

POPULATIONS AT RISK ACROSS THE LIFESPAN: POPULATION STUDIES

Benchmark Attainment by Maternal and Child Health Clients Across Public Health Nursing Agencies

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ABSTRACT Objectives: Benchmark client outcomes across public health nursing (PHN) agencies using Omaha System knowledge, behavior, and status ratings as benchmarking metrics. **Design and Sample:** A descriptive, comparative study of benchmark attainment for a retrospective cohort of PHN clients (lowincome, highrisk parents, primarily mothers) from 6 counties. **Measures:** Omaha System Problem Rating Scale for Outcomes data for selected problems. Benchmark measures were defined as a rating of 4 on a scale from 1 (lowest) to 5 (highest). **Intervention:** Family home visiting services to low income, highrisk parents. **Results:** The highest percentage of benchmark attainment was for the Postpartum problem (knowledge, 76.2%; behavior, 94.0%; status, 96.6%), and the lowest was for the Interpersonal relationship problem (knowledge, 21.7%; behavior, 69.0%; status, 40.7%). All counties showed significant increases in client knowledge benchmark attainment, and 4 of 6 counties showed significant increases from baseline in behavior and status benchmark attainment. Significant differences were found between counties in client characteristics and benchmark attainment for knowledge, behavior, and status outcomes. **Conclusions:** There were consistent patterns in benchmark attainment and outcome improvement across counties and family home visiting studies. Benchmarking appears to be useful for comparison of population health status and home visiting program outcomes.

Key words: benchmark, home visiting, interventions, Omaha System, outcomes, public health nursing standards.

It is critical for public health nursing (PHN) agencies to be accountable to their constituents and decision makers by demonstrating efficient and effective care. Therefore, performance-based evaluation of services using real-world data is a priority. Benchmarking is an evaluation approach that allows for the analysis and comparison of outcomes. Benchmarking was first practiced at the Xerox Corporation and defined as “finding and implementing best practices” (Camp & Tweet, 1994, p. 230). The basic principle of

benchmarking is to compare current practices or outcomes with an established standard. This promotes the sharing and identification of best practices and serves as a catalyst for change and advancement. Benchmarking has become a widely used technique for objectively measuring the results of health care services (Denniston & Whalen, 2005; Fagerstrom & Rauhala, 2007; Gohmann & Head, 2001). The objective of this study was to examine benchmark attainment for parenting clients by Omaha System

problem and outcome and widely disseminate findings in the public domain for use by the international Omaha System community of practice. The specific aims were to (1) compare client characteristics across counties; (2) benchmark client knowledge, behavior, and status outcomes across counties; and (3) benchmark client outcomes by problem.

Benchmarking in PHN is in its infancy, and further research is needed to advance the use of benchmarking in order to meet the goals of PHN practice efficiency and effectiveness, and improvement in population health outcomes. Benchmarks may be established using national standards or through available empirical data on a specified outcome. Several factors contribute to successful benchmark selection and implementation. First, benchmarks should reflect the mission, vision, and objectives of the organization (Fagerstrom & Rauhala, 2007; Tran, 2003). Second, key stakeholders should be included before embarking on a benchmarking project and participation in the process from all organization levels is considered essential (Tran, 2003). Third, there must be credible performance information that can be quantified using specific measurement criteria (Denniston & Whalen, 2005; Fagerstrom & Rauhala, 2007; McKinney, 2004; Nelson, 2004). Fourth, there must be demand for that information and its use (Denniston & Whalen, 2005; Fagerstrom & Rauhala, 2007; Gohmann & Head, 2001). Finally, meaningful assessment and evaluation practices are essential (Denniston & Whalen, 2005; Fagerstrom & Rauhala, 2007; Nelson, 2004).

PHN agencies typically select target outcomes based on organizational objectives and community needs assessments. However, it is often a challenge to acquire credible client and performance data for analysis, and without the foundation of strong data, a benchmark is meaningless (Chesney, 2008; Nelson, 2004). Thus, benchmarks for PHN should be established by expert PHNs who are able to define concrete, realistic performance standards. A new source of data for benchmarking evaluation and research has become available through electronic health records used by PHNs. Such electronic data are a key component to the implementation of successful benchmarking (Denniston & Whalen, 2005; Fagerstrom & Rauhala, 2007; Nelson, 2004). The collection and analysis of documentation data required for efficient and effective benchmarking can

be highly complex. The reliability of the data depends on many factors, including the documentation skills of the nurse and the documentation software (Monsen, Westra, Yu, Ramadoss, & Kerr, 2009). Health care environments may face the difficulty of establishing consistency in the definition of terms and practices, which can affect both the input and the final analysis of data (Denniston & Whalen, 2005; Fagerstrom & Rauhala, 2007; Nelson, 2004). Standardized interface terminologies improve documentation reliability and generate valuable data for benchmarking. A standardized interface terminology commonly used in PHN documentation is the Omaha System (Martin, 2005).

The Omaha System is a standardized interface terminology recognized by the American Nurses Association (2010). It is a complex, multiaxial, hierarchical, relational interface terminology developed through federally funded research. It was designed from its inception to be amenable to automation and to be used by nurses and other health care disciplines. 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 comprehensive, holistic assessment of 42 health concepts (problems) 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 care description. The Problem Rating Scale for Outcomes consists of three 5-point Likert-type ordinal rating scales, one for each of the dimensions of knowledge, behavior, and status. Similar to the Intervention Scheme, the Problem Rating Scale for Outcomes is used in conjunction with the Problem Classification Scheme, permitting the assessment of client knowledge, behavior, and status for every Omaha System problem addressed with a client. Scores range from 1 (*most negative*) to 5 (*most positive*). Problems are typically rated at admission and discharge. Outcomes benchmarks have been previously defined as a rating of 4 or greater at discharge (Monsen, Sanders, Yu, Radosevich, & Geppert, 2011b). Detailed information about the Omaha System is available online at omahasystem.org.

An early benchmarking report from a county public health department used Problem Rating

Scale for Outcomes data to define a benchmark of 4 as a program in a report to county commissioners as follows: “To evaluate the effectiveness of the nursing services, the department uses a standardized instrument to document client outcomes. Using this instrument, PHNs rate (on a scale of 1–5) the change in a client’s knowledge, behavior, and status (KBS) for each problem at the time of admission and the time of discharge. For example, a score of 1 = no knowledge; 5 = superior knowledge. The department’s goal is to annually maintain an average discharge score of 4 or more for all clients discharged” (Washington County Public Health and Environment, 2006, p. 3).

Two previous studies established a precedent for the use of the Omaha System as a benchmarking standard for PHN evaluation (Monsen et al., 2010, 2011b). Brief summaries of both studies are provided as a background for the present study.

The first outcomes comparison study established a precedent for comparing PHN outcomes across agencies (Monsen et al., 2010). Client problems and outcomes were found to be similar across counties, with problems addressed in all domains. Differential improvement was shown by problem, outcome measure, and county. Problems with greatest improvement across counties were Antepartum/postpartum and Family planning and problems with the least improvement across counties were Neglect and Substance use. These findings demonstrated that PHNs address many serious health-related problems with parenting clients. Client problems consistently showed a statistically significant improvement across counties (Monsen et al., 2010). There were several limitations in this preliminary study. First, attainment of a numeric benchmark was not evaluated, because the participating coinvestigators were not aware of benchmarking as a possible outcomes comparison metric. Second, clients from all programs were included in the sample (i.e., pregnant women, children with special health care needs, and parenting clients). Therefore, findings represented the overall agency outcomes (vs. outcomes for a specific population or program). Finally, only aggregated outcomes data were available. Therefore, further analysis by population or program was not possible.

The second study compared benchmark attainment for two cohorts of mothers receiving home visiting services: mothers with intellectual disabilities (ID) and mothers without ID from the same

data set, matched by age, race/ethnicity, and marital status (Monsen et al., 2011b). Benchmarks were differentially attained by group, problem, and outcome. The percentage of mothers with ID attaining the benchmark of 4 ranged from 13.3% (Caretaking/parenting knowledge) to 90.4% (Postpartum status) and 30% (Mental health knowledge) to 95.7% (Postpartum status) for the comparison group. For mothers with ID, the benchmark was attained by 50% of the sample for knowledge outcomes, 5 behavior outcomes, and 5 status outcomes. For the comparison group, the benchmark was attained by 50% of the sample for 3 knowledge outcomes, 6 behavior outcomes, and 5 status outcomes (Monsen et al., 2011b).

The present study advances the science of PHN outcomes benchmarking across PHN agencies by using the benchmarking metric with a large data set for parenting clients. The specific aims of the present study were to (1) compare client characteristics across counties; (2) benchmark client knowledge, behavior, and status outcomes across counties; and (3) benchmark client outcomes by problem.

Methods

Design and sample

The study was a secondary analysis of deidentified PHN client data from an existing Minnesota Department of Health multicounty data set, using a retrospective cohort design. Approval was obtained from the University of Minnesota Institutional Review Board and the Minnesota Department of Health.

The sample was a convenience sample of data submitted by local public health departments to the Minnesota Department of Health in response to a call for family home visiting outcomes data for clients who were served and discharged in 2007. The six counties self-selected into the study by submitting deidentified data generated through routine documentation of services in the course of PHN practice. To ensure that outcomes were compared for the parenting client population, data were included only for clients with the Caretaking/parenting problem ($n = 1,701$).

Measures

Variables were client identification number (fictitious); days in episode of care; demographics (age,

race, ethnicity, and marital status); problem; and final knowledge, behavior, and status ratings. Benchmark variables were dummy coded based on the Problem Rating Scale for Outcomes definitions. A score of 4 or above was chosen as the benchmark value for knowledge, behavior, and status outcomes. For knowledge, 4 is defined as adequate knowledge and 5 is defined as superior knowledge. For behavior, 4 is defined as usually appropriate behavior and 5 is defined as consistently appropriate behavior. For status, 4 is defined as minimal signs/symptoms and 5 is defined as no signs/symptoms (Martin, 2005).

Analytic strategy

As a preliminary step, a descriptive analysis of the client characteristics, problem frequencies, and knowledge, behavior, and status scores for each county and problem was conducted (Monsen et al., 2006). Mixed-methods models were used for Aim 1, compare client characteristics across counties, and Aim 2, benchmark client knowledge, behavior, and status outcomes across counties. The mixed-methods model used the PROC MIXED and GLIMMIX

procedure in SAS® System version 9.2. Scores were reported as least squares means, which are equivalent to adjusted means. Within- and between-least squares means ratings were compared, and differences in ratings were reported across the groups using corresponding *p* values. For Aim 2, analysis was performed for knowledge, behavior, and status ratings overall, not for each problem separately. For Aim 3, benchmark client outcomes by problem, benchmark attainment was assessed using descriptive statistics to determine the percentage of clients with outcome scores of 4 or greater at discharge.

Results

For Aim 1, compare client characteristics across counties, all counties served mainly White (54.2–84.0%), non-Hispanic (64.7–100%) clients, with mean ages ranging from 21.8 to 25.2 years. After Caretaking/parenting, the most common problems in all counties were Pregnancy, Postpartum, Income, and Family planning. There were significant differences between counties in the client characteristics

TABLE 1. Sample Characteristics for All Parenting Clients (n = 1,701)

	County						n = 1,701	p value
	A (n = 859)	B (n = 145)	C (n = 40)	D (n = 270)	E (n = 346)	F (n = 41)		
Age, mean ± SEM	23.0 ± 0.2	24.3 ± 0.5	24.1 ± 0.9	25.2 ± 0.4	24.4 ± 0.3	21.8 ± 0.9	23.9 ± 0.1	<.001
Race								
White	73.8	62.1	54.2	84.9	77.8	85.4	75.4	<.001
Non-White	26.2	37.9	45.8	15.1	22.2	14.6	24.6	
Ethnicity								
Non-Hispanic	64.7	80.1	100.0	97.7	97.1	92.5	76.0	<.001
Hispanic	35.3	19.9	0.0	2.3	2.9	7.5	24.0	
Percent of clients having problems								
Abuse	11.6	0.0	10.0	69.3	18.2	0.0	20.8	<.001
Residence	7.2	2.1	5.0	77.8	49.1	14.6	26.6	<.001
Income	67.3	1.4	82.5	68.2	80.4	29.3	63.9	<.001
Pregnancy	40.8	22.8	47.5	22.2	30.6	26.8	34.0	<.001
Postpartum	44.8	49.7	70.0	83.3	58.7	24.4	54.3	<.001
Substance use	17.2	2.1	7.5	69.6	33.8	4.9	27.1	<.001
Mental health	32.6	9.0	27.5	89.6	46.0	19.5	41.9	<.001
Family planning	57.4	3.9	70.0	83.3	50.0	26.8	55.3	<.001
Number of comorbidities (mean ± SEM)	3.0 (0.1)	1.0 (0.1)	3.4 (0.3)	8.2 (0.1)	3.9 (0.1)	1.5 (0.3)	3.0 (0.1)	<.001
Days in episode of care (mean ± SEM)	346.1 (7.9)	54.7 (19.3)	193.3 (36.7)	241.2 (14.1)	306.8 (12.5)	394.3 (36.2)	346.1 (7.9)	<.001

and problems ($p < .001$; Table 1). An appendix table of baseline and final knowledge, behavior, and status scores for all problems by county is available online at omahasystemmn.org (Appendix S1).

For Aim 2, benchmark client knowledge, behavior, and status outcomes across counties, attainment for each of the three outcomes consistently showed improvement. Baseline knowledge was consistently lower at baseline and showed more improvement than baseline behavior and status scores. There were significant differences in benchmark attainment between counties, with the exception of two counties (A, F) showing no differences from the total sample for all outcomes (Table 2).

For Aim 3, benchmark client outcomes by problem, benchmark attainment by problem was consistent with previous benchmarking studies. Highest benchmark attainment was achieved for Pregnancy and Postpartum problems, and lower benchmark attainment was noted for Abuse,

Residence, Cognition, and Interpersonal relationship problems (Table 3).

Discussion

In this study of parenting home visiting clients, outcomes for knowledge, behavior, and status were benchmarked by problem and county. Patterns in the results were consistent with previous PHN benchmarking studies in several respects: Omaha System problems represented in the data; benchmark attainment for knowledge, behavior, and status outcomes; and benchmark attainment by problem (Monsen et al., 2010, 2011b). These consistent patterns across benchmarking studies suggest that there are similarities across counties in public health nurse home visiting clients, services, and outcomes and demonstrate benchmarking of Omaha System data as a useful metric for program evaluation in PHN family home visiting programs.

TABLE 2. Benchmark Attainment for Knowledge, Behavior, and Status Outcomes at Admission and Discharge, Change in Benchmark Attainment Versus All Other Counties, and Differences in Benchmark Attainment at Discharge Versus All Other Counties

	Benchmark attainment (percent of clients)			Comparison of benchmark attainment at discharge versus all other counties	p value
	Admission	Discharge	Improvement in benchmark attainment		
Knowledge					
Mean	23.2	63.4	40.2		
County A	11.4 ± 1.5	60.6 ± 1.5	49.1 ± 1.7	-3.5 ± 2.62	ns
County B	38.5 ± 3.8	62.6 ± 3.8	24.1 ± 4.1	-1.0 ± 4.27	ns
County C	23.0 ± 6.6	75.5 ± 6.6	52.5 ± 7.8	14.5 ± 6.84	.035
County D	26.5 ± 3.0	70.6 ± 3.0	44.1 ± 3.0	8.6 ± 3.84	.025
County E	21.3 ± 2.3	44.1 ± 2.3	22.8 ± 2.6	-23.2 ± 3.13	< .001
County F	18.5 ± 6.5	67.3 ± 6.5	48.8 ± 7.7	4.6 ± 6.75	ns
Behavior					
Mean	74.8	85.5	10.7		
County A	77.1 ± 1.4	86.5 ± 1.4	9.4 ± 1.2	1.2 ± 2.62	ns
County B	70.5 ± 3.4	77.4 ± 3.4	6.9 ± 3.0	-9.5 ± 4.27	.014
County C	61.8 ± 5.9	86.8 ± 5.9	25.0 ± 5.7	1.4 ± 6.84	ns
County D	89.0 ± 2.7	98.2 ± 2.7	9.3 ± 2.2	14.9 ± 3.84	< .001
County E	81.3 ± 2.0	85.1 ± 2.0	3.8 ± 1.9	-0.7 ± 3.13	ns
County F	69.5 ± 5.8	79.2 ± 5.8	9.8 ± 5.6	-7.2 ± 6.75	ns
Status					
Mean	77.2	81.1	11.1		
County A	78.1 ± 1.2	89.0 ± 1.2	10.9 ± 1.2	0.8 ± 2.11	ns
County B	69.1 ± 3.0	78.8 ± 3.0	9.7 ± 2.9	-11.5 ± 3.44	< .001
County C	62.5 ± 5.3	85.0 ± 5.3	22.5 ± 5.5	-3.8 ± 5.48	ns
County D	97.0 ± 2.4	100	4.1 ± 2.1	15.7 ± 3.12	< .001
County E	92.2 ± 1.8	94.8 ± 1.8	2.6 ± 1.9	7.6 ± 2.51	.002
County F	64.1 ± 5.2	81.1 ± 5.2	17.1 ± 5.5	-8.9 ± 5.41	ns

Note. ns=not significant.

TABLE 3. Overall Percent of Parenting Clients Attaining Benchmark of 4 for Knowledge, Behavior, and Status, by Problem

Problem	% Attaining benchmark		
	Knowledge	Behavior	Status
Postpartum	76.2	94.0	96.6
Pregnancy	66.5	84.2	84.4
Substance use	65.4	61.1	68.7
Caretaking/parenting	63.5	86.5	89.2
Communication with community resources	61.5	85.1	87.9
Family planning	60.0	60.1	61.5
Health care supervision	57.0	97.8	98.7
Mental health	53.7	71.0	79.6
Income	53.5	79.1	60.3
Nutrition	50.0	60.0	60.0
Abuse	43.7	64.0	78.9
Residence	39.0	65.7	69.6
Cognition	33.3	54.2	54.2
Interpersonal relationship	21.7	69.0	40.7

Of the 42 problems in the Omaha System, 9 problems were consistently represented across the three family home visiting benchmarking studies: Postpartum, Pregnancy, Caretaking/parenting, Substance use, Family planning, Mental health, Income, and Residence, and Abuse. Postpartum and Pregnancy problems had the highest outcomes across studies, while Substance use had much lower outcomes. Similarities in the frequencies and rank order of these problems across studies suggest that PHN assessments may be useful as a population health assessment metric (Monsen et al., 2010, 2011b). The Minnesota Department of Health Family Home Visiting program uses benchmark attainment for selected problems in state program evaluation reports (personal communication, Minnesota Department of Health, April 2, 2011).

The pattern of knowledge, behavior, and status benchmark attainment was consistent across the six counties. Knowledge scores were low at baseline and showed most improvement, while behavior and status scores were relatively high at baseline and showed relatively little improvement. The clinical focus of PHN family home visiting practice is the prevention of negative life course trajectories in high-risk parenting clients with newborn infants. The goal is to improve client knowledge, while maintaining high behavior and status scores. Upon admission to services, the high-risk parenting clients served by this program may have limited or minimal

knowledge but no demonstrated inappropriate parenting behavior or signs/symptoms such as abuse or neglect (Monsen, Radosevich, Kerr, & Fulkerson, 2011a; Olds, 2002). This scenario often translates to a knowledge score of 2 (minimal knowledge), a behavior score of 4 (usually appropriate), and a status score of 5 (no signs/symptoms). In such situations, despite PHN interventions, negative changes in parenting behavior sometimes occur, due to parental stress dealing with complex social situations and the demands of a growing infant or toddler. Caretaking/parenting behavior and status scores may then decrease, for example, to a behavior score of 3 or less (consistently appropriate to not appropriate) and a status score of 3 or less (moderate signs/symptoms to extreme signs/symptoms). Thus, for the parenting home visiting client population, knowledge scores are more likely to be lower on admission and show larger increases at discharge. Behavior and status scores are likely to be higher on admission, have less room for improvement (ceiling effect), and in some cases, may decrease. In all three studies, client knowledge scores were lower on admission and showed more improvement than client behavior and status scores (Monsen et al., 2010, 2011b).

Problem-specific outcome patterns were similar across studies. Most problem-specific outcomes showed significant improvement at discharge from services, with relatively high improvement for the Pregnancy and Postpartum problems, and relatively low improvement for the Substance use problem (Monsen et al., 2010, 2011b). In the present study, benchmark attainment was calculated for each county and problem. These results are available in Appendix S1 online, due to the large size of the results table. In the present study, benchmarks were attained on average similar to the comparison cohort in the previous mothers with the ID study. For example, the average benchmark attainment for Family planning problem status was 61.5% in the present study, compared with 40.0% for mothers with ID and 54.6% for the comparison cohort. The average benchmark attainment for Substance use status was 68.7% in the present study, compared with 37.5% for mothers with ID and 76.9% for the comparison cohort. Finally, the average benchmark attainment for Pregnancy status was 84.5% in the present study, compared with 84.6% of the mothers with ID, and 95.5% of the comparison cohort.

Retrospective observational studies are strengthened when the patterns observed in the results repeat over multiple studies, methods, populations, samples, locations, and programs, as seen in this study. Together, these three studies suggest that benchmarking Omaha System outcomes for the parenting high-risk population may be meaningful for outcomes comparison in practice settings. Such a comparison would provide a metric for population health assessment (baseline ratings) and program evaluation (outcomes of care). Table 3 summarizes the overall percent of parenting clients attaining benchmark of 4 for knowledge, behavior, and status, by problem, for the combined data set, providing a comparison metric for other family home visiting programs, and future development of expected program outcomes through further research. This metric is a first step toward the development of data-based performance goals for family home visiting programs. Having performance goals is a necessary first step for using benchmarking to enhance productivity, increase quality, and promote fiscal responsibility (Camp & Tweet, 1994; Chesney, 2008).

One of the goals of benchmarking is to assess whether or not there are differences in performance across counties (Camp & Tweet, 1994; Chesney, 2008). In the previous multicounty benchmarking study, it was not possible to statistically evaluate the differences between counties due to the aggregated data reporting method. This problem was addressed in the present study using raw data from each county, which enabled the evaluation of differences between counties. Furthermore, in the previous multicounty benchmarking study, multiple client populations were included in the aggregate data analysis. In the present study, this problem was addressed by including only those family home visiting clients who received services for the Care-taking/parenting problem. While county-specific details about programs are not known, the methods used in the present study accounted for county-level effects. The results of the present study verified that intercounty differences were highly significant. However, factors related to those differences remain unknown due to limitations of the data and methods, despite the use of standardized documentation. This problem has been identified in previous multiagency studies as a major challenge that will require ongoing attention from researchers (Monsen et al., 2009). In the future, benchmarking models

should be developed that incorporate the complexities of program differences. For example, a theory-based hierarchical linear model could be used to analyze the outcomes for client problems within clients, PHNs, and counties; accounting for program admission requirements, client demographics, and services (intensity and duration). One of the challenges of this research is that a single large data set typically does not contain all of the variables that are necessary to operationalize the many important concepts within such a model.

There are several threats to the validity of the data and interpretation of findings. Extensive data and practice quality initiatives have been implemented by the Omaha System practice community to reduce observer bias and improve interrater reliability (Monsen & Martin, 2002; Monsen et al., 2006). These quality practices are widely used and lend support to the credibility to the data. Home visiting programs may differ across counties. Additional information about program characteristics, admission criteria, and PHN characteristics would improve interpretation of the results. In addition, there are many possible factors that may influence benchmark attainment in addition to PHN home visiting services. Thus, alternative explanations for improvement must be considered from a theoretical perspective such as maturation (e.g., some clients would naturally improve over time, with or without intervention) and a statistical perspective such as regression to the mean (e.g., clients beginning with very low scores may be more likely to show improvement). Only prospective, randomized trials can control for these threats.

These results support the general assumptions that benchmarking in PHN could be used to enhance productivity, increase quality, set performance goals, promote fiscal responsibility, and ultimately, to improve the outcomes of clients and communities. Benchmarking may enable PHNs to provide evidence supporting essential interventions and their effectiveness. Such data may be useful for funders, clients, governmental health and human services departments, and other health care agencies.

Benchmarking of outcomes for PHN parenting clients showed consistent patterns in benchmark attainment and improvement across counties, despite significant differences in client characteristics and outcomes between counties. Thus, benchmarking of baseline and final Omaha System Problem

Rating Scale for Outcomes scores appears to be a robust method for comparison of the health of high-risk parenting client populations and home visiting program outcomes. The benchmarking metric has potential to strengthen PHN practice when used in a comprehensive evidence-based quality improvement context, in which data reliability and practice quality are equally supported. These findings set the stage for comparison with other programs and counties, and begin the development of national and international PHN benchmarks using the Omaha System.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Appendix S1. Knowledge, behavior, and status benchmark attainment by county and problem.

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