely in the library literature, with the majority of the published articles (61%, 65/107) appearing in library journals. A relatively small number of these (7%, 8/107) appeared in the informatics literature. The remainder appeared in the health care literature, with 2 in influential Institute of Medicine reports urging new levels of quality in health care and in the education of health professionals. Papers appearing in international publications accounted for 34% (36/107) of the total. Interest in the concept over time, as reflected by the literature, has remained modest but steady: 4 articles in 2000, 12 articles in 2001, 16 articles in 2002, 8 articles in 2003, 24 articles in 2004, 20 articles in 2005, and 21 articles in 2006.

Model programs

The literature review focused first on identifying program models. Seven case reports demonstrated all four defining program attributes—that is, formal training in both information science and a relevant subject, understanding of the work culture, in-context work setting, and responsibilities for subject content such as through critical appraisal or work with complex datasets—and were coded as “classic informationist models” (Table 1). Eight case reports demonstrated one to three of the four essential program attributes and were coded as “emergent and variant informationist models” (Table 2). Both model types, classic and emergent, varied in the extent of additional optional context-driven attributes relating to technology, training, and other team roles.

There was high agreement in the independent coding (89%) for programs that demonstrated the 4 essential attributes and were therefore deemed classic programs (Table 1). Coding consistency fell to 65% for the remaining 17 papers that were reviewed for possible inclusion in Table 2 as informationist program reports. This reflected the wide range in detail and clarity in these descriptive reports.

Definition

The definition of the informationist continues to be refined. Some have cautioned that too diffuse an interpretation might result in losing the ability to differentiate the specialty from other nontraditional library roles [26, 46, 47]. The following are the qualifications, roles, and work setting characteristics as reported in the literature:

- **Qualifications** [1, 21, 26, 46, 48–51]:
  - graduate preparation in either a subject discipline and/or the information sciences with in-depth knowledge of both the domains
  - practical skills in framing questions; retrieving, appraising, and synthesizing literature; and managing and presenting information
  - applied knowledge of the research process
  - informatics training and applied technical skills
  - skills for teamwork, communication, multidisciplinary thinking, and proactive customer service along with institutional knowledge

- **Practice roles** [1, 20, 38, 47–69]:
  - recognized member of health care or research team
  - seamless integrator of appropriate evidence and tools into health care or research workflow
  - critical questioner, appraiser, and synthesizer of the literature with direct responsibility for quality of results
  - evidence educator for team and/or students
  - technology expert for team
  - resource discoverer and evaluator for discipline-specific information products
  - collaborator or coauthor in team research
  - knowledge translator and facilitator of knowledge sharing
  - information manager
  - partner in ongoing team information needs assessment
  - facilitator of collaborations in the institution and externally

- **Practice setting** [10, 46, 48, 51, 53, 70]:
  - is located outside the library
  - shapes the type of information, technical and service components, and dissemination methods
  - may house and/or fund position
The discussion of the formal educational preparation and training for the informationist specialty is ongoing. Responses to Davidoff and Florance’s vision [1] of a national program with a standardized curriculum and formal credentialing have been wide ranging. Some have advocated even more academic rigor and professional licensing [53, 56], whereas others have suggested on-the-job training supplemented by self-directed learning, continuing education, and other experiential activities [49, 71]. While many informationist programs use librarians, Swinglehurst believes the general practitioner is best suited to fill this role in clinical medicine [72]. Clearly, the multidisciplinary nature of the informationist allows a variety of pathways into the specialty. To illustrate this point, Detlefsen identifies several possible combinations of educational and experiential backgrounds in library science, informatics, biomedicine, and science that could lead to an informationist career [50].

Giuse proposes a comprehensive training framework for the informationist with competencies grouped according to knowledge, functional abilities, and personal skills [26]. The literature reinforces this framework although there are some additional suggestions and emphases. Deep understanding of the biomedical literature is fundamental to information science, from how the literature is structured to how it serves as the basis for new ideas [73]. In domain knowledge, in addition to formal education requirements, related discipline knowledge is considered important in areas ranging from biostatistics, genetics, epidemiology, and health care economics to ethics and adult learning [1, 56, 74]. Understanding of the information environment includes knowledge of health policy issues and regulations such as privacy and confidentiality (e.g., the Health Information Portability and Accountability Act [HIPAA]) and the internal review board (IRB) [38, 54]. In programs emphasizing informatics, understanding of the design and evaluation of systems, applied informatics and technology skills, and ability to function in a highly technical environment are necessary [50, 75, 76]. Among personal competencies, a sense of customer service was valued [77] (Figure 2).

Formal training models are emerging largely through multiyear NLM-funded fellowships at various universities [39–44, 78]. At least one graduate
program in information science and another in informatics offer relevant informationist training opportunities [76, 79]. Continuing education programs target specific skill sets such as bioinformatics and critical appraisal [68, 80]. Vanderbilt University provides its own formal staff development program [81, 82] (Table 3 online).

Success factors

Reports of informationist services suggested various enabling factors that contribute to the success and/or sustainability of the service. These factors have been categorized by how the service itself is constructed and delivered and the providers’ skills and attributes. Not all appeared in every success story and some may be codependent.

Organizational factors [46, 51, 52, 82–86]:
- support by a champion
- formal priority on the service
- resource availability (technology, electronic information resources, staff)
- systemic strategy to integrate knowledge or evidence into practice and into the institution’s information systems
- collaborative, multidisciplinary team environment
- support of culture with commitment to informationists’ lifelong learning

Programmatic characteristics [15, 19, 56, 62, 77, 84, 86–88]:
- is based on initial and ongoing needs assessments
- is designed and implemented to fit the work environment
- places emphasis on both technical quality and service dimension
- includes formal and informal training of health care or research team to inculcate framing of questions, use of evidence, and critical appraisal
- is characterized by fast turnaround, high-quality, “plain English,” case-specific answers with statistical information
- represents consistent sustained effort
- achieves program visibility and effective marketing
- maintains built-in feedback loop

Service provider characteristics [12, 15, 19, 26, 57, 62, 70, 86, 89]:
- solid subject background with ability to understand and function in domain
- credible critical appraisal and searching skills
- interpersonal skills to enable full integration into team, trust relationships, and contributions to outcomes
- understanding of and sensitivity to organizational and discipline cultures
- professionalism, personal motivation, enthusiasm, and personal service orientation

Challenges and barriers

Obstacles to overcome prior to widespread adoption of the informationist service relate to the workforce itself as well as to the social and organizational environments in which the informationist practices.

Workforce issues [21, 26, 48, 52, 58, 63, 76, 78, 90–98]:
- lack of qualified candidates
- need to increase workforce size and accelerate recruitment
- need for multiple formal training programs to produce more qualified workers
- need for better definition of core competencies
- need for salaries to match expected educational levels
- lack of consensus on credentialing strategy
- need to address patient confidentiality and information practice liability issues

Social barriers [10, 14, 63, 69, 84, 88, 90, 94, 96, 97, 99, 100]:
- resistance to change
- lack of interest by physicians and researchers
- physician or researcher confidence in own information retrieval skills
- general resistance to EBM, which does not always have answers and/or is perceived as cookbook approach
- consults among peers perceived as quicker and easier
- hierarchy of health care team and team acceptance
- ambivalence among librarians about accepting responsibility for their practice outcomes
- cultural differences between informationists and other library staff or librarians

Organizational and system issues [10, 14, 21, 58, 63, 69, 84, 85, 88, 90, 91, 94, 96–101]:
- retraining of existing health care workforce in routine use of point-of-need information
- secure funding—inclusion in grants, research studies, and insurance reimbursement
- required documentation of information used in patient care
- incentives for information seeking in practice environments
- scalability and sustainability
- substantial time commitment
- systematic prioritization of and methods for delivery of research to the point of need
- shifting focus of libraries to more in-context practice
- assured access to high-quality knowledge-based resources, manpower, and computers, of particular concern globally
- need to demonstrate compelling outcomes and cost benefit

Opposing opinions about the need for and merits of informationists [10, 14, 94, 102–108]:
- EBM questioning is critical to patient care and should be mastered by physicians
- physicians’ skills with the literature will decline if informationists assume this role
- knowledge management is integral to health care decision making and should not be separated
- clinical medical librarians and drug information pharmacists already provide this service
patients prefer their primary care providers as their advisors on Internet health information
- health care providers are skeptical of librarians’ ability to frame questions and critically appraise literature
- librarians should focus on identification of information resources, improved presentation of information, and development of tools to bring evidence to the bedside, whereas clinical knowledge and interpretive skills belong with the medical profession

Outcomes

Of the eleven papers that presented research findings [3, 18, 19, 57, 61, 62, 94, 100, 109–111] and thus were selected for in-depth review using the CriSTAL appraisal tool [43], five were found to contribute evidence to advance understanding and evaluation of informationist programs [3, 19, 94, 109, 110]. Highlights from these studies follow.

- **Planning and evaluation:**
  - An Australian feasibility and pilot study provides a replicable method for assessing user requirements and measuring preliminary program outcomes [94, 109].
  - Needs assessments identify appropriate services for any group: Basic elements of a bioinformatics informationist program appear to be training, consultations, and providing access to specialized resources [19].
  - A comprehensive comparative study of two very different informationist programs results in identifying six common program elements: aims and objectives, the informaticists’ role, the process for establishing local connections, progrmamatic self-perception, types of questions and questioning behaviors, evaluation approaches, and models of change [3].
  - To address both the technical and service aspects, evaluation must be holistic, contain a large sample, and examine a program where high-quality information responses are fully disseminated into the practice or workplace. Multiple methods help to more fully assess outcomes [3].

- **Program components:**
  - Informationist programs include both a technical quality and a service dimension, both of which are equally important [3].
  - Librarian informationists can effectively perform critical appraisal if trained in the domain and equipped with EBM skills [110].
  - The informationists’ subject specialization is needed to answer the large majority of questions in a bioinformatics program [9]; domain knowledge is also essential in clinical informationist programs [3].
  - Personalized local information interventions (as compared with answers provided from a distance) appear to achieve credibility, acceptance, and sustainability for informaticist programs [3].
  - Embedded positioning encourages questioning and use of service [3, 109].

Aside from the five case reports that provide evidence for their outcomes, the program effects and/or outcomes reported by other papers in this literature review are largely anecdotal. These outcomes include informationists filling information needs more efficiently and thus saving health care practitioners’ time; providing information that leads to change in patient management; identifying information resources and viewpoints not usually sought; and promoting discussion, providing reassurance, delivering evidence at the point of need when it would not otherwise have been reviewed, and enabling new knowledge or learning. Program growth is also noted as an indicator of positive program outcome as is professional growth of librarian informationists. Synthesis and appraisal, not searching, requires a significant time commitment from an informationist. Redundancy in clinical questions suggests efficiency can be gained by a tracking database. These outcomes require additional research before they can be reported with certainty.

Research questions

Given the paucity of research findings about informationists, there are many areas needing study. The literature suggested the following broad topics and specific questions:

- **Information management and dissemination** [1, 4, 10, 12, 21, 26, 32, 52, 76, 83, 104, 112–121]:
  - How can informationists improve knowledge translation?
  - What kinds of information contribute to avoiding errors, shortening length of stay, and delivering better outcomes?
  - What meta-information can be discovered?
  - Which technologies facilitate the work of informationists? Which informationist tasks can be performed by technology?
  - What range and structure of informationist services are most effective?
  - What are the core competencies of an informationist?
  - How does the informationist compare with other methods to increase access to evidence?

- **Information behaviors** [3, 15, 21, 32, 69, 83, 109, 116, 122]:
  - What factors promote questioning and use of the best knowledge?
  - What processes facilitate use of evidence?
  - What contextual factors enable implementation of the service?
  - What are the developmental aspects of the informationist’s role and team dynamics over time?
  - How does the informationist affect group information-seeking behaviors and/or team outcomes, including through technical expertise and/or the service aspect?

- **Information economics** [4, 21, 26, 46, 53, 63, 64, 70, 121]:
  - Do informationists improve quality of care?
- Do informationists result in health care that is more efficient and more cost effective or that protects against and/or reduces error?
- Do informationists reduce length of stay, readmissions, morbidity, and mortality?
- Do informationists save time for the health care team?
- Do informationists increase patient satisfaction?
- Do informationists improve researcher productivity?

**DISCUSSION**

What is apparent from this review is that uptake of the informationist concept has been relatively broad, if not deep. Initially seen as a role in a clinical or hospital setting, informationist programs are emerging throughout the biomedical and health care enterprise, including public health. Specialization, a fact of life for researchers and practitioners in this age of ever-expanding knowledge, appears to be an appropriate response for the library profession as well. However, as this review demonstrated, not all clinical or bioscience information services described as informationist can be classified as informationist programs, as they do not meet all four of the defining criteria.

If, as Davidoff and Florance recommended [1], a standard qualifying curriculum and/or specialty credentialing is adopted, who is an informationist will be clear. Meanwhile, multiple models are being tested and refined. A common thread is the informationist’s collaborative role and the convergence of domain and information science expertise. Both are required to effectively qualify the informationist as the broker between the information need and the plethora of information resources. As in-context information workers, however, it is ultimately the environment in which the informationist works that defines the precise role.

To date, there is no evidence to indicate a preferred set of knowledge prerequisites or best-practices training. Nonetheless, training is expected to include a variety of experiences from formal educational programs, experiential immersions, and practica in research and clinical processes. The general consensus is that both domain and information science knowledge are essential, reinforced with vigorous continuing education to maintain both competencies.

As has been shown in studies of the innovation process, several divergent but comparable concepts tend to emerge [123]. Two major informationist models are apparent, each demonstrating differing priorities as the program matures. Giuse proposed an informationist maturity model in which the program progresses through five stages: baseline, preliminary outreach, formalized service, established service, and iterative optimizing [26]. This review shows that, within these five stages, the maturation steps of the two major informationist models found in the literature are actually quite different. The successful clinical informationist begins by emphasizing the service dimension, establishing a team role, and making opportunities to deliver credible information. As the informationist’s role on the clinical team matures, support for more of the team’s technical or informatics information needs is added. Conversely, the bioinformatics informationist begins with a strong technical focus and with maturity offers a more personal service.

Both the informationist role and program success factors are closely tied to the institutional culture. Nonetheless, organizational commitment, needs assessments, programmatic technical excellence, and proactive service are recurring themes. The social and organizational barriers facing an informationist program reflect both the complexity of the health care environment and the rapidly changing information world.

Underpinning many of the issues is the question of funding. The grant-funded informationist models examined in this study benefited from external support to jumpstart their programs but all were time-bound; those with a combination of institutional and grant support appeared focused on adapting to secure future funding; those institutionally supported, largely by library budgets, were most stable. While Davidoff and Florance [1] advocated for support by clinical funds, forward-thinking libraries are looking to the informationist model as a new way of working and are reprioritizing toward more in-context services.

Next steps for research include more studies of classic and emerging informationist models and systematic multisite studies. By their very nature, informationist programs reach relatively small groups; therefore, to achieve adequate sample size, multisite studies are essential. Carefully controlled studies will measure baselines, develop value measures, examine short- and long-term effects, and assess whether or not issues would have been handled differently without the informationist.

**STUDY LIMITATIONS**

Although intended to be a comprehensive review of the state of the informationist, the considerable amount of electronic mailing lists and blog discussions, as well as unpublished papers, were not included in the scope of this study. Additionally, the focus of this review was on English-language, thus omitting several papers in other languages. Another limitation was the search terminology, particularly “informaticist,” which has various meanings outside the United States. This review’s results also were limited by the variability among the case reports. It was often not possible to systematically identify informationist program elements and, in some cases, to discern which were actually operational and which were in planning.

**CONCLUSION**

This paper has attempted to coalesce ideas about what an informationist is, highlighting program roles.
and models; to identify success factors and barriers to assist other early adopters with program planning; and to bring together suggestions for research needed to demonstrate value. Because innovations are tied to social change, their adoption requires effort. Factors determining the rate of adoption are the perceived advantage over previous ways of doing work; compatibility with existing values and past experiences; lack of complexity in meaning; ability to be tried out on a limited basis; and observability, that is, visibility to others [6]. While the informationist concept remains in the early adopter stage, it has the advantage of building on existing traditions, that of the CML and liaison librarian. Also, several strong programmatic models are operational and visible to the community. The informationist concept is challenged by a general lack of understanding, even within the profession, of what differentiates it from other library roles.

To date, little solid evidence has been published relating to the effectiveness of existing informationist programs or justifying new ones. Individual and widely varying case reports make generalization difficult. The informationist’s value remains to be demonstrated and measured systematically across multiple settings. A research agenda that focuses on information management, information dissemination, information behaviors, and information economics is essential for the concept to reach maturity.

Neither informationist programs nor informationists are going to look alike. This is the ultimate customization of service.

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