North Carolina Department of Health and Human Services (DHHS): Catching Up with the Times – Bringing WIC to Participants via Telehealth Solutions

NC.1. Technical Appendix

Authors:
Erin Hennessy, PhD, MPH
Alice Ammerman, DrPH
Lauren Au, PhD, RD
Alan Barnosky, MA
Jonathan Blitstein, PhD
Sheryl Cates, BA
Kenneth Kwan Ho Chui, PhD
Josephine Cialone, MS, RDN
Sujata Dixit-Joshi, PhD
Lisa Gualtieri, PhD
Jeniffer Iriondo-Perez, MS
Olga Khavjou, MA
Elizabeth Krupinski, PhD
Danielle Louder, BS
Jerold Mande, MPH
Parke Wilde, PhD
Susan Woods, MD, MPH
Catherine Wright, MS
Qi (Harry) Zhang, PhD

Submitted by:
Friedman School of Nutrition Science and Policy
Tufts University
150 Harrison Ave
Boston, MA 02111

Project Director:
Erin Hennessy, PhD, MPH

Submitted To:
Karen Castellanos-Brown, PhD, Project Officer
and Pascasie Adedze, PhD, SNAS Liaison
USDA, Food and Nutrition Service
Braddock Metro Center II
1320 Braddock Place, Fifth Floor
Alexandria, VA 22314

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Tufts University | Gerald J. and Dorothy R. Friedman School of Nutrition Science and Policy

WIC North Carolina

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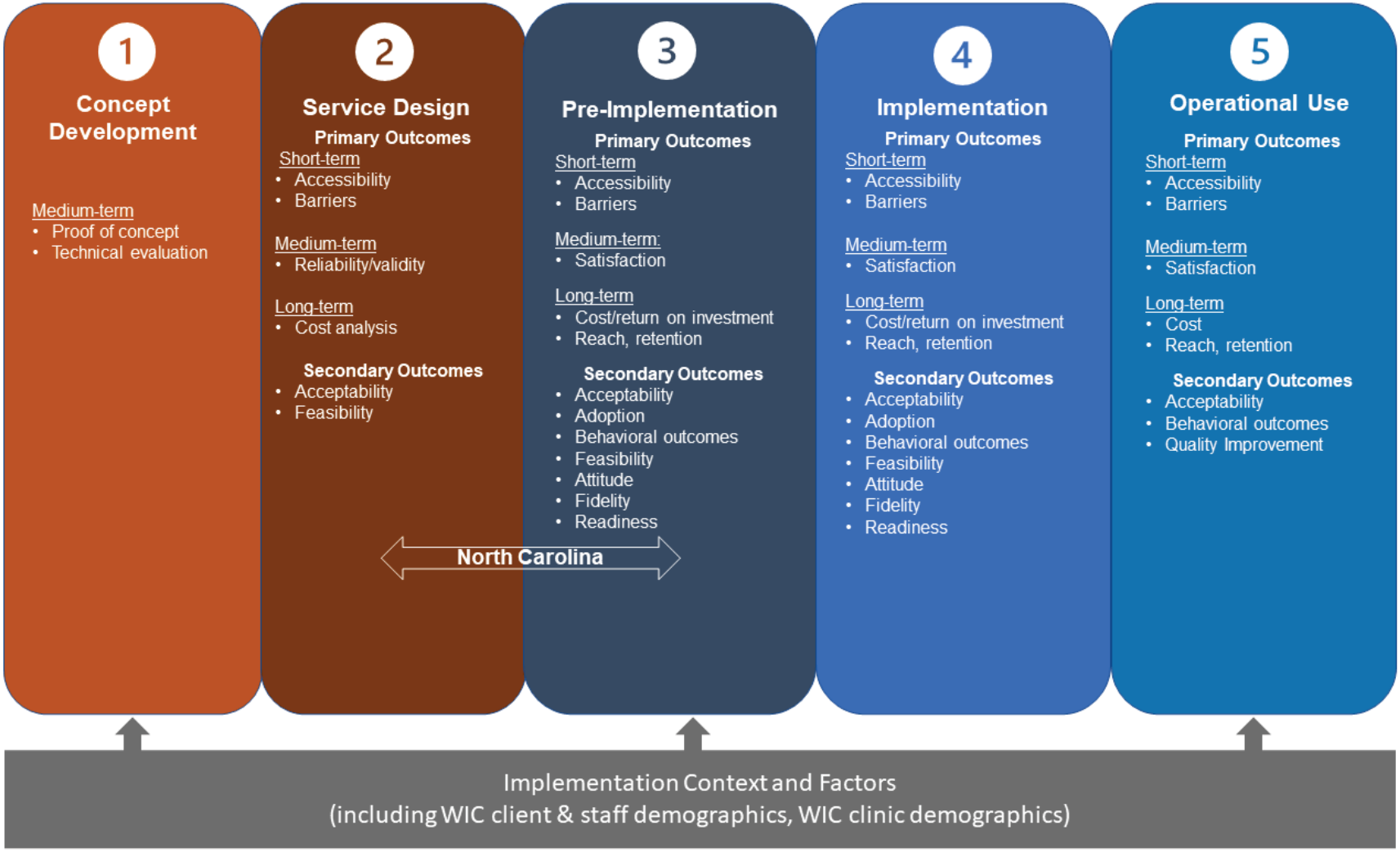
NC.1.1 THIS-WIC Study Framework

The U.S. Department of Agriculture (USDA)/Tufts Telehealth Intervention Strategies for the Supplemental Nutrition Program for Women, Infants, and Children (THIS-WIC) used the five-stage model for comprehensive research on telehealth developed by Fatehi and colleagues[1] to guide the overall design of a telehealth research program (see **Figure NC.1.1**):

- Stage 1 (concept development): Propose a technology-based solution to a health problem; this stage may include a needs analysis, proof of concept, and a technical evaluation of the concept.
- Stage 2 (service design): Study feasibility and accessibility to determine how the service delivery model should be modified to accommodate the proposed telehealth intervention.
- Stage 3 (pre-implementation): Study the telehealth solution under a controlled environment to assess efficacy.
- Stage 4 (implementation): Study the telehealth solution in real-world settings to assess effectiveness.
- Stage 5 (operational use): After implementing a telehealth intervention, focus on operational use and sustainability of the solution.

In the context of THIS-WIC, the model mapped a multistage journey from developing a telehealth solution to assessing an established telehealth service. The model's internal consistency results from previous observations of the progression of telehealth projects in the telehealth field. Fatehi and colleagues[1] noted that telehealth research evaluations may not need to include all elements or stages, particularly where comparable services have been rigorously assessed. **North Carolina (NC)** falls along the second and third stages of the model as it focuses on design and is a pilot project (i.e., pre-implementation).

Figure NC.1.1 THIS-WIC Five-Stage Model for Comprehensive Telehealth Research and Priority Areas



NC.1.2 WIC Agencies Participating in THIS-WIC Evaluation

NC identified 12 WIC agencies to participate in the THIS-WIC evaluation. Six intervention agencies were selected based on completion of prior telehealth readiness surveys, adequate staffing, willingness to implement, and support from local-level leadership. Comparison agencies were matched by demographics, caseload, and region (urban/rural). **Table NC1.1** lists the agencies involved in the evaluation; **Tables NC.1.2** and **NC.1.3** present caseload characteristics at each agency. Five additional agencies offered services through the TeleWIC service center (not shown in **Table NC1.1**).

Table NC.1.1 WIC Agencies in the Full Intervention and Comparison Groups in NC

Intervention Group	Comparison Group
Dare	Alexander
Brunswick	Haywood
Union	Catawba
Albemarle Regional Health Services (ARHS)	Onslow
Lincoln Community	Wilson
Jackson	Randolph

Source: NC WIC administrative records, December 2020.

Table NC.1.2 Local Agency and Client Characteristics of Full Intervention and Comparison Agencies in NC

Local Agency	County	Caseload	Breastfeeding	Children	Infant	Non-Breastfeeding Postpartum	Pregnant
		N					
Intervention							
Dare[a]	Dare	871	39	360	144	36	55
Brunswick[b]	Brunswick	3,275	82	1,619	610	167	201
Union[b]	Union	4,105	133	1,929	793	171	257
ARHS[a]	Pasquotank, Perquimans, Camden, Chowan, Currituck, Bertie, Gates, Hertford	4,388	78	2,216	777	269	281
Lincoln Community[b]	Dunham	8,869	192	4,458	1,585	379	545
Jackson[c]	Jackson	809	34	481	157	38	67
Comparison							
Alexander[c]	Alexander	801	22	436	147	45	45
Haywood[c]	Haywood	1,723	57	870	268	79	119
Catawba[b]	Catawba	4,529	165	2,020	921	254	312
Onslow[b]	Onslow	8,506	338	3,567	1,475	373	534
Wilson[b]	Wilson	3,353	33	1,674	600	211	183
Randolph[c]	Randolph	3,579	95	2,024	832	199	95

Source: NC WIC administrative records, December 2020.

[a] Rural/urban

[b] Urban

[c] Rural

Table NC.1.3 Race/Ethnicity of Clients from Full Intervention and Comparison Agencies in NC

Local Agency	Black or African American	White	Hispanic	American Indian or Alaska Native	Asian	Native Hawaiian or Other
	%					
Intervention						
Dare	5.6	93.1	27.0	0.1	0.9	0.2
Brunswick	19.6	78.7	16.0	0.3	8.9	0.0
Union	27.3	71.0	27.2	0.4	1.2	0.1
ARHS	53.6	45.6	3.6	0.3	0.4	0.0
Lincoln Community	52.9	45.7	34.8	0.5	1.8	0.2
Jackson	2	88.8	5.1	6.9	0.5	0.3
Comparison						
Alexander	5.9	92	6.3	0.2	1.9	0.0
Haywood	2.6	96.3	27	0.1	0.9	0.2
Catawba	17.1	73.7	16.0	0.3	8.9	0.0
Onslow	26.4	68.9	8.1	1.6	2.6	0.5
Wilson	39.5	59.5	7.9	0.4	0.6	0.0
Randolph	11.0	84.0	8.6	0.3	2.7	0.0

Source: NC WIC administrative records, December 2020.

NC.1.3 Data Sources for the THIS-WIC Evaluation in NC

Table NC.1.4 summarizes the data sources used in the THIS-WIC evaluation in NC.

Table NC.1.4 Description of Data Sources for Evaluation in NC

Data Source	Description	Developed By	Collected By
MIS Data	Caseload and client characteristic data.	State agency	State agency
Telehealth Usage Data	Telehealth usage and engagement metrics	Telehealth vendor	State agency
Surveys: Client and Staff	Telehealth satisfaction, quality of telehealth interaction, and whether telehealth solution address known barriers to WIC participation	State agency & THIS-WIC	State agency
Staff Key Informant Interviews	Telehealth experience of local and State agency stakeholders	THIS-WIC	THIS-WIC
Implementation Data	Fidelity to the intervention protocol and implementation strategies	State agency & THIS-WIC	State agency
Cost Data	Source of information on startup and ongoing costs related to telehealth adoption, implementation, and sustainability	THIS-WIC	THIS-WIC & State agency

NC.1.3.1 Telehealth Solution Implementation Data

Implementation data were collected using responses to the Implementation Tracking Tool for startup (pre-implementation), midway, and endpoint or late phase of implementation. See **Appendix NC.3** for data collection instruments.

NC.1.4 Client Survey Sample Size, Response Rate, Characteristics, and Representativeness

Information describing the sociodemographic characteristics and WIC participation for survey respondents was derived from the client survey and Management Information System (MIS). Variables from the Client Survey included respondent's race/ethnicity, total number of years the household has received WIC services, location of residence, respondent's average daily consumption of fruits and vegetables, and breastfeeding practices. The MIS record data closest to the appointment date were extracted for the following variables: presence of WIC client with high-risk status in the household, household size, annual household income, written language used at home (English, Spanish, other), and respondent's years of education.

NC.1.4.1 Client Survey Sample Size

All pregnant women, caregivers with breastfeeding infants and infants on non-standard formula, and mothers and children with food package III were included in the THIS-WIC NC evaluation. All pregnant clients in any trimester were eligible. Inclusion characteristics for infants with non-standard formula included any formula except for Gerber Good Start Gentle, Gerber Good Start Soothe, and Gerber Good Start Soy.

Respondents had to be 18 years of age or older and pregnant or caregivers of breastfeeding infants, caregivers of infants on non-standard formula, or caregivers of children receiving food package III. Sample size estimation used the composite satisfaction score derived from the Client Survey as the main outcome of interest, which ranges from 0 to 100 points, with a standard deviation (SD) of 15 points. A difference of 10 points is considered practically meaningful. Assuming a sampling ratio (intervention: comparison) of 1:1, alpha (type I error rate) 5%, and power 80%, a total minimum sample size of 144 per time point is needed to detect a difference of 10 points (i.e., 72 from intervention, 72 from comparison at the early phase; another 72 from intervention and 72 from comparison at the late phase).

Table NC.1.5 presents the caseload and target response rate for each phase, based on the total caseload at intervention and comparison agencies. Although an increase of 10 points was hypothesized to be practically important, the actual difference could be smaller in many cases. For instance, a required sample size would be inflated by about 5 times if the actual difference is only about 4. Sample sizes based on two hypothetical response rates (5% and 10%, which are typical for online surveys) are also provided for reference.

Table NC.1.5 Caseload and Target Response Rate for Each Phase for Client Survey in NC

Local Agency	Caseload	Per Phase		Response Rate	
		N if diff = 10	N if diff = 4	N with 5%	N with 10%
Intervention					
Dare	871	3	18	44	88
Brunswick	3,275	11	66	164	328
Union	4,105	14	83	206	411
ARHS	4,388	15	89	220	439
Lincoln Community	8,869	30	179	444	887
Jackson	809	3	17	41	81
Total	22,317	76	452	1,119	2,234
Comparison					
Alexander	801	3	17	41	81
Haywood	1,623	6	35	87	173
Catawba	4,529	16	91	227	453
Onslow	8,506	29	171	426	851
Wilson	3,353	12	68	168	336
Randolph	3,579	12	82	179	358
Total	22,391	78	464	1128	2252
Overall Total	44,808	154	906	2,247	4,486

Source: NC WIC administrative records, 2020

NC.1.4.2 Client Survey Invitations and Response Rate

Following their WIC appointment, staff at participating intervention and comparison agencies sent an invitation to clients, inviting them to complete a survey about their experience with the appointment. The survey was sent to 4,118 clients; 1,038 consented to complete the survey, and 499 completed the survey (**Table NC.1.6**). Of those who consented, 64.7 percent were successfully linked with the MIS identifier. One respondent was excluded from analysis because this was the only respondent from one agency.

Table NC.1.6 Client Survey Invitations, Consents, and Survey Completion in NC

Survey Status	Definition	Calculation	%
Total Surveys sent		4,118	—
Response	Consents/Invitations	1038/4118	25.2
Completion[a]	Completes/Consents	499/1038	48.1
Match[b]	MIS Matches/Consents	323/499	64.7

[a] Survey responses were not required after screening and consent. “Complete” was defined as responding to the eight satisfaction items and a clinic association.

[b] Match was defined as the ability to link WIC family-level administrative data to survey respondent.

NC.1.4.3 Sociodemographic Characteristics of Client Survey Respondents

Table NC.1.7 presents the characteristics of Client Survey respondents in NC. Of the 499 survey respondents, 72 (14%) were in agencies that received the full intervention, 158 (32%) were in agencies that received the partial intervention (TWSC), and 269 (54%) were in comparison agencies.

Overall, 44.9 percent of respondents self-identified as Non-Hispanic White, 26.5 percent identified as Hispanic, and 21.3 percent as non-Hispanic Black/African American. About 44 percent of respondents were between the ages of 26 and 35, and about 27% were between the ages of 18 and 25. For about 86 percent of respondents, the language used at home was English. The median annual household income was $31,782. Overall, 62.1 percent of respondents lived in a rural area, 24.2 percent lived in an urban area, and the remaining 13.7 percent lived in a suburban area.

Table NC.1.7 Sociodemographic Characteristics of Client Survey Respondents from Full Intervention, TWSC Only, and Comparison Agencies in NC

Variable	Overall	Full Intervention (I)	TWSC Only (II)	Comparison (III)	p-value[d]	
	%				I v. III	II v. III
Age[a]	N=468	N=68	N=154	N=246	0.5100	0.0188*
18–25	27.1	23.5	31.2	25.6		
26–35	44.4	44.1	50.6	40.7		
36–45	21.4	27.9	14.3	24.0		
46–55	2.8	1.5	0.6	4.5		
56–65	3.6	1.5	2.6	4.9		
66+	0.6	1.5	0.6	0.4		
Race/ethnicity[a]	N=465	N=67	N=154	N=244	0.0807	0.0142*
Non-Hispanic Black/African American	21.3	29.9	27.9	14.8		
Non-Hispanic White	44.9	40.3	46.1	45.5		
Hispanic/Latino	26.5	28.4	18.8	30.7		
Non-Hispanic American Indian/ Alaska Native	0.4	0.0	0.6	0.4		
Non-Hispanic Asian	1.9	0.0	1.3	2.9		
Non-Hispanic Native Hawaiian/ Pacific Islander	0.0	0.0	0.0	0.0		
Two or more races	4.3	1.5	3.9	5.3		
Other	0.6	0.0	1.3	0.4		
Language used at home (written)[b]	N=321	N=64	N=124	N=133	0.3225	<.0001*
English	85.7	78.1	99.2	76.7		
Spanish	14.0	20.3	0.8	23.3		
Other	0.3	1.6	0.0	0.0		
Place of residence[a]	N=451	N= 65	N=152	N=234	0.0520	<.0001*
Rural	62.1	52.3	79.6	53.4		
Suburban	24.2	23.1	10.5	33.3		
Urban	13.7	24.6	9.9	13.2		

(continued)

Table NC.1.7 Sociodemographic Characteristics of Client Survey Respondents from Full Intervention, TWSC Only, and Comparison Agencies in NC (continued)

Variable	Overall	Full Intervention (I)	TWSC Only (II)	Comparison (III)	p-value[d]	
	%				I v. III	II v. III
Household income ($)[b]	N= 321	N= 64	N= 124	N= 133	0.1635	0.0497*
Median [IQR][c]	31,781.9 [21,021.0, 42,000.0]	27,000.0 [21,021.0, 37,440.0]	27,749.6 [17,050.0, 42,596.5]	36,721.0 [24,660.0, 46,517.5]		

Source: [a] THIS-WIC Client Survey, [b] NC MIS

[c] IQR = Interquartile range

[d] Compared the difference in estimates for (1) agencies that received the full intervention vs. comparison agencies and (2) TWSC only agencies vs. comparison agencies. The p-values are based on chi-square test for categorical variables and two-sample median tests for continuous variables. For both comparisons (full intervention and TWSC), 25% or more of the cells have expected counts less than 5, so chi-square may not be a valid test for the following variables: race, age, and language used at home.

* $p<0.05$

NC.1.4.4 Length of WIC Tenure of Client Survey Respondents

As seen in **Table NC.1.8**, 34.2 percent of survey respondents had received WIC services for less than 1 year, and 24.6 percent had received WIC services for 1 to 2 years. About 20 percent of respondents had received WIC services for 3 to 4 years and for 5 or more years. About 64 percent of respondents had a high-risk WIC client in their household. MIS data were used to classify clients as high risk at their most recent appointment.

Table NC.1.8 Length of WIC Tenure and High-Risk Status of Client Survey Respondents in NC

Variable	Overall	Full Intervention	TWSC Only	Comparison
	%			
In total, how many years have you received WIC services? Would you say it has been…[a]	N=468	N=68	N=154	N=246
<1 year	34.2	26.5	32.5	37.4
1–2 years	24.6	30.9	21.4	24.8
3–4 years	19.9	17.6	21.4	19.5
5+ years	21.4	25.0	24.7	18.3
p-value[c]		0.2745	0.3710	
High-risk status[b,d]	N=499	N=72	N=158	N=269
Yes	64.3	88.9	78.5	49.4
No	35.7	11.1	21.5	50.6
p-value[c]		<.0001*	<.0001*	

Sources: [a] THIS-WIC Client Survey, [b] NC MIS

[c] Compared the difference in proportions for (1) comparison agencies vs. agencies that received the full intervention and (2) comparison agencies vs. TWSC agencies. p-value based on chi-square test.

[d] High-risk status is a dichotomous indicator coded "1" if one or more WIC clients in the household was assigned high-risk at their most recent WIC appointment.

* p<0.05

NC.1.5 THIS-WIC Staff Survey Respondent Characteristics

NC.1.5.1 Response Rate and Characteristics of Staff Survey Respondents

Table NC.1.9 provides the response rate for the Staff Survey, and **Table NC.1.10** presents characteristics of these respondents. Because WIC agencies experience turnover and hire new staff, the same survey was administered at both time points. The response rates for the early and late phases of the Staff Survey were 35.5 and 31.7 percent, respectively. Age distribution, race/ethnicity distribution, and prior WIC participation did not differ significantly among early- and late-phase Staff Survey respondents (see **Table NC.1.10**).

Table NC.1.9 Staff Survey Sample Size and Response Rate in NC

Agency	Early Phase		Late Phase	
	Invited	Responded	Invited	Responded
	Number of Staff			
AHRS	14	2	12	2
Brunswick	12	3	10	2
Dare	5	2	5	3
Jackson	4	3	3	1
Lincoln Community	14	4	16	4
TeleWIC Service Center[a]	3	3	3	3
Union	10	5	11	4
TOTAL	62	22	60	19
Overall response rate (%)	35.5		31.7	

Source: THIS-WIC Staff Survey

[a] TeleWIC Service Center staff were centrally located and worked across all local agencies.

Table NC.1.10 Characteristics of Early- and Late-Phase Staff Survey Respondents in NC

Variables	Early Phase	Late Phase	p-value[a]
	%		
Age	N=22	N=17	0.556
18–25	4.5	5.9	
25–35	13.6	5.9	
36–45	13.6	35.3	
46–65	40.9	35.3	
56–65	27.3	17.6	
66+	0	0	
Race/Ethnicity	N=22	N=17	0.205
Hispanic	4.5	23.5	
Non-Hispanic Black or African American	18.2	17.6	
Non-Hispanic White	77.3	58.8	
American Indian or Alaska Native	0	0	
Asian	0	0	
Native Hawaiian or multi-racial	0	0	
Previous WIC participation	N=22	N=17	
Yes	13.6	29.4	0.226

Source: THIS-WIC Staff Survey

[a] p-values are based on chi-square test.

NC.1.5.2 WIC Role and Years of Experience of Staff Survey Respondents

Role, years of WIC experience, and travel patterns did not differ significantly between WIC staff in the early- and late-phase Staff Surveys (**Table NC.1.11**).

Table NC.1.11 Role and Years of WIC Experience of Early- and Late-Phase Staff Survey Respondents in NC

Variables	Early Phase	Late Phase	p-value[a]
	%		
WIC role[b]	N=22	N=17	
CPA/CPPA	36.4	29.4	0.648
Nutrition support roles (e.g., RD, nutritionist)	40.9	47.1	0.701
Breastfeeding roles (e.g., IBCLCs)	22.7	11.8	0.376
Local agency directors	18.2	29.4	0.409
Years worked in WIC	N=22	N=17	0.728
<2 years	19.0	17.6	
2–4 years	4.8	5.9	
5–8 years	14.3	29.4	
9–12 years	4.8	0.0	
12+ years	57.1	47.1	
Pre-COVID-19 travel to provide service	N=7	N=6	
Yes	35.3	64.3	0.108

Source: THIS-WIC Staff Survey

[a] p-values are based on chi-square test.

[b] Percentages do not add up to 100 as respondents could select multiple roles.

NC.1.6 Staff Key Informant Interview Sample Size and Response Rate

All staff who completed the Staff Survey and indicated that they had used telehealth were invited to participate in the key informant interviews in the early and late phases (**Table NC.1.12**).

Table NC.1.12 Number of Staff Who Were Invited and Participated in Key Informant Interviews in NC

Agency	Early Phase		Late Phase	
	Invited	Responded	Invited	Responded
	Number of Staff			
AHRS	1	1	2	1
Brunswick	3	1	2	0
Dare	2	0	3	0
Jackson	3	1	1	1
Lincoln Community	5	2	4	0
TeleWIC Service Center[a]	3	3	3	1
Union	4	1	4	2
TOTAL	21	9	19	5
Overall response rate (%)	42.9		26.3	

[a] TeleWIC Service Center staff were centrally located and worked across all local agencies.

NC.1.7 Data Analysis

NC.1.7.1 Aggregate MIS Analysis

For NC, WIC administrative data included WIC client characteristics, certification information, nutrition and risk assessment, nutrition education, and breastfeeding practices. NC also linked the Client Survey identified with the client-level MIS data. Descriptive analyses were used to analyze the data and present the findings. All analyses were conducted in SAS 9.4. Crosstabulations and chi-square statistics were used to examine the differences between intervention and comparison agencies. See **Appendix NC.1** for details.

Aggregate MIS data were used to examine survey participants' representativeness by comparing sociodemographic characteristics of the overall caseload with those of the survey participants. Although the analysis of linked MIS and Client Survey data provides the most useful outcome variables, it is limited by sample size, depends on the representativeness of the sample, and is available only for the time periods covered by the sample.

Administrative data linked to Client Survey participants were also used to examine retention in WIC among survey participants. Crosstabulations and chi-square statistics were used to examine differences between intervention and comparison agencies.

Retention

This analysis was restricted to Client Survey respondents who completed their surveys in the first 6 months of telehealth implementation. Retention was examined by tracking the proportion of respondents (overall) who had available data on benefit redemption 6 months after their appointment.

Aggregate MIS data were also used to examine clinic-level trends in outcomes for the intervention and comparison agencies. The analysis of aggregate data has the advantage of providing information about all WIC participants in the intervention and comparison agencies, and it provides some information about additional time periods (including time periods before the intervention began); however, it is limited to the variables captured by the MIS. Descriptive analyses were used to analyze the data and present the findings. All analyses were conducted in SAS.

NC.1.7.2 Telehealth Implementation

Implementation Tracking Tool

Responses to the Implementation Tracking Tool were collected at the startup, midpoint, and endpoint of telehealth implementation. The 46 menu of distinct strategies in the Implementation Tracking Tool were grouped into eight conceptually relevant implementation categories, using the groupings developed by Powell et al.[2] Although the researchers had developed nine categories through concept mapping, the “utilize financial strategies” category was not included in the THIS-WIC menu. **Table NC.1.13** lists the eight implementation categories and corresponding menu strategies. The analysis of the Implementation Tracking Tool involved tabulating the startup, midpoint, and endpoint status for each menu strategy to assess change. The startup measures were considered the implementation plan, and the change from startup to midpoint and endpoint measures were considered indicative of fidelity. In addition to understanding the fidelity of implementation, these data were also used to provide context for the staff and client-level outcomes.

Table NC.1.13 THIS-WIC Implementation Menu Categories from the Implementation Tracking Tool

Implementation Category	Implementation Menu Strategy
Use evaluative and iterative strategies	Assess for readiness and identify barriers and facilitators.
	Conduct local needs assessment.
	Audit and provide feedback.
	Conduct small tests of change.
	Develop a formal implementation blueprint.
	Develop and organize quality monitoring systems.
	Obtain and use WIC clients and family feedback.
	Purposely reexamine the implementation.
	Stage implementation scale-up.
Provide interactive assistance	Centralize technical assistance.
	Provide local technical assistance.
Adapt and tailor to context	Promote adaptability.
	Tailor strategies.
	Use data experts.
	Use data warehousing techniques.
Develop stakeholder interrelationships	Conduct local consensus discussions.
	Develop academic partnerships.
	Build a coalition.
	Capture and share local knowledge.
	Identify and prepare champions.
	Identify early adopters.
	Inform local opinion leaders.
	Organize WIC staff implementation team meetings.
	Promote network weaving.
	Recruit, designate, and train for leadership.
	Use advisory boards and workgroups.
	Use an implementation advisor.
	Visit other sites.
Train and educate stakeholders	Conduct educational meetings.
	Conduct ongoing training.
	Develop and distribute educational materials.
	Make training dynamic.
	Provide ongoing consultation.
	Shadow other experts.
	Use train-the-trainer strategies.

(continued)

Table NC.1.13 THIS-WIC Implementation Menu Categories from the Implementation Tracking Tool (continued)

Implementation Category	Implementation Menu Strategy
Support clinicians	Create new telehealth teams.
	Develop resource sharing agreements.
	Revise professional roles.
	Facilitate relay of telehealth breastfeeding/nutrition data to staff.
	Remind WIC staff and clients.
Engage consumers	Intervene with WIC clients to enhance uptake and adherence.
	Involve WIC clients and family members.
Change infrastructure	Change record systems.
	Change physical structure and equipment.
	Change service sites.
	Start a dissemination organization/committee.

NC.1.7.3 Telehealth Metadata

The NC State agency team collected, tabulated, and submitted telehealth use data to the THIS-WIC team once at the end of the intervention period.

NC.1.7.4 Client Survey

The client outcomes evaluation examined the experiences of WIC clients who received WIC services and completed the Client Survey in one of the WIC clinics associated with the 12 agencies in the study between October 2022 and September 2023. Intervention agencies were matched with comparison agencies for race, ethnicity, and total participation/caseload. Six agencies were assigned to the intervention group, five agencies were included in the TWSC expansion group, and six matched agencies were assigned to the comparison group. There were 72 survey respondents from the full intervention agencies, 158 from the TWSC agencies, and 269 from comparison agencies. All surveys were completed by an adult to reflect WIC services they received for themselves (i.e., pregnant, postpartum, or breastfeeding women) or for their infant/child.

Breastfeeding Practices

Information from the MIS was used to summarize breastfeeding practices in households with an infant (age 0 to 12 months) during the intervention period. Two breastfeeding variables were examined: whether the infant was ever breastfed and whether the infant was exclusively breastfed for at least 6 months.

Attitudes Toward the Telehealth Solution

All respondents from the intervention agencies responded to the following six statements using a five-item, Likert-type response option that ranged from “strongly disagree” to “strongly agree”:

- I could hear the WIC nutrition educator clearly.
- I could easily talk to the WIC nutrition educator during my recent appointment.
- It was easy to figure out how to use and receive WIC services.
- My WIC appointment was shorter than usual when receiving care.
- The way I received WIC services was easier than going to a WIC clinic.
- I would like to receive services the same way at my next WIC appointment.

Respondents who completed their appointment via telehealth using Google Meets responded to three additional statements:

- I could see the WIC nutrition educator clearly during my most recent WIC appointment.
- The telehealth platform was simple to use for my WIC appointment.
- I had trouble accessing the telehealth platform.

One additional question with dichotomous response options (yes/no) asked respondents whether the content of the telehealth solution was in a language they could read.

Client/Respondent Outcomes

Primary and secondary outcomes assessed the comparative advantage of the telehealth intervention. Primary outcomes are related to WIC service delivery and include client satisfaction and barriers to participation. Secondary outcomes include client intentions to change dietary behaviors based on the assumption that improvements in service delivery led to improved client engagement.

Client Satisfaction. Eight items assessed client satisfaction, specifically respondents' experience with their most recent WIC appointment: overall satisfaction, was a good use of my time, was convenient, would recommend this WIC appointment to other WIC participants, glad I completed my WIC appointment, appointment was convenient, prefer to receive WIC services the same way at next appointment, and perceptions of the WIC nutrition educator (was friendly and easy to talk to, had good communication skills). Each item included a five-level, Likert-type response option that ranged from "strongly disagree" to "strongly agree." These items demonstrated a high degree of interrelationship (interitem correlation, alpha = 0.94) and were treated as an index. Summing the eight items produced index scores with a potential range of 20 to 100 points with higher scores indicating greater satisfaction.

Barriers. The Client Survey included questions on availability and use of technology and about administrative, individual-level, and staff-level barriers to accessing WIC services. Four questions asked about availability of a computer and smartphone at home, mode of connecting to the Internet, reasons for not connecting to the Internet at home, and frequency of Internet problems. Two questions asked about comfort with use of technology and frequency of videoconferencing to connect with family and friends.

Eight items asked respondents about barriers to accessing WIC services for their most recent WIC appointment. Barriers included administrative factors (such as receiving a specific appointment time and experiencing long wait times), individual-level factors (such as transportation issues, childcare issues, difficulty getting time away from work), and staff

interactions (such as language barrier, racial/ethnic barrier, and poor/no Internet connectivity). Each item included a four-level Likert-type response option that ranged from "frequently" to "never" with lower scores reflecting more experience with the barrier and higher scores reflecting less experience with the barrier.

Intentions to Change Dietary Behaviors

Three survey items asked respondents about their intentions to change diet-related behaviors following their WIC appointment. Using a five-level, Likert-type response option that ranged from "strongly disagree" to "strongly agree," with higher numbers indicating greater levels of agreement, participants responded to statements about their intentions to (1) change how they eat, (2) change how they feed their family, and (3) make healthier food choices.

Statistical Analysis

Descriptive Statistics. Descriptive statistics include respondent and household demographics, availability and comfort with technology, attitudes toward telehealth services and platform, and respondent behaviors (fruit and vegetable consumption and breastfeeding). Crosstabulations for categorical variables present proportions among those who provided data (i.e., missing values were excluded from the analysis) by group (intervention, TWSC, and comparison). Descriptive statistics for continuous variables present medians and interquartile ranges (25th percentile–75th percentile) because the data on household size and income were assumed to be skewed.

Significance tests compare respondent demographics and household characteristics, availability and comfort with technology, and respondent behaviors between respondents in the full intervention and comparison agencies and between the TWSC and comparison agencies. For categorical variables, chi-square tests for independence are presented. For continuous variables, the two-sample median test was used. This test examines whether the two samples come from the same population by assessing the distribution of sample scores around the median instead of comparing the actual median values.

Statistical Models. Analyses to assess client outcomes (satisfaction index, barriers, and intentions to change dietary behaviors) employed hierarchical linear regression models comparing differences in group means among respondents who received WIC services in the full intervention and comparison agencies, and among participants who received WIC services in TWSC only and comparison agencies. The models were estimated with the SAS PROC MIXED procedure using restricted maximum likelihood (REML) and Type-3 F test to assess study hypotheses with statistical significance set at $p < 0.05$. Degrees of freedom for tests of intervention effects were determined using the Kenward and Roger (1997) method.[3]

For the adjusted model for client satisfaction index, demographic/household variables that demonstrated statistically significant differences between intervention and comparison agencies were entered into multivariable hierarchical linear regression, with separate models for the two intervention groups (full intervention and TWSC agencies). Categorical variables that produced a low cell count warning were excluded as these variables have poor coverage across categories and are likely to lead to model failure. If the initial model did not converge, the model

was simplified by removing the least significant variable (i.e., in terms of relationship to the satisfaction index) if this information was available and removing the most complicated variables (i.e., has most categories) if converge problems were so extreme that significance tests could not be estimated. This process was repeated iteratively until a model solution was obtained or the adjusted model was reached.

NC.1.7.5 Staff Survey

Descriptive analyses were conducted to examine the Staff Survey data. Chi-square tests were used to examine differences in responses from early- to late-phase surveys. When analyzing the staff outcomes, attempts were made to adjust for biases in standard error estimate due to repeated measurements whenever feasible. For ordinal/continuous outcomes, the analysis adjusted for the unique participant ID numbers as random effect and corrected for repeated measurements. However, due to low sample size, the same adjustments could not be made for categorical outcomes, which impose more stringent sample size requirements. Instead, these data were analyzed as if the two time points are not related. All analyses were conducted in Stata 18 (StataCorp LLC, College Station, TX, USA).

NC.1.7.6 Staff Key Informant Interviews

All interviews were audio recorded and transcribed by Zoom verbatim in English only. Each transcript was reviewed for accuracy and corrected to reflect actual dialogue spoken, by listening to the audio recording. Before undertaking analysis, three THIS-WIC team members created a preliminary codebook, with codes deductively informed primarily by the Consolidated Framework for Implementation Science Research (CFIR)[4] and the Evaluation Framework for Telemedicine.[5] Five trained qualitative researchers who conducted the interviews also coded the interviews.

A single codebook was used to code early and late-phase interviews. The codebook included a description, inclusion and exclusion guidance, and an example quote for each code when relevant. To start, five researchers independently coded the same four transcripts from four different WIC State agencies. Coders met over video to compare codes, arrived at an agreement on differing codes through discussion, and updated the codebook to address inconsistencies or to add additional clarity.

Next, researchers established interrater reliability across four different transcripts. These four transcripts involved the WIC roles of two front-line nutrition staff (e.g., RD), one breastfeeding-focused staff (e.g., IBCLC), and one director. Researchers coded each transcript individually, ran coding comparisons against the primary coder and discussed results. Coders discussed results until all codes reached a 90 percent agreement and a Kappa coefficient of at least 0.40 (fair to good judgment). Researchers conducted the same process for all four transcripts. As new researchers joined the project, the main coder facilitated the same reliability process with the previously established agreement NVivo files until coders reached the 90 percent agreement and Kappa coefficient of at least 0.40.

Two reviewers coded the remaining transcripts. The main coder randomly assigned transcripts to coders in batches of five. After coders completed their five assignments, the group reconvened and discussed coding uncertainties as a full coding team. Researchers then updated the codebook after reaching a consensus if needed. NVivo version 13 (QSR International) was used to organize and analyze coded interviews.

NC.1.7.7 Telehealth Solution Startup and Ongoing Cost Analysis

Cost analysis was conducted to understand the (1) startup cost, (2) ongoing service delivery cost, and (3) ongoing cost per enrollment and appointment. All costs were adjusted to 2023 dollars using the Consumer Price Index. All analyses were completed in Microsoft Excel (version #2308) and Stata 18.

The COVID-19 pandemic impacted the timeline and roll-out of the telehealth platform. WIC service delivery in intervention and comparison agencies was adjusted due to the pandemic and even the comparison agencies transitioned to remote service delivery during the pandemic's height. To facilitate the comparison of costs from before to after introduction of the telehealth solution and between intervention and comparison agencies, the pre-implementation period was set to FY2019 i.e., before the start of the pandemic (NC provided the FY2019 data to THIS-WIC in 2023). The change in service delivery costs changed from pre-intervention in FY2019 to post-intervention, the February 2023 through September 2023 period, was then assessed.

Telehealth Solution Startup Cost

Statewide startup costs for telehealth solution startup were calculated as follows:

1. Generated subtotals by summing the data for each resource category in the tool (e.g., labor, equipment, indirect, contracted services).
2. Computed total cost and cost per month as follows:

   Total cost = Sum of cost across resource categories

   Cost per month = total cost/number of months in the startup period

Ongoing WIC Service Delivery Cost

Ongoing service delivery costs were computed for each participating agency at three time points: baseline/pre-implementation (FY2019), at 4 months post-implementation (May 2023), and at 8 months post-implementation (September 2023), as follows:

1. Staffing cost was calculated by multiplying the reported average number of full-time equivalents (FTEs) each staff type spent providing nutrition and breastfeeding education services by that staff type's average hourly salary.
2. If an agency purchased equipment, the cost of the equipment was amortized over the reported period, until replacement.

3. Subtotals were created for each resource category (labor, equipment, supplies, contracted services, and indirect) and then summed across categories to calculate a total by agencies.

Ongoing Implementation Cost Per Enrollment and Per Appointment

To facilitate the comparison of costs from before to after introduction of the telehealth solution and between intervention and comparison agencies, the pre-implementation period was set to FY2019 (i.e., before the start of the pandemic). Changes in service delivery costs from pre-intervention (FY2019) to post-intervention (February 2023–September 2023) were examined.

Average monthly ongoing costs, average cost per enrollment, and average cost per appointment were computed for each period of the ongoing cost analysis. The ongoing cost per enrollment and per appointment were computed by dividing the average monthly cost by the number of monthly enrollments and monthly appointments in that same period. To understand the distribution of monthly costs, mean, median, minimum, and maximum cost per enrollment and per appointment were examined across the intervention and comparison agencies. Changes in ongoing service delivery per-enrollment and per-appointment costs from the pre-implementation to the post-implementation periods were compared for intervention and comparison agencies.

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