

# Problem Stabilization

## A Metric for Problem Improvement in Home Visiting Clients

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### Keywords

Public health nursing, home visiting, standards, interventions, outcomes, methods, Omaha system

### Summary

**Background:** Public health nurse (PHN) home visiting programs have been widely employed to improve life course trajectories for high risk mothers. Home visiting programs are often lengthy, during which PHNs simultaneously address multiple problems using diverse interventions over several client encounters. To manage PHN caseloads it is critical to understand the trajectory of client improvement and the optimal duration of services. PHN documentation data enable intervention trajectory research for specific client problems. A new metric called problem stabilization is proposed for evaluating interim improvement during PHN home visiting. Problem stabilization is an intervention pattern for a client problem that is characterized by co-occurring actions (i.e. teaching, guidance, and counseling; treatments and procedures; case management; and/or surveillance) during a client encounter; followed by surveillance actions only for that problem during a subsequent client encounter. The purpose of the study was to investigate problem stabilization during home visiting services for high risk mothers.

**Methods:** A retrospective cohort was created using family home visiting intervention documentation data from a local Midwest public health agency over a six year period (2000–2005). The data set consisted of Omaha System interventions for 720 high risk mothers. Analysis was conducted using descriptive statistics and Kaplan Meier curves.

**Results:** On average 30.1% of the time, client problems stabilized before discharge. Stabilization patterns differed by problem. Time to stabilization was longest for Caretaking/parenting and Antepartum/postpartum problems, and shortest for Residence and Mental health problems.

**Conclusions:** Problem stabilization, a proposed intermediate outcome of PHN home visiting care, appears to be meaningful in describing client response to PHN intervention. This metric is an example of meaningful use of structured clinical electronic health record data for program evaluation and clinical decision support.

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*Appl Clin Inf* 2011; 2: 437–446

doi:10.4338/ACI-2011-06-RA-0038

received: June 16, 2011

accepted: September 16, 2011

published: October 26, 2011

**Citation:** Monsen KA, Farri O, McNaughton DB, Savik K: Problem stabilization: a metric for problem improvement in home visiting clients. *Appl Clin Inf* 2011; 2: 437–446

<http://dx.doi.org/10.4338/ACI-2011-06-RA-0038>

## 1. Background

### 1.1 Public Health Nurse Home Visiting

Public health nurse (PHN) home visiting, a lengthy therapeutic relationship between a PHN and a high risk parent, has been studied extensively and is generally accepted as an effective approach to improving life course trajectories for this population [1–4]. For example, young pregnant women or parents with complex social needs such as mental health or substance use problems would be eligible for PHN home visiting services. Length of PHN home visiting care varies and may be as short as a few visits to provide information and connections to resources in relatively simple situations, or as long as several years in more challenging situations to provide relationship-based therapeutic and educational interventions addressing highly complex needs. Structured home visiting programs prescribe care episode duration of up to 4 years [3]. This costly intervention strategy has been shown to save public dollars over time, especially related to decreased public assistance costs [2]. However, the home visiting research has assumed a theoretically derived duration. Studies of actual optimal duration of home visiting care are needed. In particular, intervention patterns and timing associated with client improvement during the home visiting intervention are not known. Large intervention data sets may offer opportunities to discover time-related intervention patterns or trajectories within the home visiting intervention.

### 1.2 Adoption of Electronic Health Records in Public Health Nursing

Electronic health records that incorporate standardized interface terminologies for documentation have been widely adopted in public health nursing settings [4, 5]. Practice-generated clinical data sets have potential to address gaps in knowledge about intervention patterns and trajectories through development of new metrics and models. A standardized interface terminology commonly used in community care settings is the Omaha System [6–8]. Public health nurses using the Omaha System in computerized documentation generate detailed data about client problems, nursing interventions, and client outcomes. Such detailed data enable the investigation of complex phenomena inherent within the therapeutic encounters between clients and PHNs.

### 1.3 Omaha System

The Omaha System is an interface terminology standard first recognized in 1992 by the American Nurses Association. It is listed in the US Department of Health and Human Services interoperability standards for electronic health records after successfully passing the Healthcare Information Technology Standards Panel (HITSP) Tier 2 selection criteria for Use Cases in 2007. Additionally, it is integrated into the National Library of Medicine's Metathesaurus; Cumulative Index to Nursing and Allied Health Literature (CINAHL®); Nursing Information and Data Set Evaluation Center (NIDSEC); Logical Observation Identifiers, Names, and Codes (LOINC®); and Systematized Nomenclature of Medicine-Clinical Terms (SNOMED CT®). It is registered (recognized) by Health Level Seven (HL7®), and is congruent with the reference terminology model for the International Organization for Standardization (ISO). The Omaha System became a member of the Alliance for Nursing Informatics (ANI) in 2009 [7].

The Omaha System has three components, the Problem Classification Scheme, the Intervention Scheme, and the Problem Rating Scale for Outcomes. The Problem Classification Scheme is a taxonomy of 42 health concepts organized under four domains: environmental, psychological, physiological, and health related behaviors. Each problem has a set of unique binary signs/symptoms indicators (yes/no). The Intervention Scheme consists of four levels, problem, category, target, and client specific information. The first level (problem) consists of all of the problems in the Problem Classification Scheme. The second level (category) consists of four terms:

1. teaching, guidance, and counseling;
2. treatments and procedures;
3. case management; and
4. surveillance.

Teaching, guidance, and counseling is defined as “activities designed to provide information and materials, encourage action and responsibility for self-care and coping, and assist the individual/family/community to make decisions and solve problems” (p. 373) [6]. Treatments and procedures is defined as “technical activities such as wound care, specimen collection, resistive exercises, and medication prescriptions that are designed to prevent, decrease, or alleviate signs and symptoms of the individual/family/community” (p. 373) [6]. Case management is defined as “activities such as coordination, advocacy, and referral that facilitate service delivery, improve communication among health and human service providers, promote assertiveness, and guide the individual/family/community toward use of appropriate resources” (p. 373) [6]. Surveillance is defined as “activities such as detection, measurement, critical analysis, and monitoring intended to identify the individual/family/community’s status in relation to a given condition or phenomenon.” (p. 373) [6]. The third level (target) consists of 75 targets which provide additional information about the focus of the intervention. The fourth level (care description) is not taxonomic, but some standard narrative examples are provided to guide and report typical practice interventions. The care description can be customized to record details about any individual need or health care practice. The Problem Rating Scale for Outcomes consists of three problem-specific five-point Likert-type ordinal rating scales for client knowledge, behavior, and status (1 (most negative) to 5 (most positive)). The Omaha System is particularly suited to intervention research because it generates relational problem-specific intervention and outcomes data.

## 1.4 Problem Stabilization

To address the need for clinical decision support metrics in determining optimal length of home visiting care episodes, a new metric, problem stabilization, was proposed for evaluating client progress during the home visiting intervention. Problem stabilization is an intervention pattern for a client problem that is characterized by co-occurring actions (i.e. teaching, guidance, and counseling; treatments and procedures; case management; and/or surveillance) during a client encounter; followed by surveillance actions only for that problem during a subsequent client encounter (► Fig. 1). No previous mention of problem stabilization was found in the literature. This study leverages the potential use of large data sets to investigate new health care concepts.

## 2. Objectives

The objective of the study was to investigate problem stabilization during home visiting services for high risk mothers.

## 3. Methods

### 3.1 Sample

The study was a secondary analysis re-using existing data from one Minnesota public health department. The sample was a cohort of clients from an existing PHN family health caseload data set generated through clinical documentation over a six year period (2000–2005). Data were extracted from the clinical software application and de-identified for use in the previous study. Inclusion criteria were clients of any age who received one or more home visits (encounters) during an care episode, for a total of 720 clients who received 50,360 interventions (► Table 1). The final data set included 8 problems with sufficient n to support the analysis. Stringent data quality supports were in place during the data collection period. PHNs utilized an agency-specific documentation manual to minimize data entry errors [9]. The agency established reliability with the Omaha System through an extensive inter-rater reliability process developed with an Omaha System consultant, to ensure that the PHNs used the Omaha System accurately and consistently. The process consisted of Omaha System training, question and answer meetings with the consultant, and videotaped visit simulations that were rated independently by the experts and the consultant. Percentages of agreement between the con-

sultant and the PHNs were 100% for the Problem Classification Scheme, 77% for the Intervention Scheme, and 94% for the problem rating scale for outcomes [9].

### 3.2 Variables

Demographic variables were age, sex (M/F), race/ethnicity (Caucasian/minority), and marital status (married/not married). Intervention variables were Omaha System categories (teaching, guidance, and counseling, treatments and procedures, case management, and surveillance). Time variables were admission, discharge, and intervention dates. A care episode was defined as the duration of home visiting services, calculated by subtracting the admission date from the discharge date. Mean care episodes were calculated for each problem. Problem stabilization was computed using an algorithm based on the proposed definition. The final data set was obtained by merging three data sets (demographics, interventions, and outcomes) based on fake\_id, problem, admission date and discharge date.

### 3.3 Analysis

Descriptive statistics were used to report characteristics of clients, interventions, and problem stabilization number, percent, time to outcome, and percent of care episode. Use of Kaplan Meier curves enables estimation of time to an event, allowing for differences in the length of care episodes (in this study, the event was stabilization). The probability of stabilization at any point is estimated from the cumulative probability of stabilization for each of the preceding time intervals (in this model, days). The precision of the model depends on the number of observations, so the estimates at the beginning of the curves are most precise [10] SAS 9.2 code for the analysis is available upon request from the corresponding author.

## 4. Results

On average, the length of a problem care episode was 286 days (minimum-maximum range = 237–348); time to problem stabilization was 158 days; time to discharge was 286 days; and 30.1% of clients stabilized across all problems (► Table 2). Problem stabilization patterns differed by problem. For the Residence and Family planning problems, the time to discharge was close to the mean of 286 days (313 and 289 days, respectively). Time to stabilization was much shorter for the Residence problem (110 days, 35.1% of the care episode) than the Family planning problem (196 days, 67.8% of the care episode). Only 73 (30.7%) clients receiving Family planning interventions stabilized; vs 182 (52.9%) clients receiving Residence interventions stabilized. Kaplan Meier curves illustrate differences in stabilization by problem over time (► Fig. 2).

## 5. Discussion

A proposed metric for evaluating problem stabilization during home visiting services was investigated using structured intervention data. Stabilization occurred in all of the main problems experienced by the clients. An average of 30.1% of clients stabilized across all problems. This is the first study to examine problem stabilization in PHN home visiting using a large intervention data set. Suggestions for further studies to validate problem stabilization as a concept and metric for interim improvement in home visiting are provided in the following sections.

### 5.1 New Metric for Interim Improvement in Home Visiting

Problem stabilization is a new metric that appears to describe a novel concept in PHN home visiting. The category term of the intervention (teaching, guidance, and counseling; treatments and procedures; case management; and surveillance) was useful for depicting problem-specific intervention tailoring patterns over time. This previously hidden intervention pattern appears to consist of

multiple co-occurring intervention actions that lead to improvement, after which the problem requires only the watchful eye of the PHN. Problem stabilization differs and goes beyond results of previous data mining research evaluating intervention patterns in home visiting data in which co-occurring interventions were clustered without respect to changes over time [11]. The findings of this study are consistent with the previous study in illustrating the complexity of client problems and home visiting intervention content [11–12].

## 5.2 Stabilization by Problem

Considerable variation in stabilization occurred by problem. These differences are depicted visually using Kaplan Meier curves (► Fig. 2) and are also reflected in the results of the descriptive analysis (► Table 2). Preliminary interpretation of these findings is suggested below based on the literature and clinical expertise.

### 5.2.1 Time to Stabilization

The Mental health and Residence problems stabilized frequently and early in the care episode. For example, typical PHN services addressing the Residence problem with high risk parents may consist of a home safety assessment and teaching at the beginning of care. During the assessment, safety issues may be identified that can be immediately addressed with simple child-proofing modifications. In subsequent visits, home safety issues are then monitored over time. Thus, the Residence problem could be expected to stabilize early for most clients [13, 14]. For the Mental health problem, urgent issues identified early in a care episode would be referred immediately to other providers, and subsequently monitored to ensure mental health safety over time [15, 16]. Thus, the Mental health problem could be expected to stabilize early in the care episode.

Caretaking/parenting and Antepartum/postpartum problems stabilized rarely and late in the care episode. This is consistent with evidence-based PHN services both Caretaking/parenting and Antepartum/postpartum problems, in that PHNs continuously provide considerable anticipatory guidance, education and support throughout the care episode, due to the ever-changing aspects of fetal and child development over time [12]. Thus, it would be rare for Caretaking/parenting or Antepartum/postpartum problems to stabilize. A more realistic average measure of client stabilization across problems may be obtained by excluding Caretaking/parenting and Antepartum/postpartum from the analysis. Doing so results in client stabilization of 37.5% across all problems.

Stabilization patterns for Income, Abuse, Substance use, and Family planning problems varied, indicating that problem stabilization occurred at different times for different clients. Such complex problems may require intensive interventions that are tailored to unique client situations and needs [12, 17–20]. The problem stabilization metric should be further investigated using other large data sets to evaluate the reproducibility of problem-specific intervention patterns across PHN agencies, programs, and client populations; and the relationships between stabilization and improvement in final client outcomes.

### 5.2.2 Time to Outcome

Problem stabilization occurs about half way through the care episode for most problems, perhaps indicating that extensive PHN monitoring after initial improvement helps to ensure that positive client outcomes 'stick'. This interpretation suggests that the length of PHN services may extend beyond the first signs of client improvement, and may help explain why PHN home visiting is an effective intervention for high risk mothers in complex social situations [1–4]. The implications of this finding are important for practitioners and policy makers, in allocating sufficient resources for PHN home visiting programs. Further research is needed to clarify the optimal duration of a care episode, which appears to vary by problem. Given that clients may have an average of 2.9 problems (S.D. = 2.2) it is very possible that for any client, one problem may resolve earlier than another. For example, a client may have 3 problems such as Residence, Income, and Caretaking/parenting. The Residence problem may resolve quickly after home safety concerns are addressed; the Income problem may continue for a longer period of time during which the PHN assists the client in preparing for employment; and the Caretaking/parenting problem may continue indefinitely. Future research should investigate stabilization by client to better estimate optimal length of home visiting care episodes.

### 5.3 Alternative Explanations

Due to the observational nature of the data, results must be interpreted with caution. Researchers should consider alternative explanations for the findings, and seek to validate these results through replication with other data sets. An alternative explanation for problem stabilization could be resistance to intervention. For example, a client who smokes during pregnancy may refuse to speak to the PHN about her smoking addiction. In such situations, the PHN would continue to observe and monitor tobacco use while refraining from further teaching, guidance, and counseling. This intervention data would mimic problem stabilization for Substance use, while actually depicting client resistance to PHN intervention. Another alternative explanation could include incomplete or missing data regarding the intervention content due to poor documentation quality. Further research is needed to determine if problem stabilization indicates interim improvement, resistance to intervention, and/or some other phenomenon. For example, a qualitative study of free text documentation associated with structured data indicating stabilization could reveal additional information about the intervention pattern. However, such free text tends to be limited, due to time constraints in clinical settings and need for efficiency in documentation [21]. Therefore, an alternative qualitative approach could be to identify problem stabilization in documentation for current clients, and to then interview PHNs regarding these situations.

### 5.4 Applications for Other Terminologies

The Omaha System is similar to other interface terminologies because it describes health care problems, interventions, and outcomes. Problem stabilization could be operationalized using other terminologies by mapping Omaha System category terms to interventions in other interface terminology data sets.

## 6. Conclusions

This study examined PHN intervention patterns with high risk mothers, incorporating time as a factor in the analysis. Problem stabilization, as a proposed intermediate outcome of PHN home visiting care, appears to be meaningful in describing client response to PHN intervention. Further study is needed to confirm that this metric is reproducible and accurately describes interim improvement in client problems during home visiting services. Large interface terminology data sets from clinical documentation offer opportunities to develop new metrics for evaluating intervention patterns and their relationships to client outcomes.

#### Clinical Relevance Statement

Practitioners who provide lengthy, complex services to high risk clients need data-based metrics that enable evaluating success of intervention approaches over time. An algorithm for problem stabilization could be incorporated within the EHR, and used to generate reports of interim client improvement to provide clinical decision support regarding PHN caseload management.

#### Human Subjects

No human subjects were involved in the preparation of this manuscript. University of Minnesota Institutional Review Board approval was obtained for use of de-identified clinical data.

#### Conflicts of Interest

The authors are informatics specialists and/or statisticians with expertise in use of the Omaha System in education and research. All authors declare no conflict of interest in the preparation of this manuscript. The content is solely the responsibility of the authors and does not necessarily represent the official views of the authors' employers.

### Acknowledgments

The findings reported in this article are from a study supported by the National Institute of Nursing Research (Grant #P20 NR008992; Center for Health Trajectory Research). The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute of Nursing Research or the National Institutes of Health.

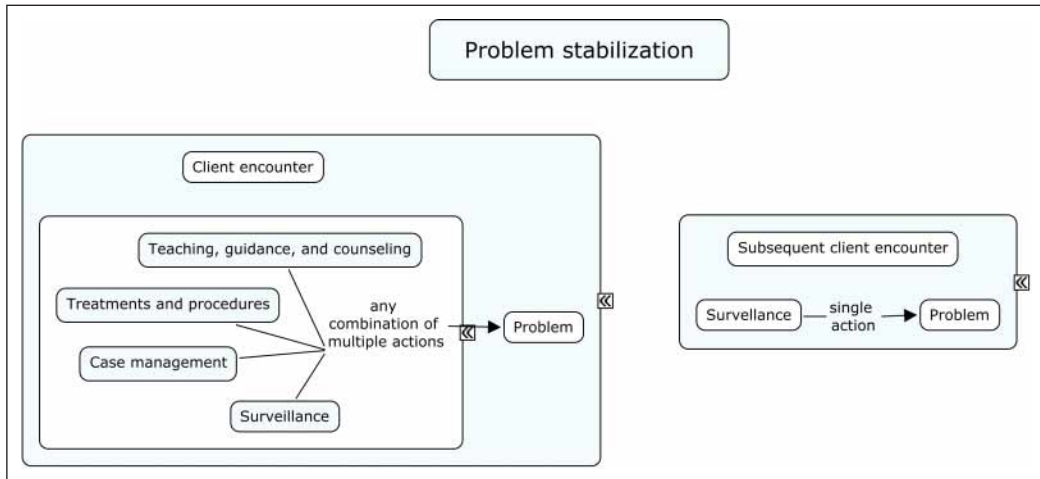


Fig. 1 Problem stabilization

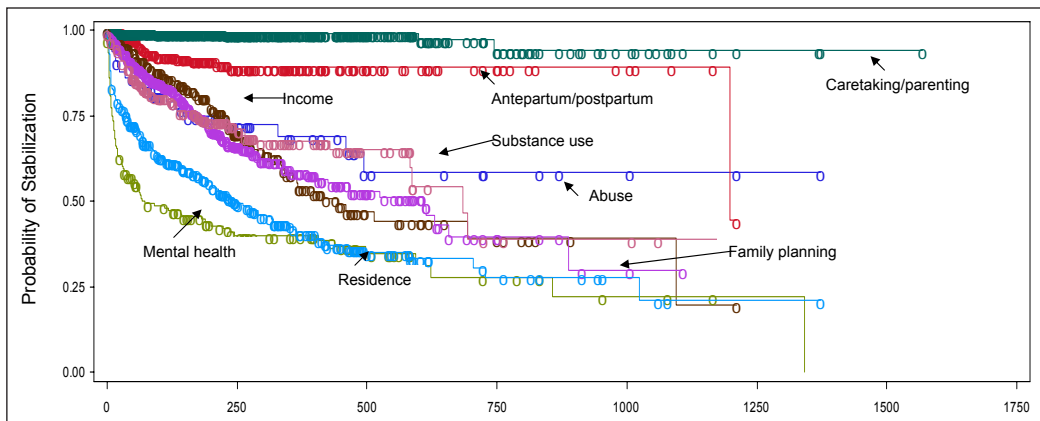


Fig. 2 Probability of stabilization by problem and number of days in care episode



Client characteristics (N = 720)			
	Mean	SD	%
Age in years	23.2	8.3	
Sex (% female)			96.1%
Race/ethnicity (% white)			79.2%
Marital status (% not married)			74.9%
Intervention characteristics (N = 50,360)			
	Mean	SD	
Problems per client	2.9	2.2	
Interventions per client	69.9	81.4	
Visits per client	6.8	8.9	
Interventions per visit	12.5	5.9	

**Table 1**  
Characteristics of clients and interventions

**Table 2** Problem stabilization number, percent, time to stabilization, and percent of mean care episode by problem.

Problem	Total	Stabilized		Time to stabilization		Length of care episode		Mean care episode
	N	N	%	Days	SD	Days	SD	%
Caretaking/parenting	620	6	1.0	336	319	252	247	>100
Antepartum/postpartum	364	26	7.1	143	262	237	234	60.3
Income	361	153	29.5	147	149	274	238	53.6
Residence	344	182	52.9	110	154	313	259	35.1
Family planning	238	73	30.7	196	177	289	239	67.8
Substance use	207	58	28	124	166	284	238	43.7
Mental health	153	93	60.8	86	198	294	275	29.3
Abuse	85	26	30.6	119	153	348	266	34.2
Mean across problems	297	77	30.1	158	197	286	250	46.3*

SD = Standard deviation

\*excludes the Caretaking/parenting problem percent of mean care episode, due to low n (n=6) and extended stabilization beyond mean length of care episode (> 100%).

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