

Evaluation of Flowsheet Documentation in the Electronic Health Record for Residence, Living Situation, and Living Conditions

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Abstract

Social determinants of health (SDOH) are important considerations in diagnosis, prevention, and health outcomes. However, they are often not well documented in the EHR and found primarily in unstructured or semi-structured text. Building upon previous work, we analyzed all flowsheet data in 2013 for information related to the SDOH topic areas of Residence, Living Situation, and Living Conditions. Overall, 91 rows were identified as being related to the topics areas resulting in 604,616 unique observations. Individual rows contained SDOH data often covered multiple concepts especially free-text entries. These data included most often references to the residence, residence details, and with whom the patient lives. Very few contained living condition references. Additionally, there was significant duplication and inconsistency of row labels, as well as variation in value list content for rows collecting the same concepts. Our findings demonstrate significant opportunities to improve and achieve better standardization in documentation around these SDOH.

Introduction

Social and individual behavioral factors play an important role in diagnosis, prevention, health outcomes, and quality of life.¹⁻⁴ Social determinants of health (SDOH) in many instances have a profound impact on our overall health. SDOH includes behavioral components, such as alcohol, drug, and tobacco use, as well as physical environmental factors that can influence the patient's health such as living conditions, social support, occupation, and physical activities.¹ They have been shown to contribute to mortality, as well as a causal mechanism for disease.⁵⁻⁹ Insecurity related to housing has been associated with poor health among children,¹⁰ barriers related to access to health care,¹¹ and chronic disease management.¹² Living situation, such as residence type, with whom the patient lives, housing density, physical living conditions, and social support, all have been shown to have significant impact on a patient's health outcomes.^{13, 14} The National Academy of Medicine (NAM), formerly Institute of Medicine (IOM), suggests that a health policy framework implemented around SDOH would achieve better population health, less inequality, and lower costs.¹⁵ There are many public health related initiatives aimed at addressing social determinants and health outcomes as well as recommendations by NAM for SDOH documentation in the EHR.¹⁶⁻¹⁸

While much work has been done to demonstrate the effect of behaviors such as alcohol and tobacco use on health outcomes,¹⁹ the majority of other social determinants have not been investigated as thoroughly. In general, housing insecurity has been associated with poor health in children, has been shown to have an impact on chronic disease management, and is linked to depression, stress, smoking, and drug use.¹⁰⁻¹² Housing, for example, has been studied with respect to the impact of homelessness on various conditions and housing related exposures.²⁰⁻²⁸ However, little work has been done around examining the health affects of housing density or with whom the patient lives.²⁹ Knowledge regarding the patient's physical living space, with whom the patient lives, and related exposures would benefit clinicians and other stakeholders in providing appropriate care as well as facilitation of appropriate housing interventions when needed.³⁰

The tremendous increase in the use of EHRs provides unprecedented opportunity to collect and analyze patient data. Even though SDOH documentation has increased in the EHR, social history information is often lacking or inadequate despite its fundamental role in understanding the context of the patient's story.³¹ Having SDOH data available in a format that can be analyzed and reused for clinical care along with other associated clinical data would enable development of more informative clinical decision support tools, better evaluation of patient outcomes, generation of additional evidence based care guidelines, and identification of patients who may benefit from special services or interventions or those who may be at higher risk for potentially preventable events.

However, well-designed discrete data collection tools for many aspects of social history information have not been widely developed and incorporated to the EHR. Currently, our work has shown that SDOH documentation may be documented as structured data or unstructured text (e.g., in clinical notes or free-text data collection fields).³² Moreover, end-users and healthcare institution are left to utilize ill-fitting tools for data collection such as flowsheets. Also, it is common practice for health care organizations to customize their EHR, such as work building flowsheets or other tools to fit specific workflows. In some cases, this customization results in SDOH information be documented in various areas of the chart ultimately making this information difficult for providers to locate. Lastly, comprehensive standards have not yet been developed to encompass all the SDOH topic areas especially the topic areas of interest in this work, namely: *Residence*, *Living Situation*, and *Living Conditions*. In previous work, we found overall that Systematized Nomenclature of Medicine - Clinical Terms (SNOMED CT) was the most comprehensive source covering these three topic areas followed by the Omaha System.³³ However, both of these sources lacked substantial detail pertaining to the three target topic areas of interest in this work. There is ongoing work to map flowsheet rows to coding systems such as SNOMED CT and Logical Observation Identifiers Names and Codes (LOINC®).^{34,35} However, those data models are still under development and, as such, they are not quite ready for widespread use in clinical documentation.

Flowsheets are critical tools in the EHR for documenting longitudinal data and information such as assessments and observations, as well as providing checklists for routine care tasks. Nurses and allied health staff, such as social workers, physical therapists, and occupational therapists are the typical primary documenters and users of flowsheet data. Since they are used by many different members of the interdisciplinary care team, they naturally provide a mechanism for communication between team members as well as the ability to combine the documentation from disparate disciplines into a single format for visualization.

In the Epic EHR, flowsheets are very flexible in design and fairly easy to build and implement; thus, they offer a popular option for building discrete data collection tools. A flowsheet “Row” is equivalent to a field in a database designed to collect “Observations” or data points. Each flowsheet row can be formatted to collect measure values (e.g., as free-text, numeric, or selection from a custom list) and each row also allows for the entry of free-text comments to accompany each measure value. Flowsheet displays are similar to spreadsheets and are intended to document brief results. Longer text strings or larger blocks of free-text cannot be displayed completely, and therefore these data are cumbersome to review in this format. Lastly, information entered as measure value comments are free-text blocks and are not accessible for typical clinical decision support purposes or for secondary use in population health research. Since flowsheets are so flexible and easy to implement, they can be overused or sometimes misused. The sheer number of rows and the organizational structure can get unwieldy unless care is taken in planning and design of these tools to ensure that each row is unique to capture a specific discrete measurement or concept.

This study is focused on the three target topic areas of *Residence*, *Living Situation*, and *Living Conditions*. Using definitions developed from previous work, *Residence* describes dwelling types, physical residence, and geographic location and includes safety considerations such as railings or number of floors and steps. *Living Situation* describes with whom the patient lives such as roommates, family members, multi-resident dwelling as well as how many others they live with. Lastly, *Living Conditions* describes environmental cleanliness and precautions against infection and disease and includes such things as animals, and presence of mold or an unclean living space.

The goals of this descriptive study were to: (1) examine flowsheet rows relevant to the three target topic areas and (2) characterize flowsheet documentation content and compare flowsheet content to that found in previous work, which analyzed existing standards and terminologies as well as unstructured text.^{32,33}

Methods

Data Sources

The data used in this study originated from the Fairview Health System (FHS) EHR system and included only data from inpatients from 2013 who had consented for their medical records to be used in research. The primary data source for this work was the Academic Health Center Information Exchange (AHC-IE) data repository, which contains clinical data from the University of Minnesota (UMN), Academic Health Center (AHC), FHS, University of Minnesota Physicians (UMP), and other external data sources (e.g., geocoding data and Minnesota Department of Health death data). Our data exploration focused on EHR data for inpatient visits for 2013 for both FHS and UMP.

Flowsheet Review

A complete dataset of all unique flowsheet row unique IDs, system names, and display names, were extracted from the AHC-IE including rows that had been retired. *System Names* are names given to the rows which are not visible to the end user whereas the *Display Names* are visible to the end user when they are documenting. The dataset was systematically searched using the list of search terms compiled from previous work, which reviewed existing interface terminologies, standards, specifications, coding terminologies, vocabularies, documentation guidelines, measures, and surveys.³³ The complete dataset of flowsheet rows was then also manually reviewed to ensure complete capture of rows that may have been missed with the search term list and related rows identified. The final set of search terms obtained from the flow sheet data review are summarized in Table 1.

Table 1. Final set of search terms for flow sheet review.

Search terms from standards	Added search terms from flowsheet review
“home”, “house”, “housing”, “residence”, “live”, “living”, “lives”, “people”, “mold”, “insect”, “rodent”, “water”, “heat”, “social”, “density”	“Stairs”, “railings”, “safety”, “safe”, “facility”, “group home”, “skilled nursing facility”, “assisted living facility”, “support system”, “family”, “support”, “housing conditions”, “caregiver”, “bathroom”, “community support”, “rehab”, “assistive device”, “social/environment”, “equipment”, “social support”, “household”, “transitional care”, “social connectedness”, “live alone”

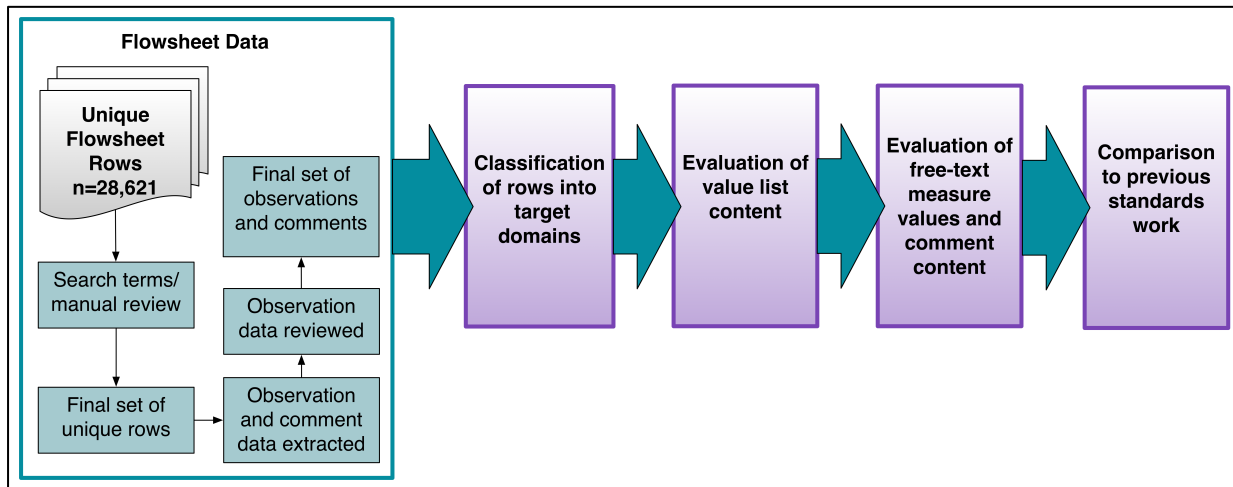


Figure 1: Flowsheet review methods.

For all rows identified as being related to the three topic areas, observation measure values and observation free-text comments were extracted. Each of the flowsheet rows and observations were examined to ensure relevance to one or more of the three topic areas and unrelated rows and observations were excluded. Rows and observations found to not be related to one or more of the three topic areas were removed from the dataset the final set of observation measure values and observation comments were reviewed. Rows were classified into target domain categories, and sorted based on data collection type, i.e., rows designed to be entered using a drop-down value list or by the entry of free-text. For those rows utilizing drop-down value lists, the complete value list values were extracted, combined, and sorted to develop harmonized value lists for the elements. Meta-data for rows utilizing value lists that included frequency of value lists updates were examined. Measure values from rows that were free-text entry as well as comment text were compiled and reviewed. Lastly the overall flowsheet documentation content was compared to content findings from previous standards work (Figure 1).^{32, 33}

Results

Flowsheet Observations

The 28,621 unique flowsheet rows system and display names were analyzed systematically using search terms (Table 1). The initial analysis yielded an initial set of 567 rows that were potentially relevant to the target topic areas. After manual review of system and display names, rows found to be unrelated to the topic areas were removed

resulting in a final list of 222 unique flowsheet rows that could potentially contain data related to the three topic areas of interest.

Flowsheet observation data were extracted from the AHC-IE database for these 222 rows resulting in an initial dataset containing 198 unique flowsheet rows with a total of 1,170,722 observations. Twenty-four of the 222 flowsheet rows were not documented on in the study period so, while they were in the list of rows, they were not represented in the final set of observations. This observation dataset represented 169,425 unique patients and 279,028 encounters. The 198 unique flowsheet rows were reviewed for relevance to the three topic areas and 107 rows were removed from the dataset leaving a total of 91 unique flowsheet rows found to be related to one or more of the three target topic areas (Table 2).

Of the 91 unique flowsheet rows, 49 were found to have been built using custom lists, i.e., pre-built value lists that the user can select from. The remaining 42 rows were built as free-text measure values. Of the 49 rows built with custom lists, 41 were designed to allow the user to select multiple values from a custom list.³² The 49 rows with custom lists accounted for a total of 480,013 observations where there was either a measure value or comment documented. For 50,066 observations, the measure value was null but there was a free-text comment entered. The 42 rows built as free-text fields resulted in 124,603 observations, i.e., observations that had a value, comment, or both. Of these, 18,932 observations had a null measure value but had a free-text comment entered.

Table 2. Summary of Flowsheet Rows, Observations, and Values.

Flowsheet Rows (Unique data capture fields)	
Total Unique Flowsheet Rows	28,621
Total rows identified with search terms and manual review	567
Total “cleaned” rows identified through search terms	222
Observations (Data points collected for the identified, 222 flowsheet rows)	
Total observations for identified rows	1,170,722
Unique rows with observations	198
Total unique patients	168,425
Total unique encounters	279,028
Total observations after manual review	604,616
Total unique flowsheet rows	91
Total unique patients	96,383
Total unique encounters	139,729
Values (Data types and presence of associated comments)	
Rows built with custom lists	49
Total observations (Value and/or Comment entered)	480,013
Total rows with Value only	429,947
Total rows with Comment only	50,066
Rows built as free-text fields	42
Total observations (Value and/or Comment entered)	124,603
Total rows with Value only	105,671
Total rows with Comment only	18,932

Table 3 characterizes the final dataset comprised of 91 unique flowsheet rows identified after manual review and the total count of observations found for each row during the study period. The Row Format column indicates the data type of the row measure value observation, i.e., whether the row is a free-text entry or uses a value list, i.e. hard coded list of options to select from with single or multiple select. This table is sorted alphabetically by Measure Display Name to show the duplication in concepts being collected via separate flowsheet rows and variation in the way identical measures are being collected wither by formatted list of single- and multi-select options or by free-text. Each row measure value was categorized according to topic area as were free-text comments. Many rows covered more than one of the three topic areas as shown in the last column “Total Topic Areas”.

Table 3. Unique flowsheet rows with observation counts and topic areas. Obs Count: number of observations for the row in the final dataset. Row Format (Data Type): FT=free-text, VLM=value list multi-select, VLS=value list single-select. Topic Areas: RS=Residence, LS=Living Situation, LC=Living Conditions. **Value lists contained only “yes” and “no” values with free-text comments.

ID	Measure Display Name	Obs Count	Row Format	Primary Topic Areas						Total Topic Areas
				Measure Value			Free-text Comments			
				RS	LS	LC	RS	LS	LC	
Residence										
1	Current Living Environment	573	VLM	X	-	-	X	X	-	2
2	Current/Future Living Arrangements	3	FT	**	-	-	X	-	-	1
3	Living Arrangement Comments	1638	FT	X	X	-	-	X	-	2
4	Living Arrangement Concerns	13899	VLS	**	-	-	X	X	X	3
5	Living Arrangement Concerns	1056	VLS	**	-	-	X	X	X	3
6	Living Arrangements	6978	VLM	X	-	-	X	X	-	2
7	Living Arrangements	8569	VLM	X	-	-	X	-	-	1
8	Living Arrangements	1165	VLM	X	-	-	X	X	-	2
9	Living Arrangements	61448	VLM	X	-	-	X	X	-	2
10	Living Arrangements Comment	36	FT	X	X	X	-	-	-	3
11	Living environment	1149	VLM	X	-	-	X	X	-	2
12	Living environment	61	VLM	X	-	-	X	X	-	2
13	Living environment	191	VLM	X	-	-	X	X	-	2
14	Living environment	3741	VLS	X	-	-	X	X	-	2
15	Living environment	1	VLM	X	-	-	-	-	-	1
16	Living environment	617	VLS	X	-	-	X	X	-	2
17	Living environment	2	VLM	X	-	-	-	-	-	1
18	Living environment	5	VLM	X	-	-	-	-	-	1
19	Living environment	282	VLM	X	-	-	X	X	-	2
20	Living environment	30	VLM	X	-	-	X	X	-	2
21	Living environment	53	VLM	X	-	-	X	X	-	2
22	Living environment	1227	VLM	X	-	-	X	X	-	2
23	Living environment	281	VLM	X	-	-	X	X	-	2
24	Living environment	70	VLM	X	-	-	X	X	X	3
25	Living Environment Comment	27037	FT	X	X	X	X	X	-	3
26	Living environment comments	650	FT	X	X	X	-	-	-	3
27	Living environment comments	100	FT	X	X	-	-	-	-	2
28	Living Environment Concerns	992	VLS	**	-	-	X	X	X	3
29	Living Status	35	FT	X	X	-	-	-	-	2
30	RETIRED Living environment comment	43	FT	X	X	X	-	-	-	3
31	Role/Living Environment Comments	319	FT	X	X	-	-	-	-	2
32	Temporary Family Living Arrangements	6035	VLM	X	X	-	X	X	-	2
33	Type of Residence	68366	VLM	X	-	-	X	X	-	2
34	Where Is Home For Me?	1437	FT	X	X	-	-	-	-	2
35	Where Is Home For Me?	336	FT	X	X	-	-	-	X	3
Residence-Bed Bath Location										
35	Additional Bathroom Location/Comments	61	FT	X	-	-	-	-	-	1
37	Additional Bathroom Set Up/Equipment	20	VLM	X	-	-	X	-	-	1
38	Primary Bathroom Location/Comments	266	FT	X	-	-	-	-	-	1
39	Primary Bathroom Set Up/Equipment	219	VLM	X	-	-	X	-	-	1
Residence-Facility Name										
40	Assisted Living Facility	446	FT	X	-	-	X	-	-	1
41	Care Facility Name	701	FT	X	-	-	-	-	-	1
42	Group Home	170	FT	X	-	-	X	-	-	1
43	Skilled Nursing Facility	48	VLS	X	-	-	X	-	-	1
44	Skilled Nursing Facility	5065	FT	X	-	-	X	-	-	1
Residence-Stairs and Railings										
45	Indicate number of stairs	15	FT	X	-	-	-	-	-	1
46	Number of Stairs	5270	FT	X	-	-	X	-	-	1
47	Number of Stairs to Enter Home	42	FT	X	-	-	X	-	-	1
48	Number of Stairs to Enter Home	347	FT	X	-	-	X	-	-	1
49	Number of Stairs to Enter Home	36167	FT	X	-	-	X	-	-	1
50	Number of Stairs Within Home	55	FT	X	-	-	X	-	-	1
51	Number of Stairs Within Home	334	FT	X	-	-	X	-	-	1
52	Number of Stairs Within Home	33579	FT	X	-	-	X	-	-	1

53	RETIRED # of Stairs to enter home	4990	VLS	X	-	-	X	-	-	1
54	RETIRED # of stairs within home	5261	FT	X	-	-	X	-	-	1
55	Stair Railings	17	VLM	X	-	-	-	-	-	1
56	Stair Railings at Home	30	VLM	X	-	-	X	-	-	1
57	Stair Railings at Home	13356	VLM	X	-	-	X	-	-	1
58	Stair Railings Entering Home	3	VLM	X	-	-	-	-	-	1
59	Stair Railings Inside Home	3	VLM	X	-	-	-	-	-	1
Residence-Safety										
60	Current assistive devices	581	VLM	X	-	-	X	-	-	1
61	Equipment Used at Home	47806	VLM	X	-	-	X	-	-	1
62	Home Accessibility	41458	VLM	X	X	-	X	X	-	2
63	Home Accessibility Comments	26	FT	X	-	-	-	-	-	1
64	Home Safety Comments	35	FT	X	X	X	-	-	-	3
65	Home/community accessibility	1433	FT	X	-	-	X	-	-	1
66	Home/community Accessibility Comments	163	FT	X	X	-	-	-	-	2
67	Home/community Accessibility Comments	30	FT	-	X	-	-	-	-	1
68	Home/community Accessibility Comments	1	FT	X	-	-	-	-	-	1
69	Home/Community Accessibility Comments	3	FT	X	X	-	-	-	-	2
70	Home/Community Accessibility Comments	3	FT	-	X	-	-	-	-	1
71	Home/community Accessibility Comments	16	FT	-	X	-	-	-	-	1
72	Home/Community Accessibility Comments	877	FT	X	X	-	X	-	-	2
73	Home/Community Accessibility Comments	41	FT	X	X	-	-	-	-	2
74	Home/Community Accessibility Comments	246	FT	X	X	X	-	-	-	3
75	Home/community Accessibility Comments	24	VLS	-	X	-	-	-	-	1
Living Conditions										
76	Family Pets	1427	FT	-	-	X	-	-	-	1
77	Family Pets	325	FT	-	-	X	-	-	-	1
78	Pets? (Name/type)	425	FT	-	-	X	-	-	-	1
79	Potentially Unsafe Housing Conditions	26	VLM	-	-	X	-	-	X	1
Living Situation										
80	Current Community Support	2478	VLM	-	X	-	X	X	X	3
81	Current living arrangement:	1	VLM	-	X	-	-	-	-	1
82	Lives With	724	VLM	-	X	-	X	X	-	2
83	Lives With	10	VLM	-	X	-	X	X	-	2
84	Lives With	349	VLM	-	X	-	X	X	-	2
85	Lives With	112	VLM	-	X	-	-	X	-	1
86	Lives With	173656	VLM	-	X	-	X	X	-	2
87	Lives With	16176	VLM	-	X	-	-	X	-	1
88	Lives With	1072	VLM	-	X	-	X	X	-	2
89	Lives With	13	VLM	-	X	-	-	-	-	1
90	Living Situation prior to adoption	50	VLM	X	-	-	-	-	-	1
91	Others Living In Residence (Non-Familial Relationships)	139	FT	-	X	-	-	X	-	1
	Totals	604,616		68	33	10	51	32	7	

Of the total 91 rows, 46% (42) were built for free-text documentation, 45% (41) were built with value lists that allowed for multiple values to be selected from the value list, and 9% (8) were built with value lists that allowed only one value to be selected from the list. Of the 49 rows with value lists, 34 had value lists that contained values related to *Residence*, 13 related to *Living Situation*, and 1 had a value list related to *Living Conditions*. Overall, 53% (48) of the 91 rows contained data related to a single topic area, 34% (31) contained data related to two topic areas, and 13% (12) contained data related to all three topic areas. Of the 42 rows with value lists, 62% (26) contained data for a single topic area, 21% (9) two topic areas, and 17% (7) to all three topic areas. Of the 49 rows that were built to collect free-text, 45% (22) contained data related to a single topic area, 45% (22) related to 2 topic areas, and 10% (5) contained data related to all three topic areas. Lastly there were two rows “Living Environment Concerns” and “Living Arrangement Concerns” that had values of “YES” and “NO”.

In flowsheet rows that were built with the intention of collecting the same information or concepts, the row display names and the value lists were not consistent across those rows. Table 4 shows an example of three flowsheet rows that had different display names and different value list members but all three were intended to capture the type of dwelling in which the patient lived.

There was also inconsistent terminology used to label the free-text rows. Comparing rows with the same display name there was variability in what data the row was intended to collect. For example “Living Environment” rows

that in most cases were intended to document residence type with value lists but in some cases the row was intended to document stairs and railings outside and inside the home. Subsequently, the measure values from the 49 rows with value lists were compiled into separate lists for each of the related elements (Table 5).

Table 4. Row display name and value lists for rows documenting the type of physical residence.

Row Display Name	Type of Residence	Living Arrangements	Living Environment
Values in value list	Assisted Living	Apartment	Apartment/condo
	Group Home	assisted living	Assisted living
	Home Care Staff	condominium	Group home
	Homeless	correctional facility	House/townhome
	Nursing Home	extended care facility	SNF
	Private Residence	foster care	Other, comments
	Other (Comment)	group home	
		Homeless	
		hotel/motel	
		House	
		independent living facility	
		mobile home	
		no permanent address	
		residential facility	
	other (see comments)		

Table 5. Flowsheet measure value list compilation (raw data) categorized in the three topic areas.

Residence Type		Residence Stairs & Railings	Residence Safety (Assistive devices)
Adult Foster Care	House	entering home	Bath bench
Apartment	House/townhome	inside home	Bath not on first floor
Apartment/condo	Independent living facility	inside, present at both sides	Bed and bath are not on the first floor
Assisted Living	Mobile home	inside, present on left side	Bed not on first floor
Condominium	No permanent address	inside, present on right side	Extended tub bench
Correctional facility	Nursing Home	none entering home	Grab bars present (bathtub)
Extended care facility	Orphanage	none inside home	Grab bars present (toilet)
Foster care	Private Residence	other (must comment)	Hand held shower
Group Home	Residential facility	other (see comments)	Raised toilet
Home	Ronald McDonald House	outside, present at both sides	Ramps present at home
Home Care Staff	Shelter	outside, present on left side	Shower grab bar
Homeless	SNF	outside, present on right side	Shower stall
Hope Lodge	Staying with family	present at both sides	Shower/tub chair
Hospitality house	Staying with friends	present of both sides	Toilet
Hotel	Townhome/townhouse	present on left side	Toilet grab bar
Hotel/motel		present on right side	Tub/shower combo
		stairs (1 railing present)	Tub/shower is not walk in
		stairs (2 railings present)	
		stairs to enter home	
		stairs within home	
		entering home	
		<number>	
		<number x # flights>	
Living Situation Subject		Living Conditions Type	
Adoptive parent(s)	Grandfather	Chipped paint	No running water
Alone	Grandmother	Insects/pests	No smoke detector
Aunt	Grandparents	No air conditioning	No working appliances
Birth family	Half-brother	No electricity	Other (see comments)
Brother	Half-sister	No heat	Paint chipped
Child(ren)	Host family	No hot water	Stairwells unsafe
Child(ren), adult	Legal guardian	No indoor plumbing	Unable to assess
Child(ren), dependent	Mother	No lighting	Unsafe stairwells
Domestic partner	Mother and partner	No phone	Windows broken
Father	Other (see comments)		
Father and partner	Other relative(s) (specify)		
Foster care	Parent(s)		
Foster family	Room mate		
Foster parent(s)	Sibling(s)		
Friend(s)	Significant other		
Grandchild(ren)			

Groupings generated five concepts: (1) Residence Type, (2) Residence Stairs and Railings, (3) Resident Safety, (4) Living Situation Subject, and (5) Living Conditions Type. The value lists showed variability in terms used as well as terms that did not necessarily belong (e.g., names of facilities like “Ronald McDonald House”).

Lastly, differences were found in the format of a number of the rows collecting similar data. For example, five unique rows were found that were intended to collect the names and contact information for care facilities each one specific to the facility type. Four of the five flowsheet rows were built as free-text measure values. Two of the rows had the same display name but one was a free-text measure value and the other was built as a custom list.

Discussion

SDOH play an important role in the provision of care. However, EHRs, for the most part, often do not contain well-designed documentation tools to collect these data or standardized storage of this information for clinical care and secondary uses. In our analysis of a large healthcare enterprise and three key SDOH, we observed that much of this information is documented in free-text form in notes or in flowsheets rows, the latter of which was the focus of this study. Flowsheets allow for documentation in a longitudinal manner; however, their format is really most efficient for short answer or numeric values. Their ongoing management across settings and certain types of care remains an important challenge. This study demonstrates that flowsheet tools are being used to document SDOH. However, the overall design of these tools is not optimal and the use of any specific standard or terminology is not clearly evident, which has broad implications to interoperability and secondary use of these data.

In total, 91 rows were found to contain either measures and/or free-text comments related to the three topic areas. Of the 49 rows built with value lists, there was significant duplication in rows with regards to naming and also multiple rows seemingly built to collect the same concepts. For example, 22 unique rows were related to *Residence* and were built with value lists to collect the type of dwelling in which the patient lives. We found inconsistencies in terminology used to label rows as well as inconsistencies in terminology and content in value lists. For example, Residence Type was documented in rows that were labeled “Type of Residence”, “Living Arrangements”, and “Living Environment”. This duplication and inconsistency demonstrates a need for more rigorous content and knowledge management of EHR documentation tools as well as a need for more attention towards overall design and architecture.

The free-text comments in many cases did not match the intent of the flowsheet row as determined by review of the value lists associated with the row. For example, the row “Type of Residence”, which was built as a multi-select value list, had free-text comments that included the name of the facility, who was living with the patient in that residence, location such as addresses, and information related to residence details such as stories and stairs. In another row entitled “Lives with”, the free-text comments included information such as the facility name, dwelling type, pets (numbers and names), details about where other family members live, and number of children and their ages.

A comparison of the flowsheet value lists compiled from this work (Table 5) with the value lists obtained from previous standards work³³ demonstrated overall similar values for residence type and living conditions although some standards, most prominently SNOMED CT, were more comprehensive in these topic areas. However, we found differences in details specifically values related to stairs, railings, and installed safety devices. The amount of flowsheet documentation found regarding these details, could indicate the importance and relevance of this information for patient care and therefore should be included in future comprehensive standards development work.

Another issue found was excessively long value lists that were high maintenance. The row “Skilled Nursing Facility” had a value list that contained well over 100 items. The value list items were composed of residential facility names, locations, and phone and fax numbers. Flowsheet metadata for these rows indicated that these value lists are updated frequently as facility names or phone and fax numbers change thus this model requires more maintenance to stay current. This brings to question whether a flowsheet is the optimal location in the EHR for a patients place of residence. The EHR does contain a designated place for patients address in the demographics section; however, many times for patients who live in residential facilities, the address entered into the patient demographics may be that of a relative or guardian. Also, since flowsheets are not necessarily readily available to all providers, it may be better to have residential facility information located elsewhere in the EHR such as in the demographic sections of the chart where it is more readily accessible for viewing and updates but separate from the billing address.

Next steps for this work include compiling and harmonizing the flowsheet value lists with the value lists from previous work evaluating existing standards and EHR free-text documentation.^{32, 33} In addition, formal annotation

techniques could be used to enhance natural language processing tools for these topic areas. Since the ultimate goal is to update the model representation from previous work, that modeling should be done using formal model representation tools such as openEHR, as well as aligning the model with existing standards such as Clinical Information Modeling Initiative and terminologies such as the Omaha System³⁶ for the three topic areas of *Residence, Living Situation, and Living Conditions*. Lastly, future work could also include an examination of patient level SDOH versus environmental level SDOH and impact to health outcomes.

Conclusion

In summary, this study demonstrated the wide variation in the design and use of flowsheet rows as data collection tools for SDOH information related to *Residence, Living Situation, and Living Conditions*. In addition, data quality is less than optimal due to the lack of standards in terminology for the element names and the value lists as well as the extensive use of free-text measure values and comments. As a result, there remains an opportunity to redesign these flowsheet rows to create efficiencies in documentation and to optimize the quality of the data being collected through pruning and combining of similar concepts into fewer rows and developing comprehensive standards and utilizing coding systems for these data. Overall, the lack of standards for SDOH documentation has implications for interoperability and secondary use of data.

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