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Original research article

Empirical evaluation of the changes in public health nursing interventions after the implementation of an evidence-based family home visiting guideline

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EB-FHV, evidence-based family home visiting
EHR, electronic health record
HFA, Healthy Families America
IOM, Institute of Medicine
PCT, problem-category-target
PHN, public health nurse

ABSTRACT

The objective of this quality evaluation was to evaluate the changes in public health nursing (PHN) interventions after the implementation of an evidence-based family home visiting (EB-FHV) guideline encoded using the Omaha System.

Design and sample: This quality improvement evaluation was conducted using a secondary dataset of 27,910 PHN family home visiting interventions from visits to 129 adult clients enrolled in EB-FHV programs in a Midwestern PHN agency. The interventions were documented 12 months before and 14 months after EB-FHV Guideline implementation. The EB-FHV consisted of 94 PHN interventions for 10 Omaha System problems, with electronic health record (EHR) data generated by PHNs during routine clinical documentation. Standard descriptive and inferential statistics were employed in the analysis.

Measures: The Omaha System was used to compare PHN practice before and after the guideline implementation.

Results: Documentation patterns revealed that PHNs tailored interventions while also shifting toward the use of the EB-FHV guideline interventions. Ten EB-FHV problems accounted for 96.3% of interventions documented before and 98.5% of interventions documented after implementation. The proportion of interventions before and after EB-FHV by problem differed significantly for all problems except Substance use. Fewer interventions were provided after EB-FHV for the primary problems of Pregnancy and Postpartum, with a shift to more interventions for Caretaking/parenting.

Conclusion: The PHN documentation demonstrated an adherence to the EB-FHV guideline, while tailoring the evidence-based interventions differentially by problem. Further research is needed to extend this quality improvement approach to other guidelines and populations.

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Introduction

The global goal of achieving health equality across populations is a high priority in the United States and worldwide [1–11]. However, health disparities persist for low-income, single, and otherwise disadvantaged mothers of young children, despite decades of awareness and intervention [1–3]. Nearly half of childbearing families in the United States are at high risk of poor parenting outcomes due to social and behavioral determinants [2, 3, 8, 9]. In response to this crisis, global and national political, philanthropic, and professional organizations have long advanced a home visiting agenda to promote evidence-based home visiting interventions for high risk families [8, 9]. Due to resource limitations, these interventions reach only a fraction of the families that could benefit from them [9]. To extend the reach of evidence-based interventions, electronic health records (EHRs) have incorporated standardized evidence-based family home visiting (EB-FHV) guidelines [10–12]. However, it is not known whether changes in PHN practice occur due to the guideline in EHRs. The purpose of this study was to examine a large dataset for evidence of practice change following EB-FHV guideline implementation.

Background

At the forefront of evidence-based family home visiting practice, public health nurses (PHNs) in local and state public health agencies routinely provide home visits to high risk families [9, 10, 13–19]. While many evidence-based home visiting programs target low-income, high risk first-time single parents, the PHN workforce especially in governmental agencies must respond to identified local needs. In many cases, this means providing home visiting interventions to those high risk families that do not meet strict inclusion criteria for these home visiting programs, such as low income single women who are pregnant with their second child. To ensure high quality across all PHN home visits toward achieving improved population health for all, it is critical that PHNs understand and use evidence-based interventions. Such interventions have been described in an Evidence-based Family Home Visiting Guideline (EB-FHV) and have been incorporated within electronic health records using the Omaha System [10–12]. The Omaha System [12] and the EB-FHV [11] are described in the methods section below.

Public health nurses are required by nursing statutes and/or agency policies to document assessments and interventions either on paper or within electronic health records (EHRs), preferably using recognized standardized terminology such as the Omaha System [10, 11, 20, 21]. The increasing adoption of EHRs in PHN agencies has been shown to support PHN data and practice quality initiatives, including the use of evidence-based Guidelines within EHRs to guide care (clinical decision support), enable clinical documentation, and generate data for program evaluation [10, 13–15, 22, 23]. The use of evidence-based and problem-oriented templates in EHRs is associated with improved note quality without significant change in total documentation time. Such templates may provide clinical decision support during documentation [22, 23]. Consistent with the goals of the Learning Health System [24], data generated by PHNs in EHRs has potential for use in evaluation and research, including benchmarking PHN outcomes across agencies [13–16]. A qualitative study revealed the importance and value of EB-FHV in practice [10]. Public health nurse perceptions of using standardized care plans to translate evidence-based guidelines into family home visiting practice were examined through semi-structured interviews of PHNs transitioning from usual practice care plans to EB-FHV. Complex and dynamic processes of knowledge management were revealed: the EB-FHV supported and stimulated PHN thinking about evidence-based interventions and their application in practice. However, PHN cognitive processes while using the EB-FHV were also related to their own knowledge and expertise, responsive to their individual client needs, and grounded in knowledge of the population or program [10]. Thus, this body of research regarding the use of the EB-FHV for documentation supports the expected and desired outcome of EHR implementation in PHN agencies to improve practice quality and demonstrate rigor of information management for practice, program evaluation and research [10, 13–16]. However, data generated by use of EB-FHV has not been evaluated to examine PHN interventions in relationship to guideline implementation.

Our objective was to evaluate the changes in PHN practice after the implementation of the EB-FHV guideline [11] encoded using the Omaha System [12]. The specific aim was for those clients served during EB-FHV implementation, to describe and compare PHN interventions before and after EB-FHV implementation.

Materials and methods

The quality improvement evaluation was conducted by the scientific team of the Omaha System Partnership for Knowledge Discovery and Health Care Quality, through the University Center for Nursing Informatics. The data analysis was conducted as part of a program evaluation project within the local public health department using existing data. Results were shared with the evaluation team in aggregate with no identifying information. Permission for this study was obtained from the University Institutional Review Board.

Intervention

The local public health agency in the Midwestern United States from which this data was gathered offers five family home visiting programs: 1) Newborn Postpartum; 2) Bright Futures; Baby Steps; 3) Steps to Success; 4) Healthy Families America (HFA); and 5) Pregnancy and Parenting Connections.

Newborn Postpartum home visits occur after the birth of a new baby to any family who is interested, and

may involve from one to three visits. Bright Futures, Baby Steps, and Steps to Success are collaborations between social services and public health, where a family receives services from both a social worker and a public health nurse. Bright Futures is specifically for teen parents; Baby Steps is for first-time parents who meet defined risk criteria; and Steps to Success serves parents whose 2nd or third baby meets these risk criteria. The criteria defining high-risk are the presence of at least three risk primary risk factors, or two primary and one secondary risk factor as follows: primary = low income, low social support, less than high school (grade 12) education, or a history of childhood maltreatment. Secondary = a history of or current involvement in corrections, a history of or current diagnosis of mental illness, a history of or current substance abuse, or cognitive impairment. Families are enrolled in the teen program at any point during pregnancy or parenting, and are enrolled in either of the other programs up to when the youngest child turns 6 weeks old. Families may remain in the programs until the child is three years old or until the teen is 20 years old. The HFA model of home visiting is a stand-alone program that also provides a basis for the overall home visiting approach of all agency programs [25–27]. The Pregnancy and Parenting Connections program serves families who are not eligible for the aforementioned programs, but still have risks or concerns related to pregnancy or parenting. Program eligibility depends on screening results from a scored structured interview called the *Parent Survey*. If families are referred during pregnancy or prior to their youngest child turning 3 months old (with a parent survey score greater than 35), they are served for 3 years under the HFA model of home visiting [25–27]. Referred families with a youngest child older than 3 months, or who score less than 35 on the parent survey, are typically served for 6 months to one year; with visits ranging from weekly to monthly according to agency policy and family needs. PHNs documented using an EB-FHV guideline that was developed and refined over a period of six years by a group of clinical and content experts using the Omaha System [10–12]. The EB-FHV Guideline was adopted by EHR vendors and clinicians [28, 29]. Training for PHNs was provided, and then the guideline was implemented to guide and document care across the five PHN home visiting programs.

Design and sample

This descriptive comparative study utilized a convenience sample of de-identified Omaha System intervention data generated through routine PHN documentation during the course of their practice. The sample consisted of data for parenting clients who received evidence-based family home visiting services in the data collection period, 12 months before and 22 months after implementation of the EB-FHV. To control the complex variability inherent in client situations and PHN-client relationships, only those clients who received PHN interventions both before and after EB-FHV implementation were included.

Measures

The Omaha System [12] is a multidisciplinary interface terminology consisting of three components that are valid, reliable instruments: Problem Classification Scheme, Intervention Scheme, and Problem Rating Scale for Outcomes. The Problem Classification Scheme taxonomically arranges 42 discrete health care concepts within four domains (Environmental, Psychosocial, Physiological, and Health-related Behaviors). Each concept ("Problem") has a definition and a unique set of signs/symptoms. The Problem Classification Scheme enables a comprehensive, holistic client assessment (see definitions, Table 1) [12].

The Intervention Scheme describes healthcare interventions in a three-level hierarchy that specifies the action of the intervention, and two additional fields to further specify the intervention. The defined terms for actions (Category terms) are Teaching, guidance and counselling, Treatments and procedures, Case management, and Surveillance. There are 75 defined terms that further describe the intervention (Target terms) arranged alphabetically from anatomy/physiology to wellness. An additional undefined term (Care description) can be customized for a given patient, population, program, or practice. Each intervention addresses one Problem concept. One intervention consists of linked terms for the Problem-Category-Target-Care description; e.g. Pregnancy – Teaching, guidance, and counselling – medical/dental care – importance of regular prenatal care. The Intervention Scheme enables evidence-based standardized care planning and documentation of healthcare interventions (see definitions, Table 1) [12]. The three intervention levels of Problem, Category, and Target are independent and may be used in any combination. The linked Problem-Category-Target (PCT) combinations can be analyzed to count the number of unique combinations in a dataset.

The Problem Rating Scale for Outcomes measures three dimensions of each Problem concept: Knowledge, Behavior, and Status [12]. These three scales are Likert-type ordinal scales ranging from 1 (lowest) to 5 (highest). The Problem Rating Scale for Outcomes enables the evaluation of client change over time relative to signs/symptoms and interventions [12].

The first version of the Omaha System EB-FHV Guideline was developed in 2008, and revised and updated in 2010–2012 using a content expert approach [11]. The first phase was conducted by a team consisting of a PHN supervisor and four home visiting PHNs in the Pacific Northwest, and an Omaha System expert, followed by a multi-state expert panel of nurses and supervisors. Concepts of EB-FHV care from the literature, models of home visiting, and best practice were represented using the Omaha System. In the 2012 revision, content was revised to streamline documentation by reducing duplication and ensuring consistency in Omaha System term usage. The revised EB-FHV Guideline with references and accompanying metadata

Table 1 – Definitions of Omaha System Terms [12]

Problem term	Definition
Income	Money from wages, pensions, subsidies, interest, dividends, or other sources available for living and health care expenses.
Residence*	Living area.
Communication with community resources	Interaction between the individual/family/community and social service organizations, schools, and businesses in regard to services, information, and goods/supplies.
Social contact*	Interaction between the individual/family/community and others outside the immediate living area.
Role change*	Additions to or removal of a set of expected behavioral characteristics.
Interpersonal relationship	Associations or bonds between the individual/family/community and others.
Mental health	Development and use of mental/emotional abilities to adjust to life situations, interact with others, and engage in activities.
Sexuality*	Attitudes, feelings, and behaviours related to intimacy and sexual activity.
Caretaking/parenting	Providing support, nurturance, stimulation, and physical care for a dependent child or adult.
Neglect*	Child or adult deprived of minimally accepted standards of food, shelter, clothing, or care.
Abuse	Child or adult subjected to nonaccidental physical, emotional, or sexual violence or injury.
Growth and development*	Progressive physical, emotional, and social maturation along the age continuum from birth to death.
Pregnancy	Period from conception to childbirth.
Postpartum	Six-week period following childbirth.
Communicable/infectious condition*	State in which organisms invade/infect and produce superficial or systemic illness with the potential for spreading or transmission.
Nutrition*	Select, consume, and use food and fluids for energy, maintenance, growth, and health.
Substance use	Consumption of medicines, recreational drugs, or other materials likely to cause mood changes and/or psychological/physical dependence, illness, and disease.
Family planning	Practices designed to plan and space pregnancy within the context of values, attitudes, and beliefs.
Health care supervision	Management of the health care treatment plan by health care providers.
Medication regimen*	Use or application of over-the-counter and prescribed/recommended medications and infusions to meet guidelines for therapeutic action, safety, and schedule.
Category term	**Definition**
Teaching, guidance, and counselling	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.
Treatments and procedures*	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.
Case management	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 the use of appropriate resources.
Surveillance	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.
Target term	**Definition**
Anatomy/physiology	Structure and function of the human body.
Anger management	Activities that decrease or control negative feelings and interactions, including violence.
Bonding/attachment	A mutual, positive relationship between two people such as a parent/caregiver and an infant/child.
Caretaking/parenting skills	Activities such as feeding, bathing, discipline, nurturing, and stimulation provided to a dependent child or adult.
Communication	Exchange of verbal or nonverbal information between the individual/family/community and others.
Coping skills	Ability to effectively manage challenges and changes such as illness, disability, loss of income, birth of a child, or death of a family member.
Day care/respite	Individuals or organizations that provide child/adult supervision while the parent/usual caregiver attends school, works, or has relief from usual responsibilities.
Dietary management	Nourishment with balanced food and fluids that sustain life, provide energy, and promote growth and health.
Discipline	Nurturing practices that promote appropriate behavior, conduct, and self-control.
Education	Formal programs that offer general, technical, or individualized studies for students of all ages.

Table 1 (Continued)

Exercises	Therapeutic physical activities such as active/passive range of motion, isometrics, stretching, and weight lifting.
Family planning care	Activities that support consideration and use of methods to prepare for and space pregnancy.
Feeding procedures	Provision of food or fluids using methods such as breast, formula spoon, tube, and intravenous solutions.
Finances	Management of income and expenses.
Growth/development care	Activities that promote progressive maturation in relation to age such as measuring weight, height, and head circumference and stimulating the achievement of developmental milestones.
Interaction	Reciprocal action or influence among people including parent-child, parent-teacher, and nurse-client.
Legal system	Authority, rules of conduct, or administration of the law.
Medical/dental care	Assessment/diagnosis and treatment provided by physicians, dentists, and their staff or assistants.
Medication action/side effects	Positive and/or negative consequences of medications.
Nutritionist care	Assessment/diagnosis and treatment provided by nutritionists/registered dieticians and their staff and assistants.
Other community resources	Organizations or groups that offer goods or services not specifically identified in other targets such as exercise facilities, food pantries/distribution centers, or faith communities.
Rest/sleep	Periodic state of quiet and varying degrees of consciousness.
Safety	Freedom from risk, the occurrence of injury, or loss.
Screening procedures	Evaluation strategies used to identify risk for conditions, diagnose disease early, and monitor change/progression over time.
Sickness/injury care	Activities in response to illness or accidents such as first aid and temperature taking.
Sign/symptoms-mental/emotional	Objective or subjective evidence of mental/emotional health problems such as depression, confusion, or agitation.
Signs/symptoms physical	Objective or subjective evidence of physical health problems such as fever, sudden weight loss, or statement of pain.
Social work/counselling care	Assessment/diagnosis and treatment provided by social workers, counsellors, and their staff or assistants.
Stimulation/nurturance	Activities that promote healthy physical, intellectual, and emotional development.
Stress management	Cognitive, emotional, and physical activities that promote healthy functioning during difficult life circumstances.
Substance use cessation	Activities that promote discontinuing the use of harmful/addictive materials.
Support group	Organized sources of information and assistance such as focused classes and organizations, telephone reassurance, and reliable Internet sites that address a specific topic such as parenting, alcoholism, obesity, and Alzheimer's disease.
Support system	Circle of family, friends and associates that provide love, care, and assistance to promote health and manage illness.
Wellness	Practices that promote physical and mental health such as exercise, nutrition, and immunizations.

* Terms found in PHN data that were not in the EB-FHV guideline.

was approved by the Omaha System Guidelines board after peer review [11]. It consisted of 94 interventions for 10 of the 42 Omaha System problem concepts, and was freely available online [11]. The 10 EB-FHV problem concepts were: Abuse, Caretaking/parenting, Family planning, Health care supervision, Income, Interpersonal relationship, Mental health, Postpartum, Pregnancy, and Substance use. The EB-FHV was then embedded within EHR software used by PHNs for clinical documentation [11].

Analytic strategy

Demographic, outcome, and intervention data were exported from the EHR in Excel format. Standard inferential and descriptive analyses were conducted using SPSS v. 22 and Microsoft Excel 2010. Frequencies and percentages of documented interventions before and after guideline implementation by Omaha System problems, categories, and targets were compared to FHV data using chi-square, with significance tested using z scores [30], and patterns

visualized using heat maps created in Excel. Baseline and final Knowledge, Behavior, and Status outcome ratings were compared using a paired samples *t*-test.

Results

Characteristics of the sample

There were 129 adult clients in the practice data, aged 16–48, with an average age of 27.8 ± 6.4 years. The majority were female (90%) and white (64%) or African American (23%); with 30% of the total sample identifying as Hispanic ethnicity. Outcome evaluation revealed that overall there were positive, significant changes (all $p < 0.001$) from baseline in Knowledge (final Knowledge score = 3.62 ± 0.52 – basic to adequate knowledge), Behavior (final Behavior score = 4.20 ± 0.46 – usually appropriate behaviour), and Status (final Status score = 4.61 ± 0.33 – minimal to no signs/symptoms). There were 27,986 interventions in the dataset (11,684 before, 16,302 after EB-FHV implementation). The intervention data included a total of 157 PCTs before guideline implementation compared to 148 PCTs after guidelines implementation, and 94 PCTs in EB-FHV. Clients received as few as 1 and as many as 36 PCTs before and as few as 1 and as many as 49 PCTs after EB-FHV implementation.

Problems

The practice data included 20 Problem concepts before and 17 Problem concepts after EB-FHV implementation. The ten EB-FHV problems accounted for 96.3% of interventions documented before and 98.5% of interventions documented after implementation. The proportion of interventions before and after EB-FHV by problem differed significantly for all problems except Substance use. Fewer interventions were provided after EB-FHV for primary problems of Pregnancy and Postpartum, with a shift to more interventions for Caretaking/parenting. After EB-FHV implementation there were many more interventions for Mental health and Interpersonal relationship problems, and there was a notable decrease in interventions for Communication with community resources (Table 2).

Table 2 – Comparison of percentages of interventions by Problem in the Evidence-based Family Home Visiting Guideline and in Public Health Nurse Documentation data before and after guideline implementation

	% PHN Before EB-FHV Implementation	% PHN After EB-FHV Implementation	% EB-FHV
EB-FHV Problems	(*N* = 11,684)	(*N* = 16,302)	(*N* = 94)
Caretaking/parenting*	65.12	75.92	24.21
Pregnancy*	15.82	4.12	18.95
Abuse*	0.27	0.65	10.53
Mental health*	2.25	6.21	9.47
Interpersonal relationship*	0.02	0.19	8.42
Income*	0.03	0.23	6.32
Postpartum*	9.92	1.48	6.32
Family planning	1.87	1.58	5.26
Health care supervision*	0.86	7.98	5.26
Substance use	0.17	0.12	5.26
Non-EB-FHV Problems			
Communication with community resources*	2.42	0.86	0.00
Medication regimen*	0.39	0.12	0.00
Role change*	0.37	0.00	0.00
Growth and development*	0.33	0.01	0.00
Sexuality*	0.06	0.00	0.00
Residence*	0.03	0.15	0.00
Social contact*	0.03	0.15	0.00
Nutrition*	0.02	0.16	0.00
Neglect*	0.01	0.07	0.00
Communicable/infectious condition*	0.01	0.00	0.00

* Denotes significant change ($p < 0.05$).

Categories

The EB-FHV included 3 Category terms: Teaching, guidance and counselling, Case management, and Surveillance that comprised all but four interventions before and all interventions after EB-FHV implementation. The distribution of interventions by Category in the data differed before and after implementation and the EB-FHV, with PHN interventions after implementation having a higher proportion of Surveillance, and lower proportions of Teaching, guidance, and counselling and Case management (Table 3).

Table 3 – Comparison of percentages of interventions by Category in the Evidence-based Family Home Visiting Guideline and in Public Health Nurse Documentation data before and after guideline implementation

	% PHN Before EB-FHV Implementation	% PHN After EB-FHV Implementation	% EB-FHV
Category	(*N* = 11,684)	(*N* = 16,302)	(*N* = 94)
Teaching, guidance, and Counselling*	43.5	37.69	44.21
Surveillance*	48.13	57.66	33.68
Case Management*	8.34	4.65	22.11
Treatments and Procedures*	0.03	0.00	0.00

* Denotes significant change ($p < 0.05$).

Table 4 – Comparison of percentages of interventions by Target in the Evidence-based Family Home Visiting Guideline and in Public Health Nurse Documentation data before and after guideline implementation

	% PHN Before EB-FHV Implementation	% PHN After EB-FHV Implementation	% EB-FHV
Target	(*N* = 11,684)	(*N* = 16,302)	(*N* = 94)
wellness	5.13	4.86	7.37
medical/dental care	5.25	5.79	6.32
signs/symptoms-mental/emotional	0.55	1.04	6.32
coping skills*	5.50	8.42	5.26
safety	3.62	1.92	5.26
signs/symptoms-physical*	0.02	0.32	5.26
bonding/attachment*	5.17	12.46	4.21
social work/counselling care*	0.50	9.70	4.21
caretaking/parenting skills*	6.28	11.99	3.16
support group*	3.69	0.25	3.16
feeding procedures*	3.68	7.27	3.16
family planning care*	1.46	1.14	3.16
support system*	0.56	0.33	3.16
education*	0.15	0.07	3.16
medication action/side effects*	0.08	0.06	3.16
finances*	0.03	0.17	3.16
dietary management*	4.57	0.77	2.11
growth/development care*	4.05	8.14	2.11
day care/respite*	3.59	1.61	2.11
anatomy/physiology*	2.80	0.41	2.11
discipline*	1.98	4.07	2.11
interaction*	0.50	0.20	2.11
anger management*	0.33	0.01	2.11
stress management	0.16	0.08	2.11
stimulation/nurturance*	0.04	0.02	2.11
other community resources*	0.03	0.00	2.11
substance use cessation*	0.00	0.75	2.11
sickness/injury care*	9.86	9.67	1.05
screening procedures*	3.41	3.77	1.05
rest/sleep*	1.88	1.34	1.05
communication*	0.29	0.47	1.05
exercises*	0.28	0.10	1.05
nutritionist care	0.00	0.03	1.05
legal system	0.00	0.01	1.05
behaviour modification*	0.05	0.00	0.00
continuity of care*	0.01	0.25	0.00
durable medical equipment*	0.39	0.00	0.00
employment*	0.03	0.00	0.00
environment*	0.14	0.03	0.00
home	0.03	0.07	0.00
infection precautions*	0.37	0.02	0.00
medication administration	1.16	0.58	0.00
nursing care	0.01	0.00	0.00
other*	1.84	1.04	0.00
personal hygiene*	0.42	0.01	0.00
positioning*	2.14	0.12	0.00
transportation	0.09	0.17	0.00
unspecified*	17.89	0.50	0.00

* Denotes significant change ($p < 0.05$).

Targets

The practice data included 44 Targets before Guideline implementation and 42 Targets after Guideline implementation with a total of 47 Targets in the entire sample. The 34 Target concepts in EB-FHV accounted for 75.4% of interventions documented before and 97.2% of interventions documented after implementation. The frequency of interventions by target in the data differed before and after implementation and in the EB-FHV. There was a significant increase in bonding/attachment, caretaking/parenting skills, social work/counselling care, sickness/injury care, coping skills, growth/development care, feeding procedures, discipline, and screening procedures. Prior to EB-FHV implementation, nearly 18% of interventions had a target that was "unspecified", compared to after guidelines implementation in which less than 1% were "unspecified" ($p < 0.001$) (Table 4). Heat maps show differences in intervention delivery compared to the percentages of EB-FHV interventions by problem, category, and target (Tables 2–4).

Discussion

This study examined a large dataset of PHN home visiting interventions before and after EB-FHV guideline implementation; and relative to the interventions in the EB-FHV. Findings revealed that patterns in documented interventions differed before and after EB-FHV guideline implementation, reflecting a shift toward the interventions within the guideline. In addition, the PHN documentation patterns differed in frequency ranking from the EB-FHV guideline. The Omaha System as an accepted standardized health care terminology is useful in describing nursing care and client outcomes, and should be evaluated for use across problems, practices, and populations. Further research is needed to examine guideline interventions vs. practice documentation for other practices, populations, and guidelines nationally and internationally.

Decreases in variability seen across PCT, Problem, Category, and Target terms after EB-FHV implementation suggest that having a standardized care plan that aligns with evidence and provides structured choices may improve data quality, aligning with findings from a previous qualitative study of PHN perceptions of using EB-FHV guidelines [10]. This quality improvement evaluation is the first to examine data generated from use of an Omaha System Guideline and exemplifies the concept of a Learning Health System [24]. Data from the use of this Guideline are now available for research on EB-FHV practice that can transform the landscape of EB-FHV research, filling a gap in intervention data not available in other EB-FHV datasets.

The findings show that overall client Knowledge, Behavior, and Status improved after receiving PHN home visits, and the PHNs providing home visits documented a high proportion of Caretaking/parenting interventions. This aligns with both the purpose of the EB-FHV program and the needs of high risk families in learning to care for their children [25–27]. The high proportion of Surveillance interventions aligns with the notion that PHNs are vigilant in monitoring the health and safety of their clients, and they have implemented programmatic surveillance requirements of the parent/child interaction at each visit [25–27]. The high proportion of bonding/attachment, caretaking/parenting skills, social work/counselling care, sickness/injury care, and coping skills aligns with the EB-FHV holistic, therapeutic approach [25–27]. These findings are similar to previous home visiting research using large PHN datasets [13–18].

The finding that PHN documentation changed after EB-FHV guideline implementation in ways that reflected the EB-FHV guideline for a group of clients receiving interventions before and after guideline implementation confirms the notion that the guideline embedded within the EHR for documentation influences intervention documentation patterns [10, 22–24]. This is seen in the increased documentation of interventions for the terms found within the EB-FHV such as the Health care supervision, Mental health, and Interpersonal relationship problems, and the large reduction of "unspecified" targets. Thus the empirical evaluation supports use of evidence-based family home visiting interventions as described in the EB-FHV guideline and offers assurance of quality PHN care across all PHN home visiting programs.

To minimize the variation due to unique client situations and PHN-client interaction, only data for clients who received interventions before and after the EB-FHV guideline implementation were included in the study. This increased confidence that changes were due to the use of the EB-FHV guideline vs variability introduced by unique client situations. However, this strategy did not account for intervention change over time due to maturation in which there would be expected decreases in Pregnancy and Postpartum, and increases in Caretaking/parenting [31]. Indeed, this shift did occur in the practice data. Further research is needed to examine how maturation may or may not influence intervention patterns by replicating this study with larger datasets; examining documentation patterns of similar populations served with and without the EB-FHV guideline.

The findings that interventions documented differed in frequency from interventions by problem in the EB-FHV showed the expected best practice of intervention tailoring to meet unique patient needs [10, 17, 18]. While it is critical to provide a guideline that supports evidence-based practice, it is also imperative to ensure that the unique client situations, values, and preferences are respected as care is provided; especially in complex social interventions such as FHV practice [9]. In addition, changes in documentation practice may be explained by PHN adherence to policy regarding required assessments [19]. The EB-FHV Guideline exists to support best practice across typical problems. As may be expected for family home visiting clients, PHNs documented the greatest frequency of Caretaking/parenting interventions. As described in the home visiting literature [8–10,13–18, 25–27], it is expected that PHNs have expert knowledge of evidence-based practice, and will first meet the immediate client needs of each individual before performing expected home visiting tasks, including standardized assessment

protocols and providing anticipatory guidance for a child's next developmental stage. It is also expected that the EB-FHV Guideline provides a menu of intervention choices that may be selected by a PHN if applicable to a particular client. Few if any clients would be expected to need an intervention for all of the problems within the EB-FHV Guideline. Thus the distribution of interventions as a whole supports the validity of the dataset and demonstrates that PHNs tailor interventions to meet the unique needs of families.

Intervention tailoring is further supported by the finding that PHNs document additional interventions as needed. The use of over 90% of intervention in the EB-FHV Guideline validates that content of the EB-FHV Guideline and demonstrates that Guidelines may influence PHN documentation, aligning with previous research [10]. Thus, the development of EB-FHV Guidelines is essential because the EB-FHV provides a menu of structured items that will enable PHNs to document services consistently. This is particularly critical due to the many ways language can be used to express health care concepts [10–12]. Data from PHN documentation will enable evaluation of quality care and adherence to guidelines. However, given that PHNs are expected to tailor interventions to meet unique client needs, it is critical to allow for and expect tailored documentation. Thus it is expected that PHNs will use additional interventions as needed for unique client problems.

Data interoperability across PHN EB-FHV programs may be widely enabled through the use of standardized EB-FHV Guidelines [12, 24]. Furthermore, the use of the Omaha System for evidence-based family home visiting program documentation may enable research that will improve understanding of PHN fidelity to an EB-FHV model such as HFA [12, 25, 26]. Such a fidelity measure may increase the confidence of program administrators and decision makers, and provide support for continued and expanded program funding. Evaluation of client outcomes relative to EB-FHV intervention patterns may inform future recommendations for revision of the EB-FHV, closing the practice-data-research-evaluation quality-cycle [24]. Furthermore, the quality of big data research in EB-FVH will be improved by use of datasets based on the same guideline. However, it is essential to support PHN workflow by providing the minimum menu of interventions possible to achieve the goal of accurately and efficiently representing EB-FHV practice [10]. The tension between extensiveness of the EB-FHV guideline, PHN documentation time constraints, and sufficient documentation for practice and evaluation is an ongoing concern that must be addressed in order to maximize PHN efficiency and effectiveness.

As with all observational data, many alternative explanations for the findings exist, due to perceptions of PHNs, agency policies, and the complexity of PHN clients and practices. The analysis should be replicated with other large data sets comparing the use of the EB-FHV Guideline for documentation of FHV care across populations and settings. Data quality issues in observational EHR data sets should be addressed by training, software engineering, and ongoing administrative support. The use of EB-FHV guidelines and other standardized evidence-based guidelines is an effective strategy to promote the quality of practice and EHR documentation.

Conclusion

This quality improvement project examined a large dataset of PHN interventions for evidence of practice change following EB-FHV guideline implementation. Findings demonstrated PHN adherence to the EB-FHV guideline, while tailoring of evidence-based interventions differentially by problem. Further research is needed to extend this quality improvement approach to other guidelines and populations.

Conflict of interest

The authors declare that there is no conflict of interest related to the manuscript entitled: "Empirical evaluation of change in public health nursing interventions after implementation of an evidence-based family home visiting guideline".

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