Protocol for a Structured Literature Review of Decision-Making Factors for the Adoption of Health Information Systems

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Overview

The purpose of this technical report is to present the review protocol of the structured literature review on understanding decision-making factors and theories related to adoption of Health Information Systems (HIS). Our motivation to undertake a structured literature review is to synthesize evidence, and bring about some structure to this research area – decision-making factors and theories for the adoption of HIS in a clinical context. Considering the broad nature of HIS, we argue that decision-makers need to have a set of criteria by which they can assess the decision-making for adoption of HIS.

The goal of a literature review is to collect and structure a large amount of accumulated knowledge in a specific area [1] and to identify the research gaps or unanswered research questions. In general, this process is divided into three phases namely planning the review, conducting and documenting the review results as demonstrated in figure 1. In this technical report, we have demonstrated the three phases and final primary studies for the literature review are presented at the end.

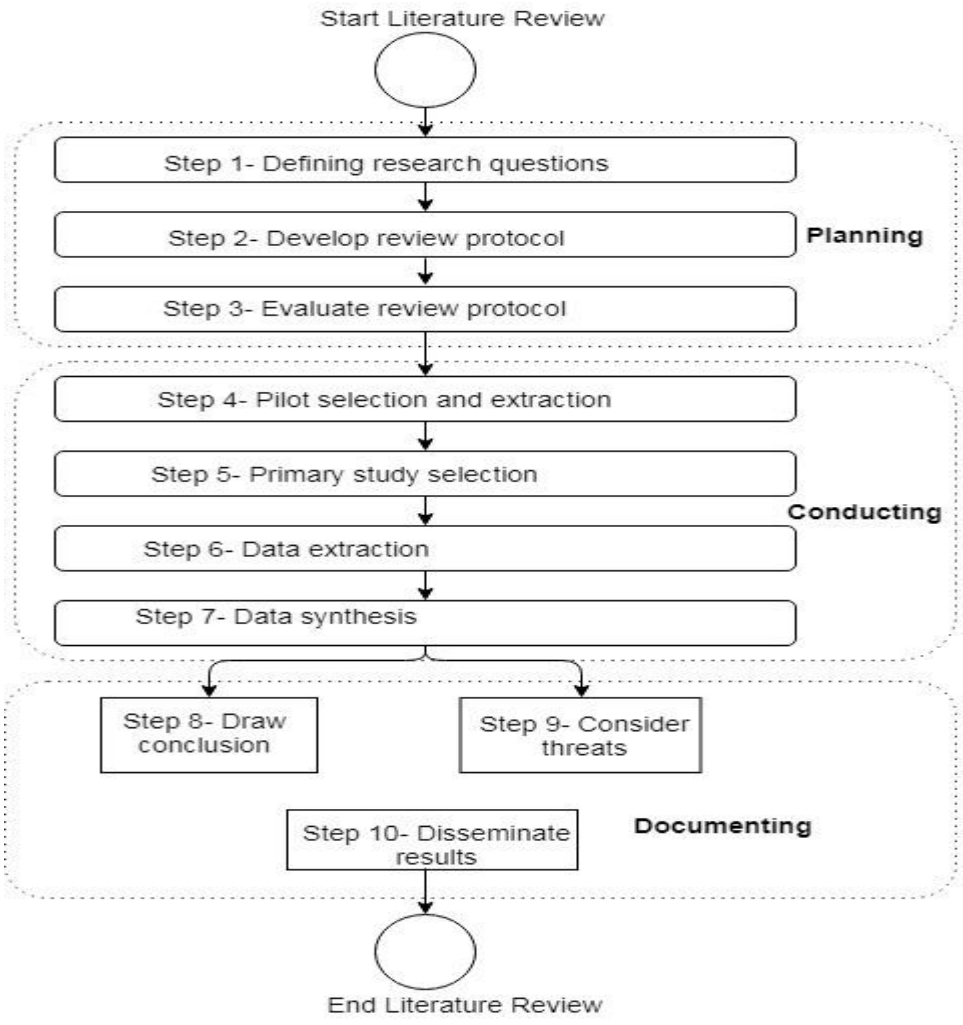

Figure 1: Structured Literature Review (adapted from [2])

Stage 1: Planning the Literature Review

Background & Research Questions:

Information Systems have become significant enabler in the provision of consistent quality of care. In recent years, its application across primary healthcare has rapidly influenced and changed care service delivery. As a result, there is a growing focus on HIS support for healthcare services which has given rise to a comprehensive sociotechnical model for managing healthcare through technology [3]. HIS deal with processes such as records management, billing and finance, aspects of human resource management (HRM), and help to support care delivery, quality improvement and research.

Research suggests that patients also want clinicians to use HIS [4]. Central to the adoption of any HIS is the decision-making process following decision guidelines to support the adoption of (HIS). However, despite an accumulation of best practices and frameworks such as Technology Organization Environment (TOE) framework or research identifying success factors, still a lot of HIS adoption projects fail [5]. Indeed, there is ample evidence to suggest that despite the proposed benefits of HIS, failing to adopt a suitable decision framework for their adoption can exculpate costs and in some cases lead to the failure of systems within healthcare organizations [6]. Adoption of a new HIS is one of the most important decisions in hospitals, yet the function of hospital decision-makers in the adoption of a new technology remains unsupported [7].

This research will examine the construct of decision-making factors for the adoption of HIS. This literature review will also identify and synthesize published research that describe decision-making models and frameworks for the adoption of HIS.

Thus, this research will be driven by following research questions:

1. What are the decision-making factors for the adoption of HIS in hospitals?
2. What decision-making models/frameworks are described in literature for the adoption of HIS?

Population and Effect:

The population consist of managers, hospital administration, policy makers and healthcare professionals. This research will present the hospitals with a decision-making guideline for future HIS adoption programmes. This research will also contribute towards software innovation community developing new HIS solutions targets at the hospital as a guideline to examine how their solutions align with the HIS decision-making criteria.

Stage 2: Conducting the Literature Review

Search Strategy

- **Source Selection Criteria:**

Source selection is based on the following criteria:

- High quality sources/peer reviewed sources
- Recommended for literature review by other studies
- Accessibility to the sources

- **Study language:**

Study language is English.

- **Source Identification:**

The first step was the creation of search strings with regards to the research questions. The four main keywords in all of the search strings were “information system”, “health”, “decision making” and “adopt”. The “*” symbol is used to retrieve the derived words from the previous prefix for instance the words adopts and adoption can be included in the derivation from adopt*. These search strings were applied to various scientific bibliographic databases (listed in Table 1) and the sole purpose of this activity was to identify primary studies.

Both automatic and manual searching(snowballing) is used to identify the relevant literature.

- **Automatic Search:** Finding primary studies using the search terms through the defined search sources. Search strings are constructed using Boolean AND’s and OR’s and some of key words based on research questions.
  - **Search Term**: ("decision making" OR "decision support") AND ("information technolog*" OR "information system*") AND (accept* OR adopt* OR usage) AND (health* OR hospital*)
- **Manual Search (Snowballing):** Manual Search (snowballing) [8] was carried out to track related references from the primary studies which were found by automatic searching.

Sr. No	Name	URL
1	CINHAL	https://www.ebscohost.com/nursing/products/cinahldatabases/cinahl-complete
2	Embase	https://www.embase.com
3	IEEE Xplore	http://ieeexplore.ieee.org
4	ACM	https://dl.acm.org/dl.cfm
5	Scopus	https://www.scopus.com/home.uri
6	Springer Link	http://www.springerlink.com
7	Web of Science	https://webofknowledge.com

Table 1: List of Databases and their URL’s

- **Studies Selection:**

Studies were eligible for inclusion if they were (i) original and peer-reviewed research written in English, (ii) qualitative, quantitative or mixed methods research, (iii) study containing healthcare organizational perspective and suggesting/recommending or containing/defining at least one decision-making factor or attribute for the adoption of HIS and (v) study describing decision-making frameworks/ theories that are associated with the adoption of IS.

Researcher excluded studies if they were (i) grey literature, (ii) presented research noted in a prior/subsequent paper, (iii) secondary (e.g. SLR) or tertiary studies (e.g. SLR of SLRs), dissertations and Master's thesis, (iv) studies that were shorter than 2 pages and (v) studies whose full-text was not available.

- **Procedure for Study Selection:**

This section explains the study refinement process by describing the details of three iterations.

- **First Iteration:**

Titles and abstracts were screened by one researcher [R1]. Out of the total 3,543 studies, 323 studies were removed by EndNote software as they were duplicated.

- **Second Iteration:**

From remaining 3,220 studies, 355 full articles were selected by R1 through applying the inclusion and exclusion criteria shown in table 2. For validation purpose, random 35 studies out of 3,220 studies were selected and sent to another researcher [R2]. Where there were conflicts with inclusion of studies, this discrepancy was resolved by arbitration and mutual consent. In next step, again inclusion and exclusion criteria was applied by R1 on the remaining 355 articles which resulted in 294 articles being excluded. For validation of the excluded articles, a randomly chosen 30 studies from these 294 articles were reviewed by R2, and agreement was observed. Out of 61 included articles, four were found to be replicated and were removed from our study.

- **Third Iteration:**

In third iteration, manually, references from included articles were checked to ensure inclusion of relevant studies which may have been overlooked. Eleven articles were added resulting in a total of 68 articles. Combined with the researcher, two outsider reviewers with considerable LR experience were involved to assess the quality of the 68 articles. With mutual consent between the three researchers and with the help of voting procedure, 68 articles were selected for the primary studies (see Appendix for detail of the primary studies). LR and study selection process can be seen in Figure 2 below:

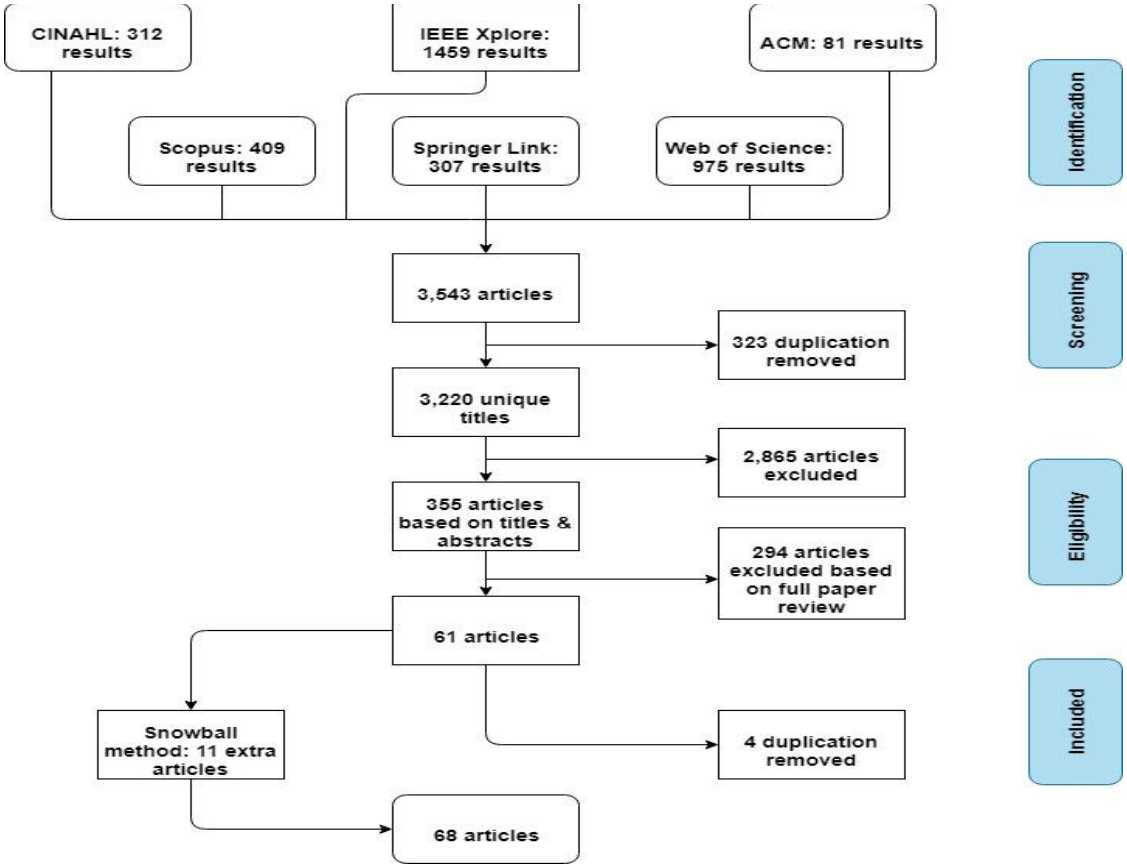

Figure 2: Study Selection Process

- **Information Extraction:**

For data extraction, we conducted a careful full-text read of the 68 selected primary papers. The first thing that was identified was the year of publication so that the analysis can be presented chronologically. We extracted and recorded the relevant data from read papers that could be useful in answering the research questions. The method used for the storage of the extracted data was tabulation method described in table 2.

Study Code:	
Journal/Conference:	**Data extracted by:**
Year:	**Date of completion:**
Research method:	
Outcomes relevant to the review:	
Framework /Model OR approach name *if available*	
Description (characteristic) about decision-making/adoption	
Key facilitators of decision-making	
Type of HIS described	
References to Framework /Model *if available*	

Table 2: Data Extraction Form

A narrative synthesis [9] was performed to summarise the evidence from the literature. Narrative synthesis is the process of synthesizing primary studies to explore heterogeneity descriptively rather than statistically.

Study Quality Assessment:

Study quality assessment was carried out to evaluate the existing research topic by using a trustworthy, rigorous and auditable methodology [10].

1. **Rigour:** Has a through and appropriate approach been applied to key research methods in the study?
2. **Credibility:** Are the findings well-presented and meaningful?
3. **Relevance:** How useful are the findings to the hospitals and the research community?

Voting procedure

Voting procedure was carried out for the quality assessment of the studies. Following voting procedure was followed:

- 5 points –Paper is highly relevant (must be included)
- 4 points –Paper is (somewhat) relevant
- 3 points –Neutral/no opinion
- 2 points –Paper is not relevant
- 1 point –Paper is absolutely irrelevant

Stage 3: Results from the Literature Review

Publications on HIS implementation are often based on case studies that report before-and-after outcomes and assessments of HIS as an intervention. Although they can provide rich detail on particular examples, they are often so focused on the specific aspects of the cases at hand that they are difficult to use as building blocks for constructing more generalizable theory. In addition, because of their focus on the process and impact of implementation, they offer limited insight into the underlying factors and conditions that shaped the outcomes [11].

A range of models and theories are used to evaluate and test the adoption of HIS. To look into underlying factors of decision-making adoption of HIS, we need to look into HIS applicability of these major theories and models that predict outcomes and to identify the important facets relating to success of adopting. Table 1 lists the decision-making theories, their description, characteristics and major decision-making factors involved in adoption of HIS.

Theory	Theory Description	Decision-making Characteristics	Corresponding theory factors
Technology diffusion [S10]	Diffusion is the process for assimilating an innovation by the members of a social system over time and through certain communication channels. This theory explains how diffusion of an innovation/technology spreads across a social system, including individuals, groups and organization.	The individual's decision adoption is influenced by five characteristics of innovation, including: relative advantage, compatibility, complexity, trialability and observability. Diffusion of an innovation occurs through a five-stage process including: knowledge, persuasion, decision, implementation and confirmation.	• Environment • Human • Organization • Technology
Theory of Reasoned	TRA is a social psychology theory which attempts to	TRA defines the links between the beliefs, attitudes, norms, intentions	• Human

Action (TRA) [S21]	explain an individual's behaviour in acquiring such an innovation.	and behaviours of individuals. An individual's decision adoption behaviour is determined by his/her behavioural intention, which is itself determined by his/her attitudes and subjective norms towards the behaviour.	• Environment
Theory of planned behaviour (TPB) [S5]	TPB was developed based on the TRA; however, TRA was related to voluntary behaviour which appears not to be 100% voluntary in certain circumstances. This resulted in the addition of another construct which is perceived behavioural control in TRA.	Perceived behavioural control is the individual's perception with regard to how easy or difficult a particular behaviour is to be performed. The decision-making intention of an individual to adopt the technology is determined by attitudes, subjective norms and perceived behavioural control.	• Human • Environment
Technology acceptance model (TAM) [S18]	TAM is an IT theory that explains how people come to accept and use a technology. TAM is an adaptation of the Theory of TRA.	TAM posits two factors that determine an individual's decision-making intention to use an innovation technology; these are Perceived Usefulness and Perceived Ease of Use. A personal behavioural intention to use a technology is directly influenced by perceived usefulness and perceived ease of use.	• Human • Technology
Unified theory of acceptance and use of technology (UTAUT) [S63]	UTAUT was a result of a review and consolidation of eight theories that earlier studies had employed to explain technology usage behaviour like TRA, TAM etc. Its main aim was to explain users' intentions to use a technology and their subsequent behaviour. It deals with individual's perceptions of whether they have the ability to decide whether or not to adopt the technology.	UTAUT posits two main decision-making factors including dependent constructs (which are behavioural intention and usage behaviour) and independent constructs (which are performance expectancy, effort expectancy, social influence, facilitating conditions, gender, age, experience and voluntariness of use).	• Human • Technology
Task-technology fit model (TTF) [S23]	TTF describes interaction of task and technology and how well technology fits within individuals.	TTF theorizes that technology utilization depends on the degree to which a technology assists an individual in performing the individual's tasks, i.e. the task-technology fit. The TTF framework adds new insight into decision-making of technology adoption by incorporating the element of task and also the fitness of the task and the technology.	• Human • Technology
Connected Health Evaluation Framework (CHEF) [S12]	CHEF enables hospitals to identify poorly designed healthcare solutions, assess performance requirements, monitors human interaction	CHEF offers first step towards employing an evaluation to extend the evidence-based foundation for the decision-making of HIS through the assessment of best practice and	• Business • Environment • Human • Organization • Technology

	(end-user) and identify potential gaps within a business strategy.	by identifying interventions and opportunities for improvement. CHEF is comprised of four main layers for HIS decision-making assessment, broadly addressing clinical, business, users and systems with a view to determine how these co-create value.	
Connected Health Delivery Framework [S42]	Connected Health Delivery framework identifies pain points, business model development, analytics, and evaluation as four main linkages between users (e.g. patients and providers) and technology.	The central point to Connected Health Delivery Framework is the use of the Design Thinking approach to understand the relationship between and explorative interplay between people, processes, technology and business needs.	• Business • Human • Organization • Technology
HOT-fit [S66]	HOT-fit theory covers human perspective issues encountered by information technology staff in an organizations.	The HOT-Fit has three decision-making aspects and different dimensions in every aspect. In technology aspect, there are three dimensions: (1) system quality; (2) information quality; (3) service quality. In human aspect, there are two dimensions: (1) system use; and (2) user satisfaction. In organization aspect, there are two dimensions: (1) structure; and (2) environment.	• Human • Organization • Technology
Precede-proceed model [S25]	Precede-proceed is a two-component conceptual model that is used extensively as the basis for planning health IT promotion programs.	Precede-proceed model is intended to guide the synthesis of more than one theoretical perspective for the purpose of developing effective multi-level interventions, providing a continuous series of phases that build logical links among multiple levels of causation. The goals of the model are to explain health-related decision-making behaviors and environments. Five phases with levels of assessment include: Organizational needs and goals, IT specifications and match with goals, Behavior and environmental, Educational and organizational, and Points for system use. Evaluation phase includes: Implementation, Process evaluation, Impact evaluation, System evaluation and Outcome evaluation	• Business • Environment • Human • Technology • Temporality
The IS Success Model [S67]	The IS Success Model examines the success of IS from a number of different perspectives and classifies them into six categories of success.	The IS Success adopts a multidimensional framework which measures independencies between the various categories such as Information, System and service quality, Use (intention to), User satisfaction and Net benefits. These dimensions suggest that there is a clear relationship between the six	• Business • Human • Organization • Technology

		categories and influences the success of the IS.	
TOE Framework [S58]	TOE focuses on the process by which a firm adopts and implements technological innovations.	TOE identifies three aspects of an enterprise's context that influence the decision-making by which it adopts and assimilates a technological innovation: technological context, organizational context, and environmental context	• Environment • Organization • Technology
CHEATS Model [S68]	CHEATS Model evaluates the use of Information & Communication Technologies in Healthcare setting.	CHEATS Model evaluates healthcare through six core areas: Clinical: focusing on issues such as quality of care, diagnosis reliability, impact and continuity of care, technology acceptance, practice changes and cultural changes; Human and Organizational: focusing on issues such as the effects of change on the individual and on the organization; Educational: focusing on issues such as recruitment and retention of staff and training; Administrative: focusing on issues such as convenience, change and cost associated with health system; Technical and Social: focusing on issues such as efficacy and effectiveness of new systems and the appropriateness of technology, usability, training and reliability of healthcare technology.	• Business • Clinical • Human • Organization • Technology

Table 3: IS decision-making related theories, its aim and theory factors

Based upon the key theory-based components of HIS [7, 11], there are six factors mentioned below that play an important role in the decision-making for the adoption of HIS. Various studies and frameworks [12-14] have taken “business” as sub-factor of “environment”, but identifying the influence of the business context in hospitals, we deemed it important to have present it separately. The six decision-making factors are:

1. **Business:** capturing business aspects of the hospital that may influence decision-making for the adoption of HIS such as vendor involvement and cost;
2. **Clinical:** related to the clinical applicability of the HIS and its impact in healthcare context;
3. **Environment:** related to external factors that cannot be controlled by the organization itself such as government rules and regulations;
4. **Human:** capturing the characteristics of the technology user that may impact on its adoption, for example, previous user experience;
5. **Organization:** relating to internal factors of a hospital that are controlled by the organization itself such as team management;
6. **Technology:** relevant to the functionality of specific technology such as complexity and readiness.

Table 4 summarises the decision-making factors taken from the literature that influence adoption of HIS.

Main decision-making factors	Sub-factors of decision-making	Studies
Business	Business competition among hospitals	S8, S15, S26, S32, S46, S57
	Vendor partnership/involvement in the project	S14, S26, S32, S61
	Financial issues related to cost of adoption and maintenance of HIS	S8, S16, S32, S38, S57
Human	Self-efficacy (believes in one's competence to use the HIS)	S5, S7, S19, S22, S41, S45, S50, S57, S62
	Motivation to use the HIS /resistance to use the HIS	S7, S19, S20, S24, S31, S36, S45, S50, S52
	Attitude of user towards usage of HIS	S5, S11, S12, S24, S30, S31, S41, S44, S47
	Perceived system usefulness (use of the HIS leads to desired outcome)	S1, S3, S17, S19, S22, S30, S35, S39, S40, S47, S56, S62
	Awareness of the existence and/or objectives of the HIS (previous experience or knowledge about HIS)	S4, S16, S29, S33, S40, S45, S57
	Agreement of users with IT solution in general (accepting/resistant)	S11, S15, S26, S29, S49, S52, S60
	Participation of end-users in the implementation strategy	S12, S20, S37, S37, S40, S53, S54
Technology	Technology readiness/receptivity	S8, S22, S29, S33, S34, S41, S46, S47
	Relative advantage of using or having HIS	S14, S18, S24, S33, S34, S39, S44, S45, S53
	Complexity involved in implementing & using HIS	S5, S9, S11, S12, S30, S31, S34, S41, S47, S53
	Compatibility or control of using HIS	S1, S15, S24, S34, S35, S54
	Design and technical concerns of HIS	S1, S3, S5, S6, S18, S27, S39, S40, S41, S51
	Time consuming/time saving (HIS saves time or it makes things difficult for the users and consumes more time by using)	S2, S6, S7, S12, S27, S31, S56
	Applicability of HIS to the clinical situation	S17, S28, S38, S45, S47, S43, S49, S61
Organization	Hospital type	S36, S46, S65
	Hospital ownership	S54, S59, S64, S65
	Hospital size	S13, S16, S36, S59, S65
	Internal needs of the hospital	S32, S41, S54, S55
	Resource management & availability	S3, S9, S13, S27, S35, S44, S56
	Technological knowledge	S15, S35, S36, S38, S40, S65
	Knowledge management capabilities (educating & learning)	S15, S45, S53, S55, S61
	Project team capability to handle and implement HIS within hospital	S9, S16, S36, S38, S54, S55, S65
	Top management support in adoption of HIS	S14, S23, S28, S34, S56, S59

	Presence and use of champion/absence of champion in adopting HIS	S11, S23, S27, S28,S44, S49, S56
	Procurement process of HIS	S15, S54, S55, S56, S65
Environment	Government involvement	S13, S14, S16, S36
	Country wealth	S16, S46, S57
	Legal issues & regulations of use around the adoption & usage of HIS	S3, S37, S43, S48

Table 4: Decision-making factors from literature

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