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Article type : Original Article

Section heading:

Original Article

Running heading:

Testing the ILS in Nursing

Title:

EBP Implementation Leadership of Frontline Nurse Managers: Validation of the Implementation Leadership Scale in Acute Care

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Accepted 20 July 2019

Keywords
nursing leadership, implementation, evidence-based practice, psychometrics, acute care

Heading level 1:

Abstract

Background: Frontline nurse managers influence the implementation of evidence-based practices (EBP); however, there is a need for valid and reliable instruments to measure their leadership behaviors for EBP implementation in acute care settings.

Aim: The aim of this study is to evaluate the validity and reliability of the Implementation Leadership Scale (ILS) in acute care settings using two unique nurse samples.

Methods: This study is a secondary analysis of ILS data obtained through two distinct multisite cross-sectional studies. Sample 1 included 200 registered nurses from one large Californian health system. Sample 2 was 284 registered nurses from seven Midwest and Northeast U.S. hospitals. Two separate studies by different research teams collected responses using written and electronic questionnaires. We analyzed each sample independently. Descriptive statistics described individual item, total, and subscale scores. We analyzed validity using confirmatory factor analysis and within unit agreement (awg). We evaluated factorial invariance using multigroup confirmatory factor analyses and evaluating change in chi-square and comparative fit index values. We evaluated reliability using Cronbach's alpha.

Results: Confirmatory factor analyses in both samples provided strong support for first- and second-order factor structure of the ILS. The factor structure did not differ between the two samples. Across both samples, internal consistency reliability was strong (Cronbach's alpha: .91–.98), as was within-unit agreement (awg: .70–.80).

Linking Evidence to Action: Frontline manager implementation leadership is a critical contextual factor influencing EBP implementation. This study provides strong evidence supporting the validity and reliability of the ILS to measure implementation leadership behaviors of nursing frontline managers in acute care. The ILS can help clinicians, researchers, and leaders in nursing contexts assess frontline manager implementation leadership, deliver interventions to target areas needing improvement, and improve implementation of EBP.

Heading level 1:

Background

Evidence-based practice (EBP) has received widespread attention over the last few decades and is a national priority for improving quality of care and population health (Agency for Healthcare Research and Quality, 2015; Institute of Medicine, 2001). Numerous EBP resources are

available to clinicians and healthcare organizations, including EBP guidelines and recommendations, systematic reviews, evidence-summary reports, and EBP education programs (e.g., workshops, inservices, webinars, certificate programs). Despite the availability of these resources, there remains a substantial gap between what is known (evidence) and what is done at the point of care delivery (Titler, 2018; BLINDED).

Implementation science addresses the evidence-to-practice gap by investigating the "processes and factors that are associated with successful integration of evidence-based interventions within a particular setting" (Rabin & Brownson, 2018, p. 26) and testing strategies targeting these processes and factors. The effect of contextual factors on implementation processes and outcomes is important and may help to explain variation in the effectiveness of implementation strategies across care settings (May, Johnson, & Finch, 2016).

Frontline unit leadership is an important contextual factor that has emerged in implementation science. Although job title varies across healthcare institutions (e.g., nurse manager, unit director), frontline nurse managers are leaders who supervise clinical staff and are responsible for the quality of care and outcomes achieved on their units. They are responsible for staffing, overseeing budgets, supporting educational opportunities, hiring and firing staff, and establishing positive work environments (American Organization for Nursing Leadership & American Organization of Nurse Executives, 2015). In light of these responsibilities, they are well-situated to promote implementation and sustainability of EBP.

Previous studies demonstrate critical attributes and behaviors of leaders that influence EBP implementation (Aarons, Ehrhart, Farahnak, & Sklar, 2014; Birken et al., 2018; Gifford et al., 2018). For example, BLINDED suggest that frontline leaders play a key role in creating practice climates that foster and promote EBP implementation. Additionally, frontline managers are pivotal in planning for implementation efforts. In a study of 102 Veterans Health Administration facilities, Robinson and colleagues (2010) found that including frontline managers in implementation planning improved implementation of a team training program for operating room clinical staff. During

implementation, leadership behaviors of support, encouragement, and engagement have been associated with higher fidelity to implementation strategies (Augustsson, von Thiele Schwarz, Stenfors-Hayes, & Hasson, 2015). Other leadership behaviors of frontline managers that influence EBP implementation include ongoing monitoring and feedback to staff regarding EBP use, role modeling, relationship building, supporting implementation efforts, and providing resources (e.g., EBP workshops; Gifford et al., 2018; Reichenpfader, Carlfjord, & Nilsen, 2015; Sandström, Borglin, Nilsson, & Willman, 2011; BLINDED). Despite recent findings regarding the importance of frontline managers to EBP implementation, common measures of frontline implementation leadership are not used across studies. This hinders our understanding of the mechanisms by which frontline leaders influence implementation processes and outcomes. Studies are needed to demonstrate the validity and reliability of pragmatic measures of leadership behaviors specific to EBP implementation (Gifford et al., 2018; Lewis et al., 2015).

To more fully comprehend and evaluate the role of frontline managers in EBP implementation, Aarons, Ehrhart, and Farahnak (2014) developed the Implementation Leadership Scale (ILS). The scale is informed by relevant implementation and organizational research literature, as well as the Exploration, Preparation, Implementation, Sustainment framework (Aarons, Hurlburt, & Horwitz, 2011). The scale focuses on specific leadership behaviors enacted by frontline managers to influence implementation, including: (a) proactive leadership; (b) knowledgeable leadership; (c) supportive leadership; and (d) perseverant leadership. The ILS, originally developed and tested in mental health settings, has been cross-validated in substance-use facilities (Aarons, Ehrhart, Torres, Finn, & Roesch, 2016), child welfare service organizations (Finn, Torres, Ehrhart, Roesch, & Aarons, 2016), and education sectors (Lyon et al., 2018). However, it has yet to be validated for use in nursing contexts.

The purpose of this study is to evaluate the psychometric properties of the ILS when used in acute care settings and completed by registered nurses providing direct patient care. Using data from two independent samples, this study evaluates the first- and second-order factor structure in each study independently. We then compare the factor

structure across the two studies. We hypothesized that the ILS would demonstrate strong first- and second-order factor structure and high reliability in both samples, and factor structure would not significantly differ between the two samples. In addition, we hypothesized that the ILS would have good to excellent support for agreement aggregated to the unit level, consistent with the conceptualization of implementation leadership as a unit-level construct (Aarons, Ehrhart, & Farahnak, 2014).

Heading level 1:

Methods

Heading level 2:

Design

This is a secondary analysis of ILS data from two multisite cross-sectional studies–the first conducted in Southern California in 2016 and the second conducted in the Midwest and Northeast U.S. in 2016 (BLINDED; BLINDED; BLINDED).

Heading level 2:

Samples

Heading level 3:

Sample 1: Southern California nurses. Study 1 recruited a convenience sample of nurses from a large community hospital system in Southern California. The hospital system consisted of several acute care and specialty hospital sites. After gaining permission from system- and hospital-level leadership at four sites, we distributed invitations to participate to registered nurses via email and in-person recruitment presentations provided during monthly unit meetings. All nurses providing direct care in one of 78 units from the four hospitals were eligible for participation.

Heading level 3:

Sample 2: Midwest and Northeast U.S. nurses. Study 2 was conducted in 24 adult medical-surgical units nested within seven acute care community hospitals in Iowa, Minnesota, New Hampshire, and Vermont. We randomly selected 30 eligible nurses from each study unit to receive electronic questionnaires. For units with fewer than 30 eligible nurses, we invited all eligible nurses. Nurses met the following inclusion criteria: worked a minimum of .40 FTE; designated as staff on a study unit (e.g., not float pool or agency); and provided direct patient care. We invited a total of 553 nurses to participate via email.

Measure

For both samples, we administered the 12-item ILS. The ILS consists of four dimensions, each consisting of three items. The four dimensions are: proactive leadership, knowledgeable leadership, supportive leadership, and perseverant leadership. Proactive leadership involves developing a plan to implement EBP, addressing barriers to implementation, and establishing clear unit standards for implementation. Knowledgeable leadership relates to the manager's competency in EBP. Supportive leadership includes recognizing staff who use EBP and supporting staff education in EBP. Finally, perseverant leadership involves the manager's ability to navigate implementation challenges and address implementation problems. Participants scored their frontline manager's EBP implementation leadership behaviors on each item. Response anchors ranged from 0 (not at all) to 4 (to a very great extent). Subscale scores are determined by calculating the mean of responses to items loading on each subscale. The mean of the subscales is computed to create the total mean score.

Heading level 2:

Procedures

Heading level 3:

Sample 1: Southern California nurses. The research team made initial contact with the research leadership at the Southern California hospital system to describe the study's purpose and establish buy-in.

Upon approval to move forward, members of the research team met with a group of nurse managers and educators at the hospital system to review the items for appropriateness in the nursing setting. No changes were made beyond minor wording adjustments for the nursing context (e.g., use of the term "nurse" instead of "employee"). After receiving Institutional Review Board (IRB) approval from the university and the participating hospital system, we recruited participants through general email announcements of the study and through in-person recruitment at unit meetings. For the in-person recruitment, participants could complete hard copies of the survey or an online version through a provided survey link. For paper-and-pencil surveys, a member of the research team left a batch of blank surveys during a regularly occurring team meeting, which could then be mailed in preaddressed envelopes or left at the hospital for a member of the research team to collect. Overall, 129 responded to the online version of the survey and 71 responded to the paper-and-pencil version. No significant differences were found in the measures based on the method of survey completion. Participants received a $5 gift certificate to a retail coffee shop for their participation.

Heading level 3:

Sample 2: Midwest and Northeast U.S. nurses. Prior to this study, the ILS was reviewed by a group of four EBP experts and two nursing scientists. It was subsequently pilot tested with four nurse managers and 26 nurses at two Iowa hospitals (not participating in the current study) to establish content validity and evaluate appropriateness, usability, and relevance to nursing. No changes were made to the ILS except for changing "supervisor" to "nurse manager" to reflect the nursing context. Next, executive nursing leadership (e.g., chief nursing officers) and other nursing leaders (e.g., nursing education directors) from each hospital participated in 1-hr conference calls with investigators to discuss the study, establish buy-in, and identify site coordinators to assist in recruitment and data collection. We trained site coordinators to study procedures using a detailed study manual and 90-min teleconference training meetings (see BLINDED). After receiving IRB approval from the university and all study hospitals, up to 30 randomly selected nurses from each study unit received an email invitation to

participate, with a link to a web-based questionnaire inclusive of the ILS. We asked participants to respond within 1 month. Weekly email reminders and a lottery drawing incentive for a $100 cash gift card encouraged response.

Heading level 2:

Statistical Analysis

Descriptive statistics (mean and standard deviation) summarized item, subscale, and total scale scores for each sample. We assessed internal consistency reliability using Cronbach's alpha. To evaluate within unit agreement of the measures, we calculated awg values. Values for awg range from -1.00 to 1.00, with values ? .60 considered acceptable agreement for aggregating to the unit level (Brown & Hauenstein, 2005). Pearson product moment correlations between factors for each sample were computed to evaluate the higher order implementation leadership factor. We conducted confirmatory factor analysis utilizing Mplus[CM2] statistical software (Muthén & Muthén, 1998–2016). The estimation method was maximum likelihood estimation with robust standard errors, which appropriately adjusts standard errors and chi-square values accounted for the nested data structure (multiple nurses within nursing units). We accounted for missing data through full information maximum likelihood estimation. We assessed model fit using the comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). CFI values greater than 0.95, RMSEA values less than 0.06, and SRMR values less than 0.08 indicate model fit that is deemed acceptable (Hu & Bentler, 1999). In order to test for factorial invariance (Dimitrov, 2010) between the two samples (i.e., are the results similar between the two samples), we used multiple group modeling in Mplus to assess the invariance in the first- and second-order factors between the two samples. Chi-square difference tests using the scaling correction factor assessed if the model fit significantly changed when the first- and second-order factors were constrained to be equal. Additionally, we also assessed the change in the CFI as an additional step to assess model fit across the invariant and constrained models

(Cheung & Rensvold, 2002). Additional details for this analysis are provided in Table 1.

Insert Table 1 about here.

Heading level 1:

Results

Heading level 2:

Participant Characteristics

Sample characteristics are provided in Table 2. Sample 1 included 200 nurses employed in 78 units in four hospitals from a regional hospital system located in Southern California. Sample 1 had an average age of 37.99 years (SD = 11.0) and average experience as a nurse of 11.15 years (SD = 10.17). The majority of Sample 1 participants reported at least a bachelor's degree or higher in nursing (56.4%). Sample 2 included 284 nurses from 24 units in seven hospitals. The sample had an average age of 34.9 (SD = 11.94) and an average experience working as a registered nurse of 7.84 (SD = 9.88). Most participants had a baccalaureate degree (59.2%). Additional characteristics of Sample 2 are published elsewhere (BLINDED).

Insert Table 2 about here.

Heading level 2:

Psychometric Findings

Table 3 provides the ILS item means, standard deviations, reliabilities, and aggregation statistics for each sample. Across both samples, the Cronbach's alpha scores for all dimensions and overall scale ranged from .91–.98, demonstrating excellent internal consistency reliability. Based on units with at least two respondents (Sample 1, *n* = 40 units; Sample 2, *n* = 24 units), results of the awg ranged from .70 to

.80, indicating support for within unit agreement and aggregation of participant responses to the unit level.

Insert Table 3 about here.

Confirmatory factor analysis results in both samples provided strong support for the ILS. In Sample 1, strong model fit statistics were found for the second-order factor structure of the ILS ($\chi2(50) = 87.06$, $p < .001$; CFI = 0.978, RMSEA = 0.061, 90% C.I. [.039, .082], probability RMSEA $\leq$ .05 = .192; SRMR = 0.030). Similarly, the model fit statistics of Sample 2 supported the strong factor structure ($\chi2(50) = 86.583$, $p < .001$; CFI = 0.986, RMSEA = 0.051, 90% C.I. [.032, .068], probability RMSEA $\leq$ .05 = .454; SRMR = 0.022). Thus, across both nursing samples there was overall support for the ILS factor structure. As shown in Table 4, the standardized factor loadings for both samples are $\geq$ .83 and all are statistically significant ($p < .001$). Factor models for both samples are depicted in Figures 1 and 2. We found significant correlations ($p < .05$) among the four factors in both samples supporting a higher order implementation leadership factor (Table 5).

Insert Tables 4 and 5 about here.

Table 1 provides the results testing for factorial invariance for the first- and second-order factors between the two samples. The results in Table 1 show evidence of invariance with respect to both the first- and second-order factor loadings between the two samples: the Chi-square change statistic ($\Delta \chi2$) is not statistically significant, and no change in the CFI was found across the models, indicating that the factor structure is similar across both samples. It should be noted here that the baseline model did have to constrain (to be invariant across the two groups) three of the four first-order factor loadings to estimate the baseline model without invariance (this was due to the high correlation between items and factors in Sample 2; see Table 5). Despite this limitation in the analytic approach, the results do suggest high similarity in the first- and second-order factor loading between both samples.

Heading level 1:

Discussion

Frontline nurse leadership is an important context factor influencing EBP implementation; however, few validated measures are available. Our study used data from two unique studies to validate the ILS in acute care nursing units. Both samples provide strong support for the factor structure of the ILS, and factor loadings are similar across samples. In addition, our results support aggregation of responses to the unit level, consistent with the conceptualization of implementation leadership as a unit level construct (Aarons et al., 2014). However, it should be noted that Sample 2 aggregation values are not as strong as Sample 1. Future studies are needed to determine the factors that contribute to within-group agreement within units. Overall, the strength of these findings is noteworthy given that data were collected independently, by two different investigative teams, in very different geographic areas of the U.S., and with broadly different nurse demographics. Our results contribute to the strong record of the scale's validity and reliability in other contexts (Aarons et al., 2014; Aarons et al., 2016; Finn et al., 2016; Lyon et al., 2018; Torres et al., 2018).

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As a brief, pragmatic instrument of EBP implementation leadership, the ILS is well-suited for inclusion in implementation studies involving nurses in acute care. This validation of the ILS allows for additional testing of the effect of frontline nurse manager leadership behaviors on implementation processes and outcomes. The four ILS domains (proactivity, knowledge, support, and perseverance) can guide intervention work by highlighting areas for improvement in frontline leaders' EBP implementation leadership behaviors and testing interventions targeted to these areas. For example, the Leadership and Organizational Change for Implementation program uses the ILS to help improve general and EBP implementation-focused leadership of frontline managers and EBP implementation climates in substance use treatment facilities (Aarons, Ehrhart, Moullin, Torres, & Green, 2017).

Our study has some limitations worth noting. First, Sample 2 included adult medical-surgical units only, and although Sample 1 included all units at one health system, our sample may not include all

types of nursing units, thus affecting generalizability. Aggregation statistics in Sample 2 are acceptable but not as strong as in Sample 1. Future studies are needed to explore intraunit alignment and its effect on EBP implementation. Finally, this study did not address the relationship of the ILS with other implementation-related variables. Future studies should address the interplay with other measures of implementation context and implementation outcomes. Despite these limitations, our study, inclusive of two unique samples, provides strong evidence supporting the validity and reliability of the ILS in acute care nursing settings.

Heading level 1:

Implications for Research and Practice

Frontline nurse managers influence the implementation and use of EBPs to improve care delivery and outcomes. The ILS is a valid and reliable instrument that can be used in future research to investigate frontline nurse managers' leadership behaviors for EBP implementation in acute care. In addition to using the scale to address research questions important to implementation science, the ILS is a pragmatic tool that frontline nurse managers can use for self-assessment, as well as for obtaining their staff perceptions regarding their leadership behaviors for EBP implementation. Identifying areas for improvement can guide nurse leaders in selection of programs or interventions to address problem areas and improve their implementation leadership. Improving their implementation leadership will contribute to more successful EBP implementation efforts on their units, ultimately leading to improved care and outcomes.

Heading level 1:

Conclusions

This study provides support for the use of the ILS in acute care using nursing samples. Numerous studies have supported the role of leadership in EBP implementation. Frontline leadership behaviors of proactivity, knowledge, support, and perseverance are critically relevant

to nursing. Investigating and improving implementation leadership using the ILS can help nurse clinicians, researchers, and leaders improve implementation processes to improve delivery of evidence-based care and patient outcomes.

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And add the three-links symbol before the title

Heading level 1:

Linking Evidence to Action

- Frontline manager implementation leadership is a critical contextual factor influencing implementation but is often ignored. There is a critical need for more research on the influence of frontline nurse managers in acute care.
- Few tools are available to measure the implementation leadership behaviors of frontline nurse managers. The ILS is a valid and reliable instrument that can be used in future research to investigate frontline nurse managers' leadership behaviors for EBP implementation in acute care.
- The ILS is a pragmatic tool that frontline nurse managers can use for self-assessment, as well as for obtaining their staff perceptions regarding their leadership behaviors for EBP implementation.
- Interventions to improve implementation leadership behaviors for frontline nurse managers are needed. The ILS can be used to identify areas needing improvement and inform intervention development and delivery targeting these areas.

Heading level 2:

References

Aarons, G. A., Ehrhart, M. G., & Farahnak, L. R. (2014). The Implementation Leadership Scale (ILS): Development of a brief measure of unit level implementation leadership. *Implementation Science*, *9*, Article 45.

Commented [TL2]: Au: Please provide a doi or linking URL for this article.

Aarons, G. A., Ehrhart, M. G., Farahnak, L. R., & Sklar, M. (2014). Aligning leadership across systems and organizations to develop a strategic climate for evidence-based practice implementation. *Annual Review of Public Health, 35,* 255–274.

Aarons, G. A., Ehrhart, M. G., Moullin, J. C., Torres, E. M., & Green, A. E. (2017). Testing the leadership and organizational change for implementation (LOCI) intervention in substance abuse treatment: A cluster randomized trial study protocol. *Implementation Science, 12,* Article 29.

Aarons, G. A., Ehrhart, M. G., Torres, E. M., Finn, N. K., & Roesch, S. C. (2016). Validation of the Implementation Leadership Scale (ILS) in substance use disorder treatment organizations. *Journal of Substance Abuse Treatment, 68,* 31–35.

Aarons, G. A., Hurlburt, M., & Horwitz, S. M. (2011). Advancing a conceptual model of evidence-based practice implementation in public service sectors. *Administration and Policy in Mental Health and Mental Health Services Research, 38*(1), 4–23.

Agency for Healthcare Research and Quality. (2015). *2014 national healthcare quality and disparities report.* Retrieved from https://www.ahrq.gov/research/findings/nhqrdr/nhqdr14/index.html

American Organization for Nursing Leadership & American Organization of Nurse Executives. (2015). *AONL nurse manager competencies.* Chicago, IL: AONL, AONE. Retrieved from https://www.aonl.org/system/files/media/file/2019/06/nurse-manager-competencies.pdf

Augustsson, H., Von Thiele Schwarz, U., Stenfors-Hayes, T., & Hasson, H. (2015). Investigating variations in implementation fidelity of an organizational-level occupational health intervention. *International Journal of Behavioral Medicine, 22*(3), 345–355.

Birken, S., Clary, A., Tabriz, A. A., Turner, K., Meza, R., Zizzi, A., . . . Charns, M. (2018). Middle managers' role in implementing evidence-based practices in healthcare: A systematic review. *Implementation Science, 13,* Article 149.

Brown, R. D., & Hauenstein, N. M. (2005). Interrater agreement reconsidered: An alternative to the rwg indices. *Organizational Research Methods, 8*(2), 165–184.

Commented [TL3]: Au: Please provide a doi or linking URL.

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling, 9*(2), 233–255.

Dimitrov, D. M. (2010). Testing for factorial invariance in the context of construct validation. *Measurement and Evaluation in Counseling and Development, 43*(2), 121–149.

Finn, N. K., Torres, E. M., Ehrhart, M. G., Roesch, S. C., & Aarons, G. A. (2016). Cross-validation of the Implementation Leadership Scale (ILS) in child welfare service organizations. *Child Maltreatment, 21*(3), 250–255.

Gifford, W. A., Squires, J. E., Angus, D. E., Ashley, L. A., Brosseau, L., Craik, J. M., . . . Wallin, L. (2018). Managerial leadership for research use in nursing and allied health care professions: A systematic review. Implementation Science, *13,* Article 127.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 1–55.

Institute of Medicine. (2001). *Crossing the quality chasm: A new health system for the 21st century.* Washington, DC: National Academies Press.

Lewis, C. C., Fischer, S., Weiner, B. J., Stanick, C., Kim, M., & Martinez, R. G. (2015). Outcomes for implementation science: An enhanced systematic review of instruments using evidence-based rating criteria. *Implementation Science, 10,* Article 155.

Lyon, A. R., Cook, C. R., Brown, E. C., Locke, J., Davis, C., Ehrhart, M., & Aarons, G. A. (2018). Assessing organizational implementation context in the education sector: Confirmatory factor analysis of measures of implementation leadership, climate, and citizenship. *Implementation Science, 13,* Article 5.

May, C. R., Johnson, M., & Finch, T. (2016). Implementation, context and complexity. *Implementation Science, 11,* Article 141.

Muthén, L. K., & Muthén, B. (1998–2016). *Mplus user's guide* (7th ed.). Los Angeles, CA: Muthén & Muthén.

Rabin, B. A., & Brownson, R. C. (2018). Terminology for dissemination and implementation research. In R. Brownson, G. Colditz, & E. Proctor (Eds.),

Commented [TL4]: Au: Please provide a doi or linking URL.

Commented [TL5]: Au: Please provide a doi or linking URL.

Dissemination and implementation research in health: Translating science to practice (2nd ed., pp. 19–45). New York, NY: Oxford University Press.
Reichenpfader, U., Carlfjord, S., & Nilsen, P. (2015). Leadership in evidence-based practice: A systematic review. *Leadership in Health Services, 28*, 298–316.
Robinson, L. D., Paull, D. E., Mazzia, L. M., Falzetta, L., Hay, J., Neily, J., . . . Bagian, J. P. (2010). The role of the operating room nurse manager in the successful implementation of preoperative briefings and postoperative debriefings in the VHA Medical Team Training Program. *Journal of PeriAnesthesia Nursing, 25*(5), 302–306.
Sandström, B., Borglin, G., Nilsson, R., & Willman, A. (2011). Promoting the implementation of evidence-based practice: A literature review focusing on the role of nursing leadership. *Worldviews on Evidence-Based Nursing, 8*(4), 212–223.
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Titler, M. G. (2018). Translation research in practice: An introduction. *Online Journal of Issues in Nursing, 23*(2).
BLINDED
Torres, E. M., Ehrhart, M. G., Beidas, R. S., Farahnak, L. R., Finn, N. K., & Aarons, G. A. (2018). Validation of the Implementation Leadership Scale (ILS) with supervisors' self-ratings. *Community Mental Health Journal, 54*(1), 49–53.

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Table 1.

Testing for Factorial Invariance of a Second-Order Factor Model Across the Two Samples

Model	$\chi 2$	df	Comparison	$\Delta \chi 2$	Δdf	CFI	ΔCFI	RMSEA
M0	193.2	105	-	-	-	.976	-	-
M1	197.4	108	M0 – M1	2.75	3	.976	.000	.058
M2	200.1	111	M2 – M1	1.87	3	.976	.000	.058

Note. CFI = comparative fit index; RMSEA = root mean square error of approximation; $\Delta \chi 2$ = Chi-square change using the scaling correction factor (analyses use MLR);
M0 = baseline model (without invariance. Note that factors for knowledgeable leadership, supportive leadership, and perseverant leadership needed to be constrained to be invariant in order for the baseline model to estimate); M1 = first-order factor loadings invariant; M2 = first-order and second-order factor loadings invariant.

Table 2.

Survey Respondent Characteristics for Sample 1 (N = 200) and Sample 2 (N = 284)

	Sample 1 n (%)	Sample 2 n (%)
Age		
20–29	49 (24.5)	121 (42.6)
30–39	65 (32.5)	64 (22.5)
40–49	44 (22.0)	38 (13.4)
50+	33 (16.5)	36 (12.7)
Missing	9 (4.5)	25 (8.8)

	Sample 1 n (%)	Sample 2 n (%)
Race		
White/Caucasian	107 (53.5)	237 (83.5)
Black/African American	30 (15.0)	3 (1.1)
Asian/Pacific Islander	33 (16.5)	2 (0.7)
American Indian/Alaskan Native	1 (.5)	2 (0.7)
Other	19 (9.5)	10 (3.5)
Missing	10 (5.0)	30 (10.5)
Primary work shift		
Days	96 (48.0)	102 (35.9)
Evenings and nights	91 (45.5)	82 (28.9)
Rotate	-	82 (28.9)
Missing	13 (6.5)	18 (6.3)

Table 3.

Descriptive Statistics for ILS Item and Dimensions for Sample 1 and Sample 2

	Sample 1					Sample 2*				
My direct supervisor/nurse manager…	**N**	**Mean**	**SD**	**Alpha**	**a_{wg}**	**N**	**Mean**	**SD**	**Alpha**	**a_{wg}**
Proactive leadership	198	2.32	1.05	.93	.80	280	2.67	.87	.90	.70
has developed a plan to facilitate implementation of EBPs	199	2.30	1.15			281	2.68	.97		
has removed obstacles to the implementation of EBPs	199	2.27	1.08			282	2.54	.95		
has established clear unit standards for the implementation of EBPs	198	2.40	1.12			283	2.80	.91		
Knowledgeable leadership	198	2.70	.95	.96	.80	282	2.99	.80	.91	.79
is knowledgeable about EBPs	198	2.72	1.00			284	3.12	.77		
is able to answer my questions about EBPs	198	2.67	1.00			282	2.89	.92		
knows what he or she is talking about when it comes to EBPs	199	2.71	.97			283	2.98	.91		
Supportive leadership	198	2.75	.92	.95	.80	281	3.03	.80	.89	.77
recognizes and appreciates nurses' efforts toward successful EBP implementation	198	2.73	.95			283	3.02	.85		
supports nurses' efforts to learn more about EBPs	200	2.73	.972			283	2.98	.95		
supports nurses' efforts to use EBPs	200	2.78	.98			283	3.09	.86		

Perseverant leadership	199	2.68	.97	.97	.80	282	2.84	.84	.91	.75
perseveres throughout the ups and downs of implementing EBPs	199	2.70	1.01			283	2.81	.93		
carries on through the challenges of implementing EBPs	199	2.68	1.01			282	2.83	.90		
reacts to critical issues regarding the implementation of EBPs	199	2.68	.98			284	2.88	.91		
ILS total score	198	2.61	.90	.98	.80	275	2.88	.78	.97	.80

Note. SD = standard deviation; Alpha = Cronbach's alpha; a_{wg} = average within group agreement. *Mean, standard deviation, and Cronbach's alpha for Sample 2 have been previously published in BLINDED.

Table 4.

Confirmatory Factor Analysis Results for Sample 1 and Sample 2

	Sample 1		Sample 2	
My direct supervisor/nurse manager…	**Standardized factor loading**	**p-value**	**Standardized factor loading**	**p-value**
Proactive leadership	.86	< .001	.96	< .001
has developed a plan to facilitate implementation of EBPs	.89	< .001	.89	< .001
has removed obstacles to the implementation of EBPs	.94	< .001	.88	< .001
has established clear unit standards for the implementation of EBPs	.90	< .001	.84	< .001
Knowledgeable leadership	.88	< .001	.96	< .001
is knowledgeable about EBPs	.93	< .001	.83	< .001
is able to answer my questions about EBPs	.96	< .001	.90	< .001
knows what he or she is talking about when it comes to EBPs	.94	< .001	.91	< .001
Supportive leadership	.95	< .001	.94	< .001
recognizes and appreciates nurses' efforts toward successful EBP implementation	.91	< .001	.84	< .001
supports nurses' efforts to learn more about EBPs	.92	< .001	.83	< .001
supports nurses' efforts to use EBPs	.94	< .001	.90	< .001
Perseverant leadership	.96	< .001	1.02	< .001
perseveres throughout the ups and	.98	< .001	.87	< .001

downs of implementing EBPs				
carries on through the challenges of implementing EBPs	.97	< .001	.87	< .001
reacts to critical issues regarding the implementation of EBPs	.90	< .001	.87	< .001

Note. EBP = evidence-based practice; standardized factor loading ≥ 1 due to high correlation among factors in Sample 2 (see Table 4).

Table 5.

ILS Subscale Intercorrelation Matrix for Sample 1 and Sample 2

	1	**2**	**3**	**4**
1. Proactive leadership	-	.82	.80	.89
2. Knowledgeable leadership	.79	-	.83	.88
3. Supportive leadership	.74	.80	-	.85
4. Perseverant leadership	.79	.81	.88	-

Note. All values significant at $p < .01$ level; correlations below the diagonal correspond to Sample 1 and above the diagonal correlations correspond to Sample 2.

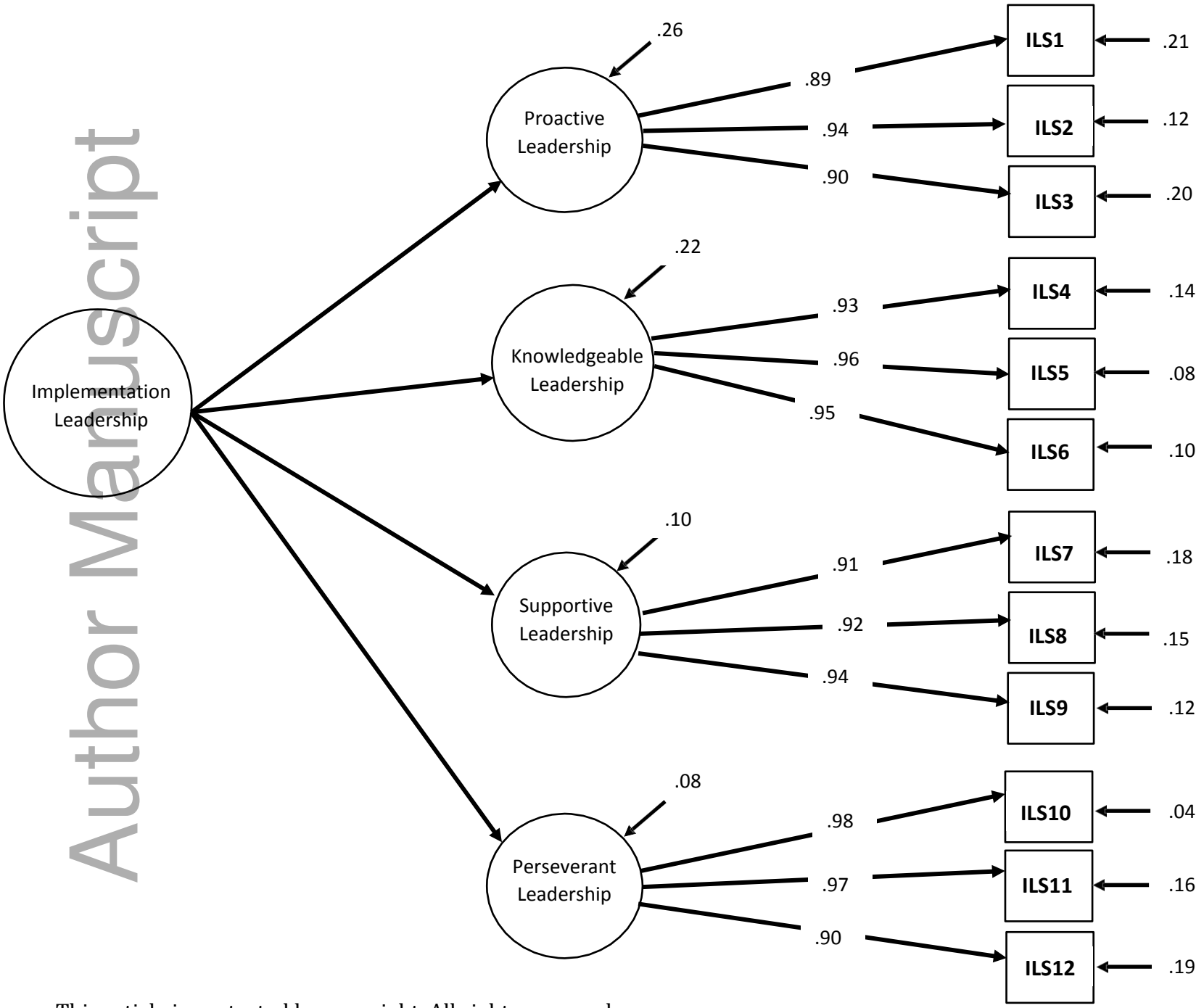

Figure 1. Sample 1 factor structure.

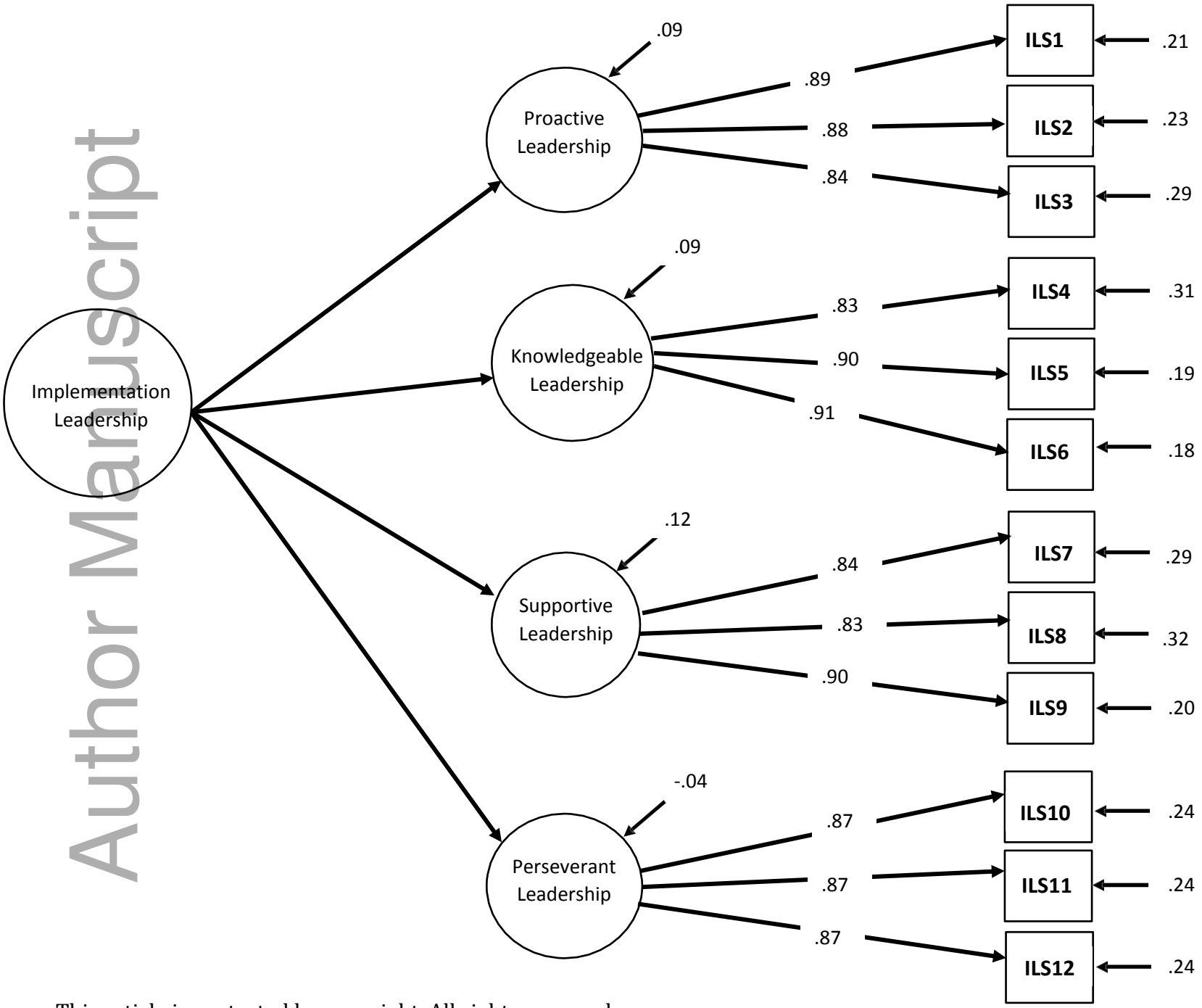

Figure 2. Sample 2 factor structure.