The Representation of Agents as Resources for the Purpose of Professional Regulation and Global Health Workforce Planning

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Abstract. International migration of health professionals has been increasing in our globalized world, compounding a pressing need to improve information systems that confirm their qualifications and track health workforce volume. This paper reports on research to help address this need by introducing a framework for defining health professionals as agents. A case study and a categorical analysis of 11 metadata schemes was conducted. The results report and discuss three approaches to the representation of agents as either Access Point, Information Object, or Resource. The schemas that describe agents as resources best align with the representation of health professionals for the purpose of health workforce research.

Keywords: Metadata · Agent metadata · Health workforce · HRIS for health

1 Introduction

The international migration of health professionals has long been a concern for regulatory authorities and health workforce researchers [1, 2]. Recipient countries struggle to interpret the qualifications of foreign trained professionals [3], and all countries struggle to maintain an adequate supply and distribution of practitioners to serve their communities [4]. The health of populations is dependent, in part, upon an adequate supply and distribution of health professionals, but health workforce monitoring and planning for the future is hampered by a lack of timely, uniform collection of data about individual practitioners internationally [5]. Researchers in many domains, including library science, education, and health informatics, have developed schemas and standards to address comparable challenges in their own fields, and their work could inform similar efforts in health professions regulation. The development of an international standard for the representation of skilled professionals and their qualifications could promote streamlined collection of interoperable agent data, advancing the accuracy of health workforce research and allowing policy-makers to more quickly respond to community health needs.

This paper reports on the results of content analysis of metadata schemes from a variety of disciplines as potential frameworks for the representation of health professionals in support of their regulation and of health workforce planning. The following sections provide background information, identify research objectives, and report our method and results in context. The conclusion summarizes results and suggests future research directions.

2   Background

2.1   Data Needs of Regulators and Workforce Researchers

Though there is no consensus on an ideal methodology for health workforce planning [6], the relative success of any methods is dependent upon accurate data. Health workforce planning at the international level is complicated by national variations in data collection practices and data availability [1]. However, there are fundamental individual characteristics relevant to health workforce research that should be obtainable by the regulatory authorities that permit practice. An individual's current employment status, location, and area of specialization serve as indicators of present health workforce participation, but additional factors are also used to project future supply and distribution. Studies have shown that system determinants such as medical school characteristics and individual factors such as ethnicity, age, and gender can affect geographical distribution of health professionals [4]. From an information science perspective, all of these attributes can be seen as metadata elements which describe agents, and there are many metadata schemas which could potentially encompass the data needs of those who monitor the health workforce.

Research in the area of health informatics has made considerable contributions to healthcare practice, but most person metadata efforts have been directed as the patient as agent rather than the health professional [7]. More recently, human resource information systems (HRIS) for health has emerged as a focus of study [8–10], but most research in this area is conducted at an institutional level rather than a national level, and most examine system implementations rather than data structures or interoperability [11]. Research in this area could be advanced through an exploration of agent-level data needs and their standardization.

2.2   Research Objective

The objective of this research is to assess metadata schemes which contain representations of agents, specifically persons in this case. This assessment was conducted in furtherance of the longer-term goal of recommending a metadata scheme for the regulatory community to represent data about health professionals. Considering the volume and diversity of metadata schemas and standards already in use, it is likely that the information needs of workforce researchers and regulators with respect to agent metadata are addressed by one or more existing standards. This research considers existing schemas and their applicability to the health workforce as a step toward establishing a standard for the representation of health professionals.

3   Methods and Procedures

This study is a content analysis of the standards documents of agent-focused metadata schemes across a number of disciplines. To begin, researchers conducted a literature review and consulted key informants to create a list of metadata standards including representations of agents, particularly persons. The initial sample of 15 standards included those created for the sole purpose of representing agent data as well as those that defined agent elements as part of a larger scheme. These are listed in Table 1.

Table 1.   Schemas including representations of agents

Schema type	Schemas identified
Schema primarily for agent data	EAC-CPF, ISAAR (CPF), FOAF, hCard, MedBiquitous Healthcare Professional Profile, Library of Congress Name Authority File, MADS, ULAN, vCard
Agent data included in a larger schema	CASS, CTDL, Europass, HR Open Standard CandidateProfile, PESC Academic ePortfolio, schema.org

Several of the schemas in Table 1 were excluded from subsequent analysis for different reasons. The Union List of Artist Names (ULAN) and other name authority files and thesauri were excluded because they did not publish standards as a basis for their resources or they were operationalizations of another reviewed schema, such as the Metadata Authority Description Standard (MADS). The Credential Transparency Description Language (CTDL) – a recently developed standard for the description of qualifications, their requirements, and their accreditation – was excluded because subclasses of its Agent class are used predominantly for the representation of organizations and "do not include people to whom credentials have been awarded" [12]. The CASS schema – an open source effort to represent competencies and competency frameworks – was excluded because it was developed as an extension of schema.org with no additional agent elements defined [13].

Once the final study sample of 11 standards was determined, each schema's documentation was reviewed, and their characteristics were tabulated. Agent metadata sets from each schema were compared and classified into three groups based on number, focus, granularity, and extensibility of metadata elements describing agents. The following section presents our results in context by categorical grouping.

4   Results: Review and Categorization of Agent Schemas

The representation of agents, specifically individuals in this case, has been a feature common to many metadata schemas developed over the past several decades. However, the relative level of detail among different areas of agent characteristics (e.g., demographic data or employment information) has varied according to the underlying purpose of the schema and the field or context in which it was developed. This paper describes

three broad groups of schemas categorized by their context and associated focus and level of detail. A summary of the reviewed schemas is presented in Table 2, and a categorization of these schemas is presented in Table 3.

Table 2. Schema sample for analysis

Schemes	Domain	Published encoding	Number of metadata elements
PESC Academic ePortfolio	Education	XML	12 metadata element sets
HR Open Standard CandidateProfile	Human resources	XML or JSON	24 attribute sets
EAC-CPF	Archiving	XML	90 elements; 30 attributes
Europass	Human resources	XML	> 25 schemata + 3 adjusted ISO standards
FOAF	Web-based information about people, networking	RDF	19 core classes + 25 social web classes
hCard	Web-based information about people, networking	HTML	38 properties
ISAAR (CPF)	Archiving	(multiple)	31 elements
MADS	Cataloging	XML	3 main elements, 8 descriptor elements, 9 minor elements
MedBiquitous Healthcare Professional Profile	Health professions education	XML	8 element sets; ~ 150 elements
schema.org	Web-based information	(multiple)	571 types; 832 properties; 114 enumeration values
vCard	Business card information, networking	Proprietary file format	~25 properties

4.1   Schema Group 1: Agent as Access Point

The earliest standards that provide frameworks for the description of agents were developed in the field of library science and archiving. Some of these standards guided the development of name authority files, including those that catalog agent names. For example, the Metadata Authority Description Standard (MADS) was developed for the presentation of authority data, specifically the type of data that would be included in the MARC Authority element [14]. Other standards were developed specifically for the representation of agents related to archival objects. Examples include the Encoded Archival Context for Corporate Bodies, Persons, and Families (EAC-CPF) [15] and

Table 3. Categorization of schemas incorporating agents

Category	Schemes	Characteristics
Agent as access point	EAC-CPF, ISAAR(CPF), MADS	• Context: information science, archiving • Lean structure for describing agents • Emphasis on identity and relationships
Agent as information object	hCard, vCard, FOAF, schema.org	• Context: web-based linked data, self-documentation • Lean but extensible structure for describing agents • Emphasis on contact information and web interoperability
Agent as resource	Europass, HR Open Standard CandidateProfile, MedBiquitous Healthcare Professional Profile, PESC Academic ePortfolio	• Context: multiple domains (education, human resources, health) • Granular structure specific to domain • Emphasis on detailed representation of agent characteristics, qualifications

International Standard Archival Authority Record for Corporate Bodies, Persons and Families [ISAAR (CPF)] [16]. A major strength of these schemas is that they were constructed with international use in mind, providing mechanisms for representing multiple variations of agent names in multiple languages and formats.

In each of these schemas, representations of agents are designed primarily to serve in the context of their relationship to information objects, hence their categorization under the Agent as Access Point heading. Agent representations in these schemas emphasize factors crucial to identifying and differentiating among agents (e.g., current and former names), capturing an agent's relationships with other agents (e.g., an individual's membership in an organization), and finding the information objects with which those agents are associated. While these schemas excel at capturing identifying characteristics of agents irrespective of national origin, they do not have the level of detail required by regulators in the area of professional qualifications.

4.2   Schema Group 2: Agent as Information Object

The second category of schemas can be associated with the rise of linked data on the web. These schemas are designed to capture formatted information about agents as independent objects, not as metadata describing related information objects. These schemas are more likely than others to be used for the purpose of self-documentation by agents themselves. Early examples of this type of schema are hCard and vCard [17], both developed for the purpose of sharing personal contact information as a kind of

electronic business card. While agents are described in these schemas as the point of interest, rather than as an access point to other resources, they are limited in the scope of agent characteristics captured.

More recently developed schemas under the heading of Agent as Information Object have defined a greater number of detailed elements to represent other agent characteristics. The FOAF (friend of a friend) ontology is widely used to represent individuals and their relationships on the web, particularly within social networks [18]. While some researchers have explored using FOAF as a method for describing the demographic and dynamic properties of patients [19], this schema's application to the health workforce has not been investigated. Agents are also represented in detail in schema.org, a standard that was designed to represent any kind of object on the web [20]. In this schema, the Person entity type is a child entity of the Thing entity type, and it has approximately 50 allowable properties defined in addition to those inherited from the Thing type. Only one subtype of Person is defined in an extension to schema.org: the Patient type.

The Agent as Information Object schemas are more amenable to extension than those that represent agents primarily as an access point, which would theoretically allow for the incorporation of additional agent characteristics necessary for health workforce analysis. On the other hand, the only healthcare-related elements so far proposed by the communities that author extensions to these schemas are those related to patient data.

4.3   Schema Group 3: Agent as Resource

The third category of schemas includes those schemas with the most detailed representations of agents. In this group, schemas represent agents as the information object or resource of interest. Metadata in these schemas are created within specific use contexts and contain element definitions for a variety of characteristics relevant to those contexts. The domains of education and human resources are both home to metadata schemas where detailed individual characteristics, particularly those that are of use to regulators and workforce researchers, are represented.

In the field of human resources, metadata schemas have been developed to capture agent characteristics relevant to employers. The HR Open Standards group provides several XML schema standards used to support human resources activities such as recruiting, payroll, and performance evaluation. The CandidateProfile metadata element group of the Recruiting Specification [21] includes element sets for employment history, education history, licenses, certifications, publications, affiliations, references, and other topic areas used evaluating job candidates. The European Centre for the Development of Vocational Training (CEDEFOP) has developed a similar standard, the Europass schema, which supports the Curriculum Vitae and the Language Passport, standardized documents that are designed to assist educators, learners, and employers in communicating skills and qualifications in a uniform manner across Europe [22]. CEDEFOP emphasizes internationality and interoperability by supporting multiple languages, referencing ISO standards for languages and occupations, and making available APIs for use with their schema. The elements represented in these human resource schemas overlap strongly with the types of data elements needed in the assessment of individual fitness to practice and in health workforce analysis and projection.

Similarly, in the field of education, a number of schemas have developed to capture an individual's competencies and educational achievements. As the education community has turned its attention to competency-based and workplace-based education, their data standards have evolved to capture these more diverse activities. The Academic ePortfolio is an XML standard approved by the PK20W Education Standards Council (PESC) for the representation of an individual's educational activities and achievements, including those outside the classroom [23]. Included are elements to describe competencies, employment history, military history, licenses, and other credentials. Finally, the MedBiqitous organization has developed a number of XML standards for the exchange of data in the specific area of health professions education [24]. Their Healthcare Professional Profile (HPP) schema provides a framework for describing this particular group of agents. In addition to the educational characteristics found in the Academic ePortfolio, the HPP schema includes elements for representing an agent's clinical status and any disciplinary actions taken against the health professional by regulatory authorities.

Each of the schemas described in this section capture a variety of agent metadata often in a complex hierarchical structure. These are the schemas that seem most directly relevant to the context of professional regulation and workforce analysis. Only the schemas in this Agent as Resource category capture agent qualifications in sufficient detail to be of use in the evaluation of an individual's fitness to practice or in the assessment of health workforce supply and distribution.

5   Conclusion

The results of this research indicate that existing metadata schemas incorporating agents can be classified into different groups based on the agent's purpose in context and the granularity of agent data represented. Those that describe agents as resources best align with the representation of health professionals metadata for the purpose of health workforce research. The work reported here is a first step in ongoing research to define an agent metadata framework fit for global use in this area. Next steps will include the review of additional schemes and soliciting feedback from regulatory authorities and workforce researchers.

If health workforce research is to progress and become useful as a tool for correcting shortages and maldistributions, the promotion of an international standard for the collection of individual level data describing health professionals is crucial. Decades of work in the development of agent representations in various metadata schemas across a number of fields and contexts can provide guidance on the development of such a standard for the regulatory context. Metadata science can guide the development of health workforce informatics as an area of study that can inform policies to improve global health.

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