Well-Child Care Clinical Practice Redesign for Young Children: A Systematic Review of Strategies and Tools

AUTHORS: Tumaini R. Coker, MD, MBA,[a,b,c] Annika Windon, AB,[d] Candice Moreno, MD, MPH,[a,b] Mark A. Schuster, MD, PhD,[e,f] and Paul J. Chung, MD, MS[a,b,c,g]

[a]Department of Pediatrics, Mattel Children's Hospital, David Geffen School of Medicine, University of California at Los Angeles, Los Angeles, California; [b]UCLA/RAND Prevention Research Center, Los Angeles, California; [c]RAND, Santa Monica, California; [d]Meharry Medical College, Nashville, Tennessee; [e]Division of General Pediatrics, Children's Hospital Boston, Boston, Massachusetts; [f]Department of Pediatrics, Harvard Medical School, Cambridge, Massachusetts; and [g]Department of Health Services, UCLA School of Public Health, Los Angeles, California

KEY WORDS

well-child care, practice redesign, patient-centered medical home

ABBREVIATIONS

AOR—adjusted odds ratio
CI—confidence interval
ED—emergency department
GWCC—group well-child care
HS—Healthy Steps for Young Children Program
HSS—Healthy Steps specialist
IRR—incidence rate ratio
IWCC—individual well-child care
NP—nurse practitioner
RCT—randomized controlled trials
WCC—well-child care

Drs Coker, Schuster, and Chung are former Robert Woods Johnson Foundation Clinical Scholars.

Dr Moreno is currently affiliated with University of Illinois College of Medicine, Chicago, Illinois.

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Address correspondence to Tumaini Coker, MD, MBA, David Geffen School of Medicine at UCLA, UCLA/RAND Center for Adolescent Health Promotion, 10960 Wilshire Blvd, Suite 1550, Los Angeles, CA 90024. E-mail: tcoker@mednet.ucla.edu

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abstract

BACKGROUND AND OBJECTIVE: Various proposals have been made to redesign well-child care (WCC) for young children, yet no peer-reviewed publication has examined the evidence for these. The objective of this study was to conduct a systematic review on WCC clinical practice redesign for children aged 0 to 5 years.

METHODS: PubMed was searched using criteria to identify relevant English-language articles published from January 1981 through February 2012. Observational studies, controlled trials, and systematic reviews evaluating efficiency and effectiveness of WCC for children aged 0 to 5 were selected. Interventions were organized into 3 categories: providers, formats (how care is provided; eg, non–face-to-face formats), and locations for care. Data were extracted by independent article review, including study quality, of 3 investigators with consensus resolution of discrepancies.

RESULTS: Of 275 articles screened, 33 met inclusion criteria. Seventeen articles focused on providers, 13 on formats, 2 on locations, and 1 miscellaneous. We found evidence that WCC provided in groups is at least as effective in providing WCC as 1-on-1 visits. There was limited evidence regarding other formats, although evidence suggested that non-face-to-face formats, particularly web-based tools, could enhance anticipatory guidance and possibly reduce parents' need for clinical contacts for minor concerns between well-child visits. The addition of a non–medical professional trained as a developmental specialist may improve receipt of WCC services and enhance parenting practices. There was insufficient evidence on nonclinical locations for WCC.

CONCLUSIONS: Evidence suggests that there are promising WCC redesign tools and strategies that may be ready for larger-scale testing and may have important implications for preventive care delivery to young children in the United States. *Pediatrics* 2013;131:S5–S25

Well-child care (WCC) during infancy and early childhood provides a critical opportunity to address important social, developmental, behavioral, and health issues for children. Ideally, WCC provides parents with the knowledge and confidence necessary to ensure that their children meet their full developmental potential and optimal health status. In our current WCC system, this opportunity is often missed; many children either do not receive these important services or receive low-quality services.[1,2] Many parents leave visits with unaddressed psychosocial, developmental, and behavioral concerns,[3–5] and many children do not receive recommended screening for developmental delay.[6,7]

WCC in the United States is structured so that the clinician (pediatrician, family physician, or nurse practitioner [NP]) is expected to provide nearly all recommended services in 13 face-to-face visits during the first 5 years of life. The number of recommended services has expanded beyond what can be accomplished in the typical visit, perhaps contributing to the wide variation in the quantity and quality of services received.[8–10] Pediatric practices interested in changing how they provide WCC can turn to the pediatric literature for a variety of clinical practice redesign options. Researchers and clinicians have described options for improving the delivery of care by focusing on changes to structural elements of care (eg, personnel and organization used for care provision). These changes include using nonphysicians to provide more WCC services, providing some services in non–face-to-face visits, and offering some services outside the clinical setting.[11–18] A comprehensive review of these proposed tools and strategies is needed to help providers make evidence-based decisions regarding WCC clinical practice redesign. To our knowledge, this article provides the first such published systematic review.

The objective of this systematic review is to examine tools and strategies for WCC clinical practice redesign for US children aged 0 to 5, focusing on changes to the structure of care (nonphysician providers [eg, nurses, lay health educators], nonmedical locations [eg, day-care centers, home visits], and alternative formats [eg, group visits, Internet]) that may affect receipt of WCC services, child health and developmental outcomes, and overall quality of WCC.

The conceptual model for this review is based on Donabedian's model for assessing the quality of care based on structure, process, and outcome.[19,20] Structures of care (eg, facilities, equipment, personnel, and organization used for the provision of care) directly influence processes of care (ie, how care is provided and received), ultimately leading to health outcomes (eg, health status),[21] as detailed by Starfield (Fig 1).

METHODS

Data Sources and Article Selection

We searched PubMed for peer-reviewed English-language articles published January 1, 1981, through February 1, 2012 using keywords for WCC (WCC, well-baby care, health supervision) and MeSH terms (primary care, preventive care). We also searched the references of accepted articles. We looked for articles that evaluated a practice-based intervention to change WCC delivery for children aged 0 to 5.

This review focused on interventions to change WCC delivery in primary care settings in the United States. To fulfill this objective, interventions had to be practice-based, applicable to WCC delivery, and based in the United States or other developed country. We did not include articles that (1) evaluated a quality improvement process without identifying a specific change to care delivery, (2) addressed only 1 topic within WCC (eg, car-seat safety) and not WCC services more generally (eg, anticipatory guidance), (3) focused on changes to WCC content or screening without addressing changes in the delivery of services, or (4) evaluated interventions designed solely to increase compliance with or use of typical WCC.

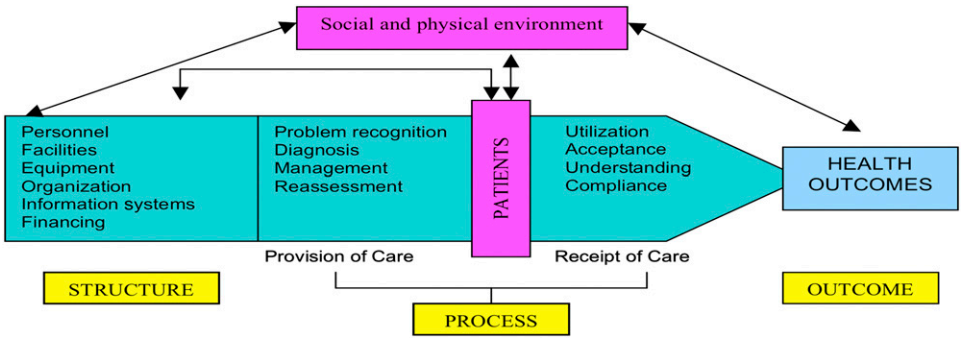

FIGURE 1
Conceptual model: dynamics of health outcome (adapted from Starfield[21]).

Accepted articles were systematic reviews, randomized controlled trials (RCTs), nonrandomized trials, or observational studies of interventions that included children aged 0 to 5 and reported findings related to receipt of WCC services, child health and developmental outcomes, and quality of care.

Three investigators independently screened the initial list of titles to exclude those that appeared irrelevant to the search. Abstracts for all potentially relevant titles were screened by 2 investigators (TC, CM) using a brief structured screening tool to determine whether the article met the inclusion criteria, including (1) study design (systematic review, RCT, non-RCT, observational study), (2) study topic (WCC clinical practice redesign), (3) target population (aged 0–5 years), and (e) country (developed nation[22]). The third investigator (PC) reviewed abstract screening results; disagreements were resolved by consensus. Full-text articles were obtained for accepted abstracts; 2 investigators used a structured form to extract data on design, methods, outcomes, and findings. For RCTs, overall methodologic quality was assessed using the 5-point Jadad score, which evaluates the quality of randomization, blinding, and description of withdrawals and dropouts.[23] Double-blinding is part of the criteria and accounts for 2 points; however, because double-blinding is not feasible in most clinical practice redesign interventions, 3 out of 5 was our maximum score. For observational studies and nonrandomized trials, we used a modified version of the Downs and Black checklist to assess overall methodologic quality, focusing on external validity (3 items), bias (5 items), confounding (4 items), and power (1 item).[24] The maximum possible total score was 13 (1 point per item).

RESULTS

Our initial PubMed search yielded 2234 titles (Fig 2). After 1959 titles were excluded because they were not relevant to WCC clinical practice redesign, 275 titles remained for abstract screening. Of these, 233 abstracts did not meet inclusion criteria for reasons described in Fig 2; 42 abstracts went on to full-text article data extraction. Twenty articles were rejected because they did not meet criteria for WCC clinical practice redesign. Eleven articles were identified through a reference search of accepted articles. Thirty-three articles were accepted; these included 13 articles primarily on alternative formats for WCC,[16,25–36] 2 articles primarily on nonclinical locations for WCC,[37,38] 17 articles primarily on nonphysicians/non-NPs added to enhance WCC,[17,39–54] and 1 miscellaneous article.[55]

Of 13 WCC format articles, 5 were on non–face-to-face formats,[25–28,36] and 8 were on group visit formats.[16,29–35] Of the 17 WCC provider articles, 13 articles and 1 systematic review reported on the Healthy Steps for Young Children Program (HS, which uses a developmental specialist in WCC),[17,39–51] 2 articles reported on a study using a developmental specialist in another intervention,[52,53] and 1 reported on use of a parent coach.[54] The WCC location articles included 1 intervention of home WCC[37] and 1 for preschool-based WCC.[38] The miscellaneous article reported findings from an intervention that included a social worker in visits and so was placed in the provider category. The RCT quality scores (Jadad) were 2 to 3 points; the observational and non-RCT quality scores (modified Downs and Black) were 6 to 12 points (Tables 1, 2, 3, 4, and 5).

Alternative Formats

Group Visits

We found 8 articles (Table 1) that evaluated group WCC (GWCC). In GWCC, families are seen for a well-child visit in a group of 4 to 6 families with similarly aged children. All but 1 study examined GWCC for children from newborn through 12 to 15 months of age; 1 study examined GWCC for children up to age 12. The group discussion section of the GWCC visit was often conducted by the physician or NP and was preceded or followed by measurement, physical examination, and immunization of each child. The group visit took 60 to 90 minutes, allowed parents to have more provider time, and maintained or increased the usual provider time per patient.

Taylor and colleagues[31–33] performed an RCT of GWCC among children at high risk (eg, maternal poverty) and reported results in 3 publications. Investigators enrolled 220 mothers (111 GWCC; 109 individual WCC [IWCC]). There were few statistically significant differences between the study arms in health care utilization, visit compliance, maternal outcomes (eg, stress), and child development. The authors concluded that GWCC was at least as effective as IWCC in providing WCC to children aged 4 to 15 months. In a controlled trial of GWCC with 50 families,[16] investigators found few differences in outcomes between the 2 study arms, but a chart review showed that intervention children had fewer illness visits between well-child visits than control children (27 visits/10 control patients vs 5 visits/12 GWCC patients). These studies do not report an a priori power analysis for all major outcomes and may not be sufficiently powered. In another controlled trial of GWCC (n = 78), intervention parents were less likely to seek advice concerning their child between well-child visits (did not seek advice 89 vs 49 times, $P < .05$).[29] The reason for this decrease in utilization is unclear; parents could have been less likely to seek advice between visits for a number of reasons, ranging from more effective parent education to weaker doctor-parent relationships. Dodds et al[35] conducted an observational

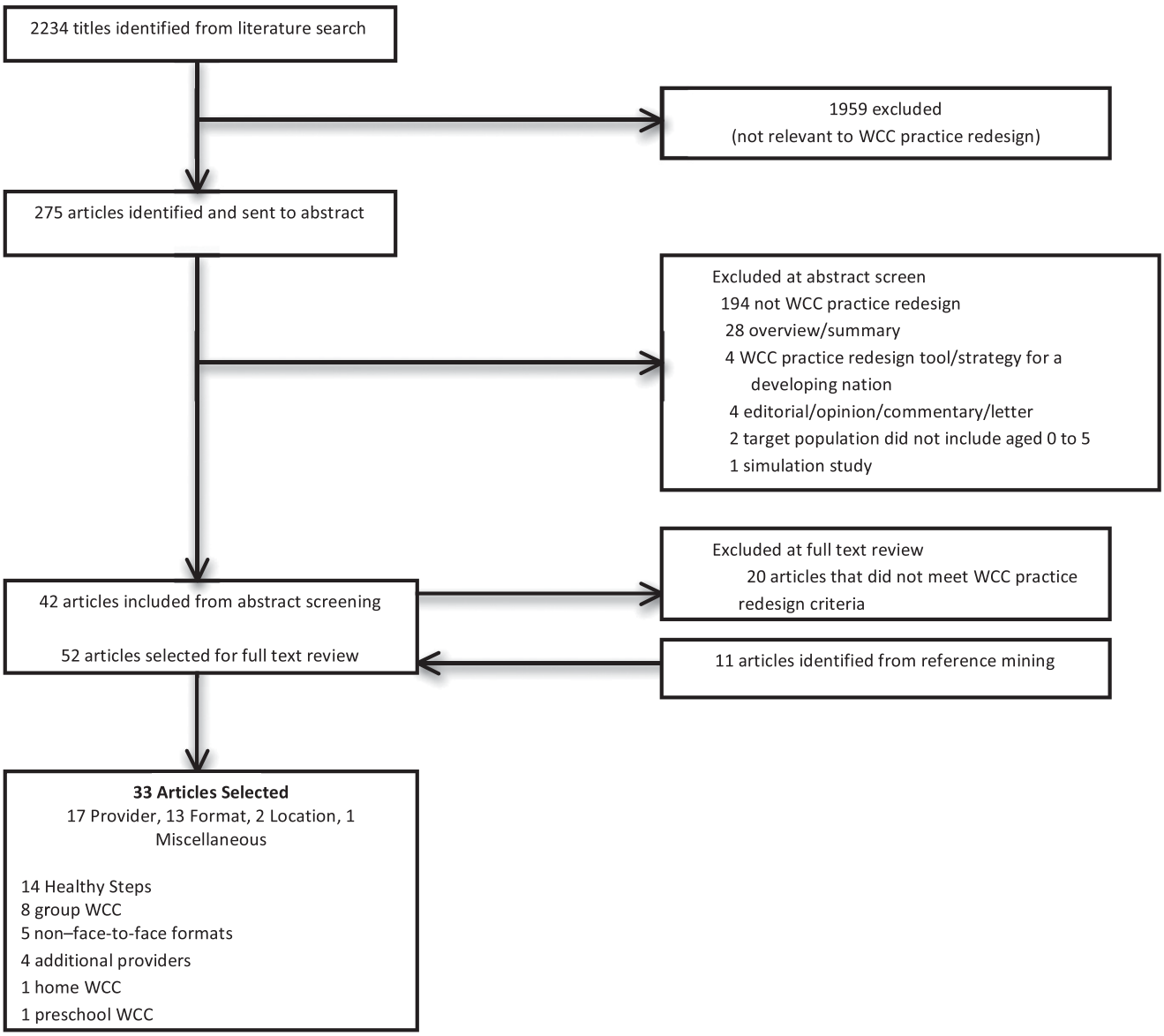

FIGURE 2
Article selection.

study comparing GWCC with IWCC and found that more anticipatory guidance content was covered in GWCC compared with IWCC (eg, 69% vs 41% of behavioral/developmental content, $P < .01$).

Page et al[34] interviewed mothers who participated in GWCC to examine perceptions of the visit format. Participating mothers highlighted several benefits of GWCC, including (1) support from other women, (2) opportunities to make developmental comparisons with other infants, (3) the chance to learn from other participants' experiences, (4) enhanced parental involvement in the visit, and (5) more time with the provider. Saysana et al[30] conducted a study of GWCC in a pediatric residency continuity clinic, with a primary objective of comparing learning experiences for pediatric residents participating in GWCC versus IWCC; the investigators also assessed visit satisfaction for the 7 families who participated in GWCC. Parents were generally satisfied with the visits, but no comparison group was included for parents.

Non–Face-to-Face Formats

Two studies incorporated an Internet-based tool into WCC to deliver anticipatory guidance (Table 2). In Christakis et al,[28] parents received a link to a web-based system, MyHealthyChild, before their well-child visit. On the web site, parents could select age-appropriate and personally relevant topics to receive more information on and to discuss with their provider at the next visit. Providers could access parents' responses and scores on the previsit assessment to tailor the visit. An RCT

TABLE 1 Articles on Group Well-Child Care

First author, year	Design, measurement, outcomes	Major findings
Page, 2010[34]	Controlled trial Enrolled: *N* = 55 families (13 intervention; 42 comparison) Intervention: GWCC facilitated by physician Child age: 0–12 mo Qualitative interviews and chart review Outcomes included • Parent perspectives on GWCC • Health care utilization and clinic retention at 12 mo Downs & Black score (modified): 8	Mothers reported the following benefits from group visits: 1. Support from other women 2. Opportunities to make developmental comparisons with other infants 3. Learning from other participants' experiences 4. Enhanced parental involvement in the visit 5. More time with the provider in the visit Healthcare utilization / GWCC (*n* = 11) / IWCC (*n* = 25) ED visits: 7 visits/11 patients (0.64); 20 visits/25 patients (0.8) Hospitalizations: 0 hospitalizations; 1 hospitalization Acute ambulatory visits: 43 visits/11 patients (3.9); 110 visits/25 patients (4.4) No statistical testing was performed on quantitative data.
Saysana, 2011[30]	Observational study *N* = 7 families (7 intervention; no comparison group) Intervention: 6 scheduled group well-child visits for first year of infant's life Child age: 1–12 mo Six-item parent survey after each group visit Outcome: parent satisfaction Downs & Black score (modified): 7 Cluster RCT Enrolled: *N* =27 residents (9 intervention; 18 control) Resident survey Outcome: resident learning experience (results not reported here) Downs & Black score: N/A	Results of parent survey: Twenty-eight surveys were collected from the 7 intervention families, nearly always answering "agree" or "strongly agree" for • Satisfaction with visits, • Understanding of information shared at visits, • Usefulness of information shared, • Having their questions answered, and • Having enough time to ask questions at visits

TABLE 1 Continued

First author, year	Design, measurement, outcomes	Major findings			
Taylor, 1997, Taylor, 1997a, Taylor, 1998[31]	RCT	Outcomes (Taylor 1997[33])	GWCC (n = 106)	IWCC (n = 104)	P value
	Enrolled: n = 220 families (111 intervention; 109 control)	Visit compliance	47%	54%	NS
		Provider time per patient, minute, mean (SD)	19 (7.1)	20 (8.6)	NS
	Intervention: GWCC visits	Immunizations up-to-date at 1 y	67%	73%	NS
		ED visits, mean (SD)	1.12(1.98)	1.18(1.62)	NS
	Child age: 4–15 mo	Child health status score, mean (SD)	92.4 (1.4)	92.5(1.1)	NS
	Parent questionnaires, standardized inventories, and chart review	Outcomes (Taylor 1998)	GWCC	IWCC	P value
	Outcomes included the following:	Maternal competence (% with low-risk score)	41/72 (57%)	35/69(51%)	NS
	• Health care utilization	Maternal social isolation (% with low-risk score)	48/71 (68%)	61/80 (76%)	NS
	• Child health status	Maternal social support (% with low-risk score)	56/75 (75%)	66/83 (80%)	NS
	• Maternal competence	Child Protective Services referral	7/80 (9%)	7/84 (8%)	NS
	• Maternal isolation				
	• Maternal support	Outcomes (Taylor 1997[32])	GWCC (n = 50)	IWCC (n = 50)	P value
	• CPS referral	Bayley motor index, mean (SD)	103.6(11.5)	100.0 (12.4)	NS
	• Infant development (Bayley)	Bayley mental index, mean (SD)	99.3 (14.8)	100.4 (14.3)	NS
	• Maternal-child interactions (NCATS)	NCATS, high risk (%)	10%	10%	NS
	• Home environment (HOME)	HOME assessment, high risk (%)	4%	16%	NS
	Jadad score: 2				
Rice, 1997[16]	Controlled trial (sequential assignment to intervention versus control)	Outcomes	GWCC (n = 25)	IWCC (n = 25)	P value
		Knowledge of child health and development, mean score (SD)	5.08 (3.58)	3.24 (3.39)	NS
	Enrolled: n = 50 families (25 intervention; 25 control)	Maternal social support, mean score (SD)	0.28 (3.96)	0.48 (5.56)	NS
	Intervention: GWCC	Maternal depression, mean score (SD)	2.00 (6.65)	4.38 (10.45)	NS
	Child age: 2–10 mo				
	Parent questionnaires, standardized instruments, and chart review	Outcomes	GWCC (n = 12)	IWCC (n = 10)	P value
		Illness-related office visits up to 4 mo of age	NR	NR	NS
	Outcomes included:	Illness-related office visits from 4–6 mo of age	5 visits in 12 patients	27 visits in 10 patients	NR
	• Parent knowledge of child health and development				
	• Maternal social support				
	• Depression recovery				
	• Illness-related visits				
	Downs & Black score (modified): 9				

TABLE 1 Continued

First author, year	Design, measurement, outcomes	Major findings			
Dodds, 1993[35]	Observational study	For most AAP-recommend categories, more content was covered in GWCC versus IWCC visits			
	N = 76 health supervision visits (14 intervention; 62 comparison group)	Percent of content covered	GWCC	IWCC	*P* value
	Intervention: GWCC	Safety	51%	25%	<.01
	Child age: 2 and 12 mo	Nutrition	59%	47%	<.01
	14 GWCC visits observed 62 IWCC visits observed	Behavior and development	69%	41%	<.01
		Family and parenting issues	56%	15%	NS
	Coded visit content for topic categories	Sleep	72%	50%	<.01
	Outcome: amount of content covered during health supervision visits	Toilet	100%	66%	NS
	Downs & Black score (modified): 10				
Osborn, 1981[29]	Controlled study	Outcomes	GWCC *N* = 42	IWCC *N* = 36	*P* value
	Enrolled: *N* = 78 families (42 intervention; 36 control)	Clinician time per infant, min, mean	15	16	NS
		Visit compliance, number of visits, mean	3.4	2.9	NS
	Intervention: 3 GWCC visits within first 6 mo of life	Number of times illness not reported in infant	97	55	<.001
		Number of times mothers sought advice between visits	54	54	NS
		Number of times mothers did not seek advice between visits	89	49	<.05
	Child age: 2 wk–6 mo	Content analysis of visits:			
	Parent questionnaires, parent interviews, and tape recordings	Comparing GWCC to baseline, more time was spent discussing personal concerns in the infant's daily care (28% vs 11%, $P < .005$), and less time was spent discussing medical aspects of care (23% vs 57%, $P < .002$). Similar results were found comparing GWCC to the IWCC study visits; more time spent discussing personal concerns (28% vs 22%, $P < .002$) and less time spent discussing medical aspects (23% vs 43%, $P < .02$)			
	Outcomes included the following:	Process analysis of visits:			
	• Clinician time spent per infant	Compared with baseline, providers in GWCC visits had a decrease in direct questions (10% vs 29%, $P < .001$) and reassurance (4% vs 10%, $P < .02$) but an increase in explanations (57% vs 28%, $P < .001$). Compared with IWCC study visits, the intervention visits had more indirect questions (11% vs 7%, $P < .02$), less reassurance (4% vs 9%, $P < .02$), and fewer direct questions (10% vs 22%, $P < .001$).			
	• Patient visit compliance				
	• Health care utilization				
	• Content and process of visits				
	Downs & Black score (modified): 9				

AAP, American Academy of Pediatrics; HOME, Home Observation for Measurement of the Environment; NCATS, Nursing Child Assessment Teaching Scale; NR, not reported; NS, not significant.

TABLE 2 Non–Face-to-Face Formats

First author, year	Study design	Major findings
Paradis, 2011[27]	RCT Enrolled: *N* = 137 families (70 intervention; 67 control) Intervention: 15-min educational DVD for anticipatory guidance at newborn visit Child age: ≤1–2 mo Parent survey and chart review Outcomes included: • Parent knowledge of infant development • Self-efficacy with infant care skills • Problem-solving competence Jadad score: 3	No differences in scores on scales for parent competence, self-efficacy, or knowledge of infant development. Parents in control group had 2.6 times greater odds of having 1 additional office visits between the newborn and 2-mo visits (adjusted odds ratio 2.6, 95% CI: 1.3–5.5)
Bergman, 2009[25]	Observational study Families: *N* = 78 • E-visit only (*n* = 10) • E-visit with brief provider visit (*n* = 25) • Extended CSHCN visit (*n* = 15) Tailored visit (*n* = 28)[a] Providers: *N* = 7 Intervention: model for WCC that includes 3 visit types Parent and provider phone surveys Outcomes included • Feasibility of intervention • Acceptance of intervention Downs & Black score (modified): 6	Outcomes: Parent satisfaction with WCC visit — E-visit: 80% — E-visit + in-person visit: 84% — Tailored visit: 80% Parent perception that the model of care: Helped them to prepare for visit — E-visit: N/A — E-visit + in-person visit: 92% — Tailored visit: 94% Helped to them identify important topics — E-visit: 70% — E-visit + in-person visit: 84% — Tailored visit: 80% Improved efficiency of WCC visit — E-visit: 90% — E-visit + in-person visit: 88% — Tailored visit: 80%
Christakis, 2006[28]	RCT Enrolled: *N* = 887 families Web content + provider notification (*n* = 210) Web content only (*n* = 238) Provider notification only (*n* = 211) Control group (*n* = 228) Intervention: tailored, evidence-based web site for prevention topics Child age: 0–11 y Parent interview and home visit validation of practices Outcomes included • Number of prevention topics discussed • Number of prevention practices adopted Jadad score: 3	Discussion of prevention topics • All intervention groups vs control: IRR (CI) 1.07 (1.01–1.14) • Content + notification group vs control: IRR 1.09 (1.00–1.20) Implementation of prevention topics • All intervention groups vs control: IRR 1.04 (1.01–1.06) • Content + notification group vs control: IRR 1.07 (1.03–1.11)

TABLE 2 Continued

First author, year	Study design	Major findings	Intervention (N = 49)	Control (N = 52)	P value
Sanghavi, 2005[26]	Controlled trial	Parent knowledge of AG topics			
	N = 101 families (49 intervention; 52 control)	Perfect score or only 1 question wrong	35%	2%	<.001
	Intervention: interactive, self-guided educational kiosk for anticipatory guidance	Average % of questions correct	81%	61%	.01
	Child age: 6 wk and 4 mo				
	Parent questionnaire				
	Outcome: parent knowledge of AG topics				
	Downs & Black score (modified): 12				
Kempe, 1999[36]	Observational study	Audiotaped survey of users			
	N = 561 audiotaped survey users	PAL made a call to physician unnecessary: 69%			
		PAL made a visit to physician unnecessary: 70%			
	N = 137 telephone survey users/nonusers (44 users; 93 nonusers)	PAL answered their question: 87%			
		Would use PAL again: 98%			
	Intervention: Parent Advice Line (PAL), collection of 278 health-related messages accessible by phone	Telephone survey of random sample of users (n = 44)			
	Child age: <12 y	Satisfaction with PAL: 86%			
	Audiotaped survey and telephone survey				
	Outcomes included				
	• Utilization of PAL				
	• User satisfaction				
	• Effect on health-seeking behavior				
	Downs & Black score (modified): 8				

[a] All participants completed the web-based preassessment tool; participants in the tailored visit group had a regular visit tailored to their responses. AG, anticipatory guidance.

with 887 parents was conducted, demonstrating a modest increase in the number of topics discussed (8%–9% more topics discussed in intervention visits; incidence rate ratio [IRR] 1.07, 95% confidence interval [CI]: 1.01–1.14) and in the number of prevention-related changes parents made in response (implemented 5%–7% more topic suggestions; IRR 1.04, 95% CI: 1.01–1.06). A similar tool was studied in Sanghavi et al.[26] An educational kiosk provided anticipatory guidance to parents in the waiting room before a 6-week and 4-month well-child visit. The controlled trial showed greater knowledge among intervention versus control parents on prevention-related topics (81% vs 61% of questions answered correctly, P = .01).

Bergman et al[25] recognized that one format may not work for all families. This study examined a tailored WCC model in which the provider chose visit type on the basis of the family's needs. Parents completed web-based developmental and behavioral screening before their visit. Sixty-three families received WCC in 1 of 3 ways: (1) electronically (e-visit) with no in-person contact with the provider, (2) as an e-visit paired with a brief in-office encounter, or (3) as an expanded well-child visit for children with special health care needs. Parents with each visit type were satisfied with their visit and reported that it was more efficient than a usual visit. Parents with an e-visit only did not think that it should be used for all visits.

Two studies examined more "low-tech" formats to enhance anticipatory guidance in WCC. Kemp et al[36] examined a parent phone advice line that provided pre-recorded messages on 278 topics related to preventive care, health promotion, behavior and development, and mild acute illness management. Of 561 phone-system users, most reported that their use of the phone system had

TABLE 3 Alternative Locations of Care

First author, year	Study Design	Major Findings
Gance-Cleveland, 2005[38]	Observational study *N* = 261 families 130 families from preschool with PBHC 131 families from preschool without PBHC Intervention: PBHC program that included WCC, minor acute care, immunizations, mental health services, and assistance with enrolling in low-cost insurance Child age: 3–5 y Parent survey Outcomes included the following: • Obtaining healthcare services • Satisfaction with care (results not reported here) • Parent-perceived child health problems Downs & Black score (modified): 6	The 2 groups of parents were not demographically similar and no adjustments were made in the analysis. Parents without access to the PBHC were more likely to receive public assistance, have a child on the free/reduced lunch program, have a single parent household, and have lower educational goals for their child. The study found no significant differences in parent-reported health problems between the 2 groups, but did find that the PBHC children had fewer parent-reported behavioral problems in school. Other significant findings (PBHC vs comparison group): • Access to care (97% vs 89%, $P < .001$) • No problems getting care for child (64% vs 50%, $P = .019$) • No problems getting immunizations (92% vs 82%, $P = .005$) • No problems getting physical health services (84% vs 79%, $P = .045$)

Christ, 2007[37]	Controlled trial[a]	Outcomes	Intervention %	Control %	*P* value
		Maternal satisfaction with			
	Enrolled: *N* = 630 families (150 intervention; 480 control)	• Convenience of visit	91	61	<.05
		• Caring attitude of provider	93	75	<.05
	Intervention: home visit for 2-wk well-baby visit	• Time spent with provider	86	64	<.05
		• Skills/abilities of provider	90	73	<.05
	Child age: 2 wk; assessment at 4–6 wk	• Preventive advice given	85	65	<.05
		• Overall care since birth	86	73	NS
	Parent telephone questionnaire	Preference for clinic over home visit	6	48	<.05
		Anticipatory guidance given on			
	Outcomes included the following:	• Sleep position	96	69	<.05
	• Maternal satisfaction	• Comforting baby	85	55	<.05
	• Quality of anticipatory guidance	• How to get help for the baby	97	72	<.05
	• Health care utilization	• Baby's weight	99	95	NS
		Exclusive breastfeeding	47	38	NS
		Utilization outcomes	Intervention no.	Control no.	*P* value
	Downs & Black score (modified): 9	Contacted advice lines	0	0	NS
		Acute care visits to ED or clinic	1	1	NS

NS, not significant; PBHC, preschool-based health center.

[a] The study was likely underpowered to detect differences between the 2 groups; the authors provided a power analysis estimation of 500 patients per study arm.

made a subsequent call (69%) or related visit (70%) to their doctor unnecessary. Paradis et al[27] conducted an RCT of an anticipatory guidance DVD shown to 70 parents at the newborn visit. Scores on parent knowledge, self-efficacy, and competency measured after 2 weeks were similar between the 2 groups; however, intervention parents were less likely to have a sick visit or other problem-related visit outside of scheduled WCC visits (39% vs 63%, $P = .01$). It is not clear whether this decreased utilization was related to a reduced need (eg, improved parent knowledge) or unmet need.

Nonclinical Locations

Two studies examined WCC redesign in terms of location of care (Table 3). Other studies that we reviewed incorporated home visits into their WCC model (ie, HS); however, only 1 study used home visits as its primary location for WCC. There is a large literature on home

TABLE 4 Other Providers Added to the Well-Child Visit

First author, year	Study Design	Major Findings			
Farber, 2009[54]	Observational study	Parent outcomes	Intervention mean (SD)	Comparison mean (SD)	*P* value
	N = 80 families (50 intervention; 30 comparison)	Total basic needs score (*n* = 65)	52.4 (7.8)	44.9 (9.0)	.001
			28.0 (3.4)	20.2 (7.2)	<.001
			28.8 (5.0)	25.5 (5.8)	.025
	Intervention: parent mentoring with a parent coach to strengthen anticipatory guidance	Total needs and resources score[a]	117.8 (15.9)	96.1 (20.3)	<.001
		Total knowledge of nurturing practices and childrearing beliefs[a] (*n* = 65)	0.63 (0.76)	1.50 (1.10)	.001
		Total resilience score (*n* = 58)	108.5 (11.0)	101.2 (11.2)	.026
	Child age: newborn–18 mo	Child Outcomes	Intervention mean (SD)	Comparison mean (SD)	*P* value
	Standardized inventories and instruments, and chart review	Expressive vocabulary, mean (*n* = 40)	83 (9.6)	73 (12.2)	.01
		Receptive vocabulary, mean (*n* = 40)	89 (11.6)	79 (12.5)	.02
	Parent outcomes: • Adequacy of family needs and resources • Parent knowledge of nurturing practices and childrearing beliefs • Personal resilience				
	Child outcomes: • Immunizations • Developmental milestones • Emerging language competency				
	Downs & Black score (modified): 6				
Mendelsohn, 2005,[52] 2007[53]	RCT	Outcomes at 21 mo (Mendelsohn 2005)	ANOVA, *F* statistic		*P* value
	Enrolled: *n* = 150 families (77 intervention; 73 control)	Cognitive development (MDI)	*F* = 5.4 (*n* = 93)		.02
	Intervention: an approach to WCC that adds a child developmental specialist to the regular well visit from age 2 wk to 3 y	Language development (expressive)	*F* = 2.0 (*n* = 91)		.16
		Language development (receptive)	*F* = 1.2 (*n* = 91)		.27
	Child age: 2 wk–33 mo; assessments at 6, 9, 21, 33 mo	Outcomes at 33 mo (Mendelsohn 2007)	Intervention (*N* = 51)	Control (*N* = 46)	*P* value
	Standardized inventories and instruments, and video recording	Parenting stress (PSI), % in clinical range	39	59	.09
		Parent-child dysfunction subscale, % in clinical range	37	48	.40
	Outcomes included:	Difficult child subscale, % in clinical range	29	28	1.0
	• Maternal depression (CES-D)	Maternal depression, % in clinical range	19	26	.61
	• Parenting stress (PSI) and subscales	Cognitive MDI score, % normal	64	44	.048
	• Child cognitive development (MDI)	Language PLS-3 score, % normal	31	36	.69
	• Language development (PLS-3)	Behavior CBCL score, % in clinical range	8	17	.16
	• Child behavior (CBCL) Jadad score: 2				

TABLE 4 Continued

First author, year	Study Design	Major Findings			
O'Sullivan, 1992[55]	RCT	Outcomes at 18 mo	Intervention %	Control %	*P* value
	N = 243 teen mothers (120 intervention; 123 control)	Visit attendance for well-baby visits	40	18	.002
	Intervention: physician/nurse practitioner alternating WCC visits; social worker at 2-wk visit; waiting-room health education by NP and trained volunteers using video and slides	Repeat pregnancies	12	27	.003
		Return to school	56	55	NS
		Infant fully immunized	33	18	.011
		At least 1 ED visit for infant care	76	85	NS
	Child age: newborn to 18 mo				
	Parent interview, chart review, and school attendance				
	Outcomes: • Repeat pregnancy rate • Mother returning to school • Immunization status • ED visits				
	Jadad score: 2				

ANOVA, analysis of variance; CBCL, Child Behavior Checklist, CBCL, Child Behavior Checklist; CES-D, Center for Epidemiological Studies-Depression Scale; MDI, Bayley Scales of Infant Development, 2nd Edition, Mental Development Index; PLS-3, Preschool Language Scale -3; PSI, Parenting Stress Index.

[a] Higher scores on this scale indicate parenting difficulties.

visitation to improve health and well-being for families with young children; this literature is reviewed elsewhere.[56–60] We focus on studies that examined home visits explicitly to deliver WCC.

Christ et al[37] conducted a controlled trial of home WCC among military families for the 2-week well-child visit. Home visits lasted 60 to 90 minutes, were provided by an NP, and included all typical WCC services. The investigators compared 480 usual care clinic visits to 150 home visits and found that maternal perceptions of visit quality was higher for home visits (satisfaction with preventive advice given was 85% vs 65%, $P < .05$), but they found no differences in acute care utilization.

Gance-Cleveland et al[38] compared parent-reported child health status, access to care, perceptions of care, and health care utilization for 261 children aged 3 to 5 years at 2 preschools, 1 with and 1 without access to a preschool-based health center that provided WCC. The preschoolers with health center access were less likely to have behavioral problems in school ($P = .01$, estimates not reported), problems getting care (64% vs 50%, $P = .02$), and unnecessary emergency department (ED) visits (12% vs 22%, $P < .001$) reported by parents. However, there were significant differences in respondents' demographics, suggesting that the 2 schools were not adequately matched on socioeconomics. Parents of children from the preschool without health center access were more likely to receive public assistance ($P = .003$, point estimates not reported), to use the free or reduced lunch program ($P < .001$), to have a single-parent household (*P* value not reported), and to report lower educational goals for their children (*P* value not reported).

Nonphysician Providers

Studies of 3 interventions examined the use of additional providers to enhance WCC. The first of these interventions, HS, is a program in which a physician and child developmental specialist (typically a nurse, social worker, or early childhood educator[61]) provide WCC in partnership. The program includes well-child visits conducted jointly or consecutively by the physician and HS specialist (HSS), as well as other services offered by the HSS, including 6 home visits during the first 3 years of life, a child development telephone information line, written information on prevention, and monthly parent group sessions. In 2009, Piotrowski et al published a systematic review of the literature evaluating HS.[51] There were 13 articles included in this review, from 1999 to 2007; we have summarized them in Table 5. Among the 13 articles, 8 analyzed data from a large, national 3-year prospective, randomized controlled and quasi-experimental trial at 15 US sites that evaluated the program with 5565 newborns.[17,39,40,45–49] Three articles report data from an extension study at a large integrated health maintenance organization,[41–43] and 2 report findings from residency continuity clinics that implemented HS as part of the national program.[44,50]

Chart review and parent interview at child age 30 to 33 months revealed that intervention children were more likely to have timely well-child visits (eg, 12-month visit 90% vs 81%, $P < .001$), be up-to-date on vaccinations at 24 months (83% vs 75%, $P < .001$), remain at the practice for ≥20 months (70% vs

TABLE 5 Healthy Steps Articles Included in Piotrowski et al Review

First Author, Year	Design, Outcomes	Findings			
			Adjusted odds ratio (95% CI)	Child age	Article first author, yr
Minkovitz, 2001[47]; Minkovitz, 2003[17]; Minkovitz, 2007[49]	Controlled trial				
	6 RCT sites (n = 1987)				
	9 quasi-experimental sites (n = 2909)	Quality of care outcomes			
	Parent questionnaire at enrollment	Patient-centeredness			
		• Providers' helpfulness	2.09 (1.80–2.43)	30 mo	Minkovitz, 03
	Phone interview at infant age 2–4 mo	• Dissatisfied with provider support	0.37 (0.30–0.46)	30 mo	Minkovitz, 03
		• Dissatisfied with provider listening	0.67 (0.53–0.84)	30 mo	Minkovitz, 03
	Phone interview at child age 30–33 mo	• Dissatisfied with provider respect	0.79 (0.63–1.00)	30 mo	Minkovitz, 03
	6 RCT sites (n = 1593)	Up to date with immunizations at 24 mo	1.59 (1.27–1.98)	30 mo	Minkovitz, 03
	9 quasi-experimental sites (n = 2144)	Had 24 mo WCV	1.68 (1.35–2.09)	30 mo	Minkovitz, 03
		Had developmental assessment	8.00 (6.69–9.56)	30 mo	Minkovitz, 03
	Phone interview at child age 5.5 y	Discussed 5 of 6 AG topics at 2 mo, >7 of 10	2.41 (2.10–2.75)	2 mo	Minkovitz, 01
		AG topics at 30 mo, or >4 of 6	10.36 (8.5–12.6)	30 mo	Minkovitz, 03
		AG topics at 5 y	1.33 (1.13–1.56)	5 y	Minkovitz, 07
	6 RCT sites (n = 1724)	Composite measure -clinician provides	2.33 (1.82–3.03)	2 mo	Minkovitz, 01
	9 quasi-experimental sites (n = 1441)	support for parent	2.70 (2.17–3.45)	30 mo	Minkovitz, 03
			1.25 (1.02–1.53)	5 y	Minkovitz, 07
	Outcomes:	• Remained at practice	1.82 (1.57–2.12)	30 mo	Minkovitz, 03
	• Receipt of intervention services (results		1.19 (1.01–1.39)	5 y	Minkovitz, 07
	not reported here)	• Hospitalizations in past year	1.14 (0.84–1.54)	30 mo	Minkovitz, 03
	• Parenting practices		0.90 (0.57–1.42)	5 y	Minkovitz, 07
	• Perceptions of care	• ED use in past year	1.03 (0.89–1.20)	30 mo	Minkovitz, 03
	• Quality of care	• ED use in past year, injury-related	0.77 (0.61–0.97)	30 mo	Minkovitz, 03
	• Child behavior		1.00 (0.83–1.20)	5 y	Minkovitz, 07
	Downs & Black score (modified): 12	Discipline			
		• Ever slap face or spank with object	0.73 (0.55–0.97)	30 mo	Minkovitz, 03
			0.68 (0.54–0.86)	5 y	Minkovitz, 07
		• Use harsh discipline	0.78 (0.62–0.99)	30 mo	Minkovitz, 03
			0.98 (0.74–1.30)	5 y	Minkovitz, 08
		• Use negotiation	1.16 (1.01–1.34)	30 mo	Minkovitz, 03
			1.20 (1.03–1.39)	5 y	Minkovitz, 07
		• Ignore misbehavior	1.38 (1.10–1.73)	30 mo	Minkovitz, 03
			1.24 (0.97–1.59)	5 y	Minkovitz. 07
		Parent perception of child behavior and development			
		• Parent concern for behavior	1.26 (1.01–1.57)	30 mo	Minkovitz, 03
			1.35 (1.10–1.64)	5 y	Minkovitz. 07
		Aggressive behavior	0.40 (0.06–0.75)	30 mo	Minkovitz, 03
		Anxious or depressed	0.19 (−0.004–0.38)	30 mo	Minkovitz, 03
		Problems sleeping	0.20 (0.03–0.36)	30 mo	Minkovitz, 03
		Parenting practices			
		• Follows routines	1.00 (0.88–1.13	2 mo	Minkovitz, 01
			1.03 (0.88–1.20)	30 mo	Minkovitz, 03
			1.02 (0.82–1.26)	5 y	Minkovitz, 07

TABLE 5 Continued

First Author, Year	Design, Outcomes	Findings		
		• Depressed parent discussed sadness with someone in practice	1.60 (1.09–2.36)	30 mo Minkovitz, 03
		• Parent and child book sharing	1.22 (1.07–1.40)	2 mo Minkovitz, 01
			0.96 (0.82–1.12)	30 mo Minkovitz, 03
			1.16 (1.00–1.35)	5 y Minkovitz, 07
		• Lowered water temp on water heater	1.03 (0.89–1.20)	30 mo Minkovitz, 03
		• Uses covers on outlets	1.17 (0.92–1.48)	30 mo Minkovitz, 03
		• Uses safety latches on cabinets	1.09 (0.86–1.39)	30 mo Minkovitz, 03
Caughy, 2003;[40] Caughy, 2004[39]	Observational study of 2 HS randomized sites *N* = 378 families at 16- to 17-mo home observation (217 intervention, 161 control) *N* = 233 families at 34- to 37-mo home observation (34 intervention, 99 control) Child age: birth to 37 mo In-home observation and parent interview Parenting outcomes • Sensitive parent-child interaction- Nursing Child Assessment by Satellite Training • Appropriate Parent Interaction-Parent/Caregiver Involvement Scale (P/CIS) • Optimal home environment—Home Observation for Measurement of the Environment Inventory Child outcomes • Child attachment—Attachment Q-Sort • Problem behaviors—Child Behavior Checklist • Self-regulation—Toy Clean Up Task Discipline outcomes • Inductive/authoritative discipline strategies (eg, timeouts) vs punitive discipline strategies (eg, spanking)—Parental Responses to Child Misbehavior Downs & Black score (modified): 11	Caughv 2003 Parent discipline • Intervention parents were more likely to use inductive/authoritative discipline strategies compared with control group parents at 16 mo; at 34 mo, there was no difference between the 2 groups. There was no difference between groups at either 16 or 34 mo on the use of punitive strategies. • Intervention vs control mean scores (SD) for inductive/authoritative: 0.10 (0.07) vs –0.12 (0.08) at 16 mo, $P < .05$ Caughv 2004 Parent outcomes • No differences in parent outcomes between intervention and control at 16 mo. At 34 mo, intervention group parents were more likely to interact sensitively and appropriately with their child compared with control parents. Child outcomes No differences in child outcome at 16 or 34 mo between intervention and control.		
Huebner, 2004,[41]; Johnston, 2004[43]; Johnston, 2006[42]	Quasi-experimental comparison Enrolled: *N* = 439 women (301 intervention; 136 comparison) Integrated delivery system Three intervention clinics Two comparison clinics Intervention: HS + prenatal component or HS alone	Outcome Child Health and Development (Johnston 2006) 24-mo well-visit attendance Immunization up to date at 24 mo Language development • Combines 2 words at 24 mo	Adjusted rate ratio (95% CI) 1.0 9 (0.97–1.22) 1.06 (1.02–1.09) 1.02 (0.94–1.12)	

TABLE 5 Continued

First Author, Year	Design, Outcomes	Findings	
	Child age: 0–30 mo	• Two-word endings, ≥3 vs <3	1.10 (0.82–1.50)
	Parent survey at 3 mo and 30 mo	Maternal Depression	
	Outcomes	• Clinically significant symptoms	1.21 (0.80–1.82)
	• At 3 mo-	• Discussed sadness with provider	1.45 (0.95–2.21)
	• Parental knowledge of development	Breastfeeding duration >6 mo	1.18 (1.11–1.26)
	• Parenting practices	Parenting Practices	
	• Parental satisfaction with quality of provider	Reads with child	1.03 (0.96–1.10)
	• At 30 mo-	Plays with child	1.01 (0.99–1.02)
	• Child health and development	TV viewing >1 h/d	0.75 (0.62–0.90)
	Child behavioral problems	Follows 3 routines	1.12 (1.03–1.22)
	• Nurturing parenting style	Injury prevention index (5 vs <5 score)	1.19 (1.09–1.28)
	• Parenting self-efficacy	Spanking with object/slapping in face	0.46 (0.29–0.73)
	• Health care self-efficacy	Continuous outcomes (Johnston 2006)	Adjusted linear coefficient (95% CI)
	Maternal depressive symptoms	Child behavior problems	
	Parenting Practices	• Aggressive behavior score, continuous	0.83 (0.37 to 1.30)
	Downs & Black score (modified): 12	• Sleep problems score, continuous	0.09 (−0.29 to 0.48)
		• Anxious or depressed mood score, continuous	0.03 (−0.44 to 0.50)
		Parenting competence score, continuous	−0.92 (−1.40 to −0.44)
		Health care self-efficacy score, continuous	0.04 (−0.28 to 0.36)
		Parenting nurturing scale, continuous	−0.06 (−0.42 to 0.31)
		Outcome (Johnston 2004)	Adjusted rate ratio (95% CI) or linear regression coefficient (95% CI) when indicated
		Parental knowledge	
		• of infant development, linear regression	0.02 (0.00– 0.03)
		• of safe sleep positions	1.01 (0.98 – 1.04)
		• of appropriate discipline	1.08 (1.04 – 1.11)
		Parenting practices	
		• Home safety score, linear regression	0.10 (0.02– 0.17)
		• Breastfeeding at 3 mo	1.14 (1.09–1.20)
		• Tobacco-free home	0.97 (0.94–0.99)
		• Safe sleep	1.02 (0.98–1.05)
		• Reading with child	1.12 (1.04–1.22)
Minkovitz, 2003a		Clinician perspectives	Intervention group providers odds ratio (95% CI) 30-mo vs baseline
	Cross-sectional survey	Practice barriers	
	N = 118 clinicians at baseline (80 intervention surveys, 70 control surveys)	• Limited staff to address needs of families	0.43 (0.08–2.40)
		• Problems with reimbursement	1.86 (0.76–4.53)
		• Inadequate time with families	1.87 (0.76–4.56)

TABLE 5 Continued

First Author, Year	Design, Outcomes	Findings
	N = 99 clinicians at 30-mo follow-up (69 intervention surveys, 70 control surveys)	Discussed family psychosocial risk factors 0.64 (0.33–1.25)
	Child age: birth-3 y Provider and staff surveys Outcomes included the following: • Perspectives on HSS • Perspectives on HS program Results shown are for quasi-experimental group only; changes from baseline to 30 mo Downs & Black score: N/A[a]	Satisfied with ability of clinical staff to meet needs of families 4.05 (1.15–14.2) Perceptions of HSS • Talks to parents about child behavior/development 7.58 (2.08–27.67) • Shows parents activities and gives information about what to do with their child 5.85 (1.89–18.09) • Provides parents with support, helps with stress, and refers for parent emotional problems 5.84 (1.80–19.01) • Discusses temperament and/or sleep problems 5.64 (1.40–22.68)
Kizner, 2004[44]	Observational study N = 37 residents (37 intervention; no comparison) Child age: birth to 3 y Survey of resident physicians involved with JS Outcomes included: • Perceptions of HSS • Perception of HS program Downs & Black score: N/A[a]	Resident perceptions of HSS (N = 29 residents) • 69%: HSS assisted with resident learning of anticipatory guidance • 69%: HSS facilitated resident knowledge of common responses to behavioral and developmental concerns • 69%: HSS helped patients receive information efficiently • 62%: HSS did not interfere with resident-parent relationship • 66%: Enjoyed working with the HSS • 76%: Would consider using HSS in their future practice • 35%: HSS improved clinic efficiency Resident perceptions of Healthy Steps Program (N = 29 residents) • 90%: HS did not help improve resident knowledge of family violence • 97%: HS did not help improve resident awareness of mental illness • 69%: HS did not help the resident establish community contacts and referrals
Niederman, 2007[50]	Controlled trial N = 363 children (71 intervention, 292 control) Child age: birth to 3 y Chart review Outcomes included the following: • Continuity of care • Longitudinal care • Quality of care • Rates of diagnoses Downs & Black score (modified): 9	Intervention children had greater continuity of care for well-child visits compared with control children (52% vs 28% with scores indicating excellent continuity). This was measured for intervention and control group children at 1 site (n = 263) using the Continuity of Care Index of Bice and Boxerman. The score is 0 to1, with 0 indicating that all visits were made with different providers and 1 indicating that all visits were made with 1 provider. There were no statistically significant differences between intervention and control children for • longitudinality of care • quality of care (immunizations, anemia and lead screening) • behavioral, developmental, or psychosocial diagnoses
McLearn, 2004[45]	Cross-sectional survey of clinicians (physicians and NPs) at 20 HS program sites N = 104 clinicians at baseline N = 120 clinicians at 30 mo Outcome: perspectives on HS program	Does not compare intervention versus control clinicians; compares clinician perceptions by income level of patients served

TABLE 5 Continued

First Author, Year	Design, Outcomes	Findings
	Downs & Black score: N/A	
McLearn, 2004[46]	Observational study *N* = 1910 families (1910 families; no comparison) Child age: 1–33 mo; assessments at 2–3 and 30–33 mo Parent survey Outcomes: • Quality of care • Parent experiences and satisfaction with care Downs & Black score: N/A[a]	Does not compare intervention versus control families; compares outcomes for intervention group families by income level

AG, anticipatory guidance; WCV, well-child visit.

[a] Downs and Black checklist was only used for studies that reported parent or child outcomes and included an intervention and comparison group.

57% $P < .001$), have better parent report of 4 family-centeredness of care measures (eg, disagreed that clinician listened to parent; 10% vs 14%, $P < .001$), and have discussed more than 6 anticipatory topics during their visits (87% vs 43%, $P < .001$). There were no statistically significant differences in hospitalizations or ED use in general, but intervention children did have a slightly decreased odds of an ED visit for an injury-related cause (9% vs 11%, adjusted odds ratio [AOR] 0.77, 95% CI: 0.61–0.97).[17]

Intervention parents were less likely to report using harsh discipline (9% vs 12%, $P = .006$) and slapping their child in the face or spanking them with an object (6% vs 8%, $P = .01$), and were more likely to report ignoring misbehavior (13% vs 9%, $P = .003$). Intervention parents scored slightly higher than control parents on a scale for child aggressive behavior and sleeping problems (difference of mean scores, AOR 0.40, 95% CI: 0.06–0.75; AOR 0.20, 95% CI: 0.03–0.36). There were no statistically significant differences in parental practices of reading or playing with the child, following daily routines, or child safety practices. Of those parents at risk for depression, intervention parents were more likely to report discussing sadness with their provider (24% vs 14% $P < .001$).[3]

At child age 5.5 years, 2 years after study completion, 57% of parents completed another interview, and some of these positive findings were modestly sustained. Intervention families were less likely to slap or spank their child with an object (10% vs 14%, $P < .001$) and more likely to use negotiation as a discipline strategy (60% vs 56%, $P < .05$), book sharing with their child (59% vs 54%, $P < .001$), and recommended car restraints (43% vs 47% did not use a booster seat, $P = .01$). There were no differences between the 2 groups in child health status, developmental concerns, perceived social skills, following daily routines, hospitalizations, or ED use.[49]

Studies also reported clinician perceptions of HS. Overall, clinicians were satisfied with the program and with the role of the HSS with parents.[48]

Mendelsohn et al[52,53] conducted a 3-year RCT of another intervention that added a developmental specialist encounter to each visit. The level of training for the specialists is not delineated in the article, but the study does reference HSS. Children in the intervention group had twelve 30- to 45-minute developmental specialist sessions from 2 weeks to 3 years of age. Visits focused on child development and included discussion of a video recording of the parent and child engaging in an activity. Investigators enrolled 150 Latina mothers without a high school degree and found that at 33 months, intervention children were more likely to have normal cognitive development scores (64% vs 44%, $P < .05$), but there were no differences at 33 months for language development, behavioral problems, or eligibility for early intervention.

The third study, by Farber et al,[54] examined an intervention of parent coaches to strengthen anticipatory guidance for 50 Latino and African American families in Washington, DC. Parent coaches were not medical professionals but had a college degree in early child development. Parent coaches met with families at clinic visits from the newborn through 18-month visit. Compared with the 30 comparison parents, 35 intervention parents had better scores on scales for parenting practices and adequacy of family resources, but no differences were detected in child immunization or developmental status. Intervention children performed better than the comparison group on vocabulary achievement scores for receptive

(mean score 89 [SD 11.6] vs 79 [12.5], $P = .02$) and expressive language (83 [9.6] vs 73[12.2]).

O'Sullivan et al[55] reported findings from an RCT of an intervention of enhanced WCC for adolescent mothers. Although the study did not fit well into our 3 WCC clinical practice redesign categories, it used social workers as an additional provider for WCC (Table 4). A social worker was included at the 2-week visit to discuss baby care and family planning; at each well-child visit through 18 months, mothers received teaching on infant care and mild acute illness management in the waiting room. At the end of the study, intervention mothers ($n = 120$) were more likely to still be attending well-child visits compared with control mothers ($n = 123$; 40% vs 18%, $P < .05$), but the dropout rate in both groups was high. Using an intention-to-treat analysis, intervention group children were more likely to be fully immunized at 18 months (33% vs 18%, $P = .01$); there was no statistically significant difference in the proportion of children in each group with ≥1 ED visit.

DISCUSSION

This is the first published, peer-reviewed systematic review of WCC clinical practice redesign. We found evidence suggesting improved effectiveness and efficiency for WCC delivery using group formats for visits, non–face-to-face formats for anticipatory guidance, and non–medical professional providers for anticipatory guidance and developmental and behavioral services. Studies suggest that these strategies may potentially have an impact on parents' experiences with care, parenting skills and knowledge, and health care utilization.

Evidence for GWCC suggests that it may be at least as effective in providing care as IWCC. Studies demonstrated efficiency for GWCC; parents had longer visits with more content, but provider time per patient was not increased. Longer WCC visits have been associated with more anticipatory guidance, family-centered care, and parent satisfaction.[62] Group visits may be led by non–medical professionals, allowing for even more efficient use of physician time.[63] In the GWCC studies, a physician or NP moderated the group discussion. More studies may be necessary to determine whether these findings are replicated in GWCC when the facilitator is not a medical professional.

Evidence for web-based tools for anticipatory guidance was limited; 2 trials demonstrated improvements in parent knowledge, discussion, and action on anticipatory guidance topics. Lack of Internet access may be a barrier in some populations; however, the digital divide may be narrowing as more low-income families are gaining access to the Internet.[64]

The large HS trial demonstrated important, although somewhat modest, improvements in receipt of WCC services, positive parenting practices, and parent experiences with care. Despite this, its adoption has been limited. In 2010, only 50 sites nationwide were using HS. The median annual program cost of $65 500 has proved to be the greatest barrier to adopting and sustaining the program in community practices.[65]

Another consideration is whether the studies' findings justify the costs of implementing these clinical practice redesign tools and strategies. These include financial costs as well the opportunity costs of time, personnel, and effort in implementing these changes compared with other practice improvements that do not alter the structure of care. Break-even analyses and cost-effectiveness analyses may help practices with these decisions.

Most interventions, except for GWCC, were designed as an enhancement, rather than a replacement, for what takes place in usual care. Web-based tools provided additional anticipatory guidance and a way to tailor anticipatory guidance during the visit but did not replace anticipatory guidance in the visit. In HS, parents spend between 15 and 30 minutes with an HSS at each visit,[61] with physician time being reduced from 18 to 12 minutes.[65] For WCC clinical practice redesign to be sustainable, interventions may need to demonstrate greater efficiencies in physician/NP time per patient.

Parent knowledge of mild acute illness management is a desirable outcome of anticipatory guidance and can reduce unnecessary clinical contacts between scheduled well-child visits. Reduced utilization for acute care was noted in several studies; however, other reasons for decreased utilization (eg, poor patient-doctor relationship; perceived poor access) cannot be excluded in some of these studies.

There are several limitations to consider. We limited our review to peer-reviewed publications on WCC clinical practice redesign for children aged 0 to 5; however, there are redesign tools that are not in the peer-reviewed literature or that have been described but not implemented or evaluated.[14,18] Some have been used outside of WCC that might be applicable to child preventive care,[66–74] and some that are not practice-based could be adapted for use in a practice setting.[75,76] We omitted tools that did not alter the delivery of WCC services (eg, handheld patient records)[77,78] and tools that focused on clinical practice redesign for only 1 WCC topic; these tools should be considered in other reviews. Criteria for defining clinical practice redesign were somewhat stringent and limited the number of articles included. A review with a different set of criteria or fewer criteria for article inclusion could be helpful

in giving pediatric practices a broader range of options for clinical practice improvements.

Because of the heterogeneity of interventions and outcomes measured, a meta-analysis was not possible. Study design heterogeneity precluded use of a single quality assessment tool for all studies; however, we used the Jadad scale for RCTs and a modified Downs and Black checklist for non-RCTs and observational studies. There is the possibility of publication bias in which studies of interventions with negative results never make it to the peer-reviewed literature.

Despite these limitations, this review has important implications for child preventive care. First, many WCC clinical practice redesign tools examined in this review are also more broadly part of efforts to transform practices into patient-centered medical homes.[79–81] Group visits, non–face-to-face formats, and additional providers for WCC can increase accessibility, comprehensiveness, and family-centeredness of care (key elements of the medical home). Practices working toward a transformation into patient-centered medical homes can consider implementing WCC redesign strategies that have demonstrated some promising, albeit preliminary, results for WCC delivery.

Next, there are several provisions of the health care reform law that make WCC clinical practice redesign a timely proposition for primary care practices.[82] The Affordable Care Act includes the Centers for Medicare and Medicaid Services Innovation Center, which will investigate new service delivery and payment models, and the Prevention and Public Health Fund, which provides mandatory funding for prevention and wellness programs.

Finally, despite promising evidence for these interventions, they have not been widely adopted. In a recent study examining health plan leaders' views on WCC clinical practice redesign, participants reported a lack of incentives for practices and health plans to invest in WCC clinical practice redesign. Furthermore, some states require Medicaid and Children's Health Insurance Program–contracted plans to report on a set of quality measures that reward the number of face-to-face well-child visits and inadvertently discourage the use of non–face-to-face strategies.[83]

There are promising tools and strategies for WCC clinical practice redesign that may be ready for larger-scale trials. Future directions for research include reporting intervention costs and potential cost savings and a commonly defined set of child and parent outcomes to help researchers build capacity for comparative studies across interventions.

REFERENCES

1. Chung PJ, Lee TC, Morrison JL, Schuster MA. Preventive care for children in the United States: quality and barriers. *Annu Rev Public Health*. 2006;27:491–515
2. Norlin C, Crawford MA, Bell CT, Sheng X, Stein MT. Delivery of well-child care: a look inside the door. *Acad Pediatr*. 2011;11(1):18–26
3. Schuster MA, Duan N, Regalado M, Klein DJ. Anticipatory guidance: what information do parents receive? What information do they want? *Arch Pediatr Adolesc Med*. 2000;154(12):1191–1198
4. Triggs EG, Perrin EC. Listening carefully. Improving communication about behavior and development. Recognizing parental concerns. *Clin Pediatr (Phila)*. 1989;28(4):185–192
5. Bethell C, Reuland CH, Halfon N, Schor EL. Measuring the quality of preventive and developmental services for young children: national estimates and patterns of clinicians' performance. *Pediatrics*. 2004;113(suppl 6):1973–1983
6. Halfon N, Regalado M, Sareen H, et al. Assessing development in the pediatric office. *Pediatrics*. 2004;113(suppl 6):1926–1933
7. Bethell C, Reuland C, Schor E, Abrahms M, Halfon N. Rates of parent-centered developmental screening: disparities and links to services access. *Pediatrics*. 2011;128(1):146–155
8. Belamarich PF, Gandica R, Stein REK, Racine AD. Drowning in a sea of advice: pediatricians and American Academy of Pediatrics policy statements. *Pediatrics*. 2006;118(4). Available at: www.pediatrics.org/cgi/content/full/118/4/e964
9. Council on Pediatric Practice. *Standards of Child Health Care*. Evanston, IL: American Academy of Pediatrics; 1967
10. Bright Futures/American Academy of Pediatrics. *Recommendations for Preventive Pediatric Health Care*. Elk Grove, IL: American Academy of Pediatrics; 2008
11. Kuo AA, Inkelas M, Lotstein DS, Samson KM, Schor EL, Halfon N. Rethinking well-child care in the United States: an international comparison. *Pediatrics*. 2006;118(4):1692–1702
12. Coker T, Casalino LP, Alexander GC, Lantos J. Should our well-child care system be redesigned? A national survey of pediatricians. *Pediatrics*. 2006;118(5):1852–1857
13. Bergman D, Pisek P, Saunders M. A high-performing system for well-child care: a vision for the future. *The Commonwealth Fund*. 2006;40:1–59
14. Schor EL. Rethinking well-child care. *Pediatrics*. 2004;114(1):210–216
15. Williams BC, Miller CA. American Academy of Pediatrics. Preventive health care for young children: Findings from a 10-country study and directions for United States policy. *Pediatrics*. 1992;89(5 pt 2):981–998
16. Rice RL, Slater CJ. An analysis of group versus individual child health supervision. *Clin Pediatr (Phila)*. 1997;36(12):685–689
17. Minkovitz CS, Hughart N, Strobino D, et al. A practice-based intervention to enhance quality of care in the first 3 years of life: the Healthy Steps for Young Children Program. *JAMA*. 2003;290(23):3081–3091
18. Zuckerman B, Parker S. Preventive pediatrics—new models of providing needed health services. *Pediatrics*. 1995;95(5):758–762
19. Donabedian A. Evaluating the quality of medical care. *Milbank Mem Fund Q*. 1966;44(suppl 3):166–206

20. Donabedian A. The quality of care. How can it be assessed? *JAMA*. 1988;260(12):1743–1748
21. Starfield B. Health services research: a working model. *N Engl J Med*. 1973;289(3):132–136
22. United Nations Development Programme. *Human Development Index*. New York, NY: Oxford University Press; 2011
23. Jadad AR, Moore RA, Carroll D, et al. Assessing the quality of reports of randomized clinical trials: is blinding necessary? *Control Clin Trials*. 1996;17(1):1–12
24. Downs SH, Black N. The feasibility of creating a checklist for the assessment of the methodological quality both of randomised and non-randomised studies of health care interventions. *J Epidemiol Community Health*. 1998;52(6):377–384
25. Bergman DA, Beck A, Rahm AK. The use of internet-based technology to tailor well-child care encounters. *Pediatrics*. 2009;124(1). Available at: www.pediatrics.org/cgi/content/full/124/1/e37
26. Sanghavi DM. Taking well-child care into the 21st century: a novel, effective method for improving parent knowledge using computerized tutorials. *Arch Pediatr Adolesc Med*. 2005;159(5):482–485
27. Paradis HA, Conn KM, Gewirtz JR, Halterman JS. Innovative delivery of newborn anticipatory guidance: a randomized, controlled trial incorporating media-based learning into primary care. *Acad Pediatr*. 2011;11(1):27–33
28. Christakis DA, Zimmerman FJ, Rivara FP, Ebel B. Improving pediatric prevention via the Internet: a randomized, controlled trial. *Pediatrics*. 2006;118(3):1157–1166
29. Osborn LM, Woolley FR. Use of groups in well child care. *Pediatrics*. 1981;67(5):701–706
30. Saysana M, Downs SM. Piloting group well child visits in pediatric resident continuity clinic. *Clin Pediatr (Phila)*. 2012;51(2):134–139
31. Taylor JA, Kemper KJ. Group well-child care for high-risk families: maternal outcomes. *Arch Pediatr Adolesc Med*. 1998;152(6):579–584
32. Taylor JA, Davis RL, Kemper KJ. A randomized controlled trial of group versus individual well child care for high-risk children: maternal-child interaction and developmental outcomes. *Pediatrics*. 1997;99(6). Available at: www.pediatrics.org/cgi/content/full/99/6/E9
33. Taylor JA, Davis RL, Kemper KJ. Health care utilization and health status in high-risk children randomized to receive group or individual well child care. *Pediatrics*. 1997;100(3). Available at: www.pediatrics.org/cgi/content/full/100/3/E1
34. Page C, Reid A, Hoagland E, Leonard SB. WellBabies: mothers' perspectives on an innovative model of group well-child care. *Fam Med*. 2010;42(3):202–207
35. Dodds M, Nicholson L, Muse B III, Osborn LM. Group health supervision visits more effective than individual visits in delivering health care information. *Pediatrics*. 1993;91(3):668–670
36. Kempe A, Dempsey C, Poole SR. Introduction of a recorded health information line into a pediatric practice. *Arch Pediatr Adolesc Med*. 1999;153(6):604–610
37. Christ M, Sawyer T, Muench D, Huillet A, Batts S, Thompson M. Comparison of home and clinic well-baby visits in a military population. *Mil Med*. 2007;172(5):515–519
38. Gance-Cleveland B, Yousey Y. Benefits of a school-based health center in a preschool. *Clin Nurs Res*. 2005;14(4):327–342
39. Caughy MO, Huang K-Y, Miller T, Genevro JL. The effects of the Healthy Steps for Young Children Program: results from observations of parenting and child development. *Early Child Res Q*. 2004;19(4):611–630
40. Caughy MO, Miller TL, Genevro JL, Huang K-Y, Nautiyal C. The effects of Healthy Steps on discipline strategies of parents of young children. *J Appl Dev Psychol*. 2003;24(5):517–534
41. Huebner CE, Barlow WE, Tyll LT, Johnston BD, Thompson RS. Expanding developmental and behavioral services for newborns in primary care: program design, delivery, and evaluation framework. *Am J Prev Med*. 2004;26(4):344–355
42. Johnston BD, Huebner CE, Anderson ML, Tyll LT, Thompson RS. Healthy steps in an integrated delivery system: child and parent outcomes at 30 months. *Arch Pediatr Adolesc Med*. 2006;160(8):793–800
43. Johnston BD, Huebner CE, Tyll LT, Barlow WE, Thompson RS. Expanding developmental and behavioral services for newborns in primary care; Effects on parental well-being, practice, and satisfaction. *Am J Prev Med*. 2004;26(4):356–366
44. Kinzer SL, Dungy CI, Link EA. Healthy Steps: resident's perceptions. *Clin Pediatr (Phila)*. 2004;43(8):743–748
45. McLearn KT, Strobino DM, Hughart N, et al. Developmental services in primary care for low-income children: clinicians' perceptions of the Healthy Steps for Young Children program. *J Urban Health*. 2004;81(2):206–221
46. McLearn KT, Strobino DM, Minkovitz CS, Marks E, Bishai D, Hou W. Narrowing the income gaps in preventive care for young children: families in healthy steps. *J Urban Health*. 2004;81(4):556–567
47. Minkovitz C, Strobino D, Hughart N, Scharfstein D, Guyer B; Healthy Steps Evaluation Team. Early effects of the healthy steps for young children program. *Arch Pediatr Adolesc Med*. 2001;155(4):470–479
48. Minkovitz CS, Strobino D, Hughart N, et al. Developmental specialists in pediatric practices: perspectives of clinicians and staff. *Ambul Pediatr*. 2003;3(6):295–303
49. Minkovitz CS, Strobino D, Mistry KB, et al. Healthy Steps for Young Children: sustained results at 5.5 years. *Pediatrics*. 2007;120(3). Available at: www.pediatrics.org/cgi/content/full/120/3/e658
50. Niederman LG, Schwartz A, Connell KJ, Silverman K. Healthy Steps for Young Children program in pediatric residency training: impact on primary care outcomes. *Pediatrics*. 2007;120(3). Available at: www.pediatrics.org/cgi/content/full/120/3/e596
51. Piotrowski CC, Talavera GA, Mayer JA. Healthy Steps: a systematic review of a preventive practice-based model of pediatric care. *J Dev Behav Pediatr*. 2009;30(1):91–103
52. Mendelsohn AL, Dreyer BP, Flynn V, et al. Use of videotaped interactions during pediatric well-child care to promote child development: a randomized, controlled trial. *J Dev Behav Pediatr*. 2005;26(1):34–41
53. Mendelsohn AL, Valdez PT, Flynn V, et al. Use of videotaped interactions during pediatric well-child care: impact at 33 months on parenting and on child development. *J Dev Behav Pediatr*. 2007;28(3):206–212
54. Farber MLZ. Parent mentoring and child anticipatory guidance with Latino and African American families. *Health Soc Work*. 2009;34(3):179–189
55. O'Sullivan AL, Jacobsen BS. A randomized trial of a health care program for first-time adolescent mothers and their infants. *Nurs Res*. 1992;41(4):210–215
56. Sweet MA, Appelbaum MI. Is home visiting an effective strategy? A meta-analytic review of home visiting programs for families with young children. *Child Dev*. 2004;75(5):1435–1456
57. Olds DL, Kitzman HJ. Review of research on home visiting for pregnant women and parents of young children. *Future Child*. 1993;3(3):53–92
58. Kendrick D, Elkan R, Hewitt M, et al. Does home visiting improve parenting and the quality of the home environment? A systematic review and meta analysis. *Arch Dis Child*. 2000;82(6):443–451
59. Gomby DS, Culross PL, Behrman RE. Home visiting: recent program evaluations—

analysis and recommendations. *Future Child*. 1999;9(1):4–26, 195–223

60. Howard KS, Brooks-Gunn J. The role of home-visiting programs in preventing child abuse and neglect. *Future Child*. 2009;19(2):119–146
61. Zuckerman B, Parker S, Kaplan-Sanoff M, Augustyn M, Barth MC. Healthy Steps: a case study of innovation in pediatric practice. *Pediatrics*. 2004;114(3):820–826
62. Halfon N, Stevens GD, Larson K, Olson LM. Duration of a well-child visit: association with content, family-centeredness, and satisfaction. *Pediatrics*. 2011;128(4):657–664
63. Burke RE, O'Grady ET. Group visits hold great potential for improving diabetes care and outcomes, but best practices must be developed. *Health Aff (Millwood)*. 2012;31(1):103–109
64. Public Policy Institute of California. *Just the Facts: California's Digital Divide*. 2010. Available at: www.ppic.org/content/pubs/jtf/JTF_DigitalDivideJTF.pdf. Accessed March 1, 2011
65. Barth MC. Healthy Steps at 15: The Past and Future of an Innovative Preventive Care Model for Young Children. New York, NY: The Commonwealth Fund; 2010
66. Mehrotra A, Wang MC, Lave JR, Adams JL, McGlynn EA. Retail clinics, primary care physicians, and emergency departments: a comparison of patients' visits. *Health Aff (Millwood)*. 2008;27(5):1272–1282
67. Gray JE, Safran C, Davis RB, et al. Baby CareLink: using the internet and telemedicine to improve care for high-risk infants. *Pediatrics*. 2000;106(6):1318–1324
68. Rosen P, Kwoh CK. Patient-physician e-mail: an opportunity to transform pediatric health care delivery. *Pediatrics*. 2007;120(4):701–706
69. Jones CA, Clement LT, Morphew T, et al. Achieving and maintaining asthma control in an urban pediatric disease management program: the Breathmobile Program. *J Allergy Clin Immunol*. 2007;119(6):1445–1453
70. Laurant M, Reeves D, Hermens R, Braspenning J, Grol R, Sibbald B. Substitution of doctors by nurses in primary care. *Cochrane Database Syst Rev*. 2005;(2):CD001271
71. McConnochie KM, Tan J, Wood NE, et al. Acute illness utilization patterns before and after telemedicine in childcare for inner-city children: a cohort study. *Telemed J E Health*. 2007;13(4):381–390
72. McConnochie KM. Potential of telemedicine in pediatric primary care. *Pediatr Rev*. 2006;27:e58–e65
73. McConnochie KM, Conners GP, Brayer AF, et al. Differences in diagnosis and treatment using telemedicine versus in-person evaluation of acute illness. *Ambul Pediatr*. 2006;6(4):187–195; discussion 196–187
74. Lim MS, Hocking JS, Aitken CK, et al. Impact of text and email messaging on the sexual health of young people: a randomised controlled trial. *J Epidemiol Community Health*. 2012;66(1):69–74
75. Levine D, McCright J, Dobkin L, Woodruff AJ, Klausner JD. SEXINFO: a sexual health text messaging service for San Francisco youth. *Am J Public Health*. 2008;98(3):393–395
76. Text4baby. Available at: www.text4baby.org/index.php/about. 2011. Accessed July 18, 2011
77. Poon EG, Wald J, Schnipper JL, et al. Empowering patients to improve the quality of their care: design and implementation of a shared health maintenance module in a US integrated healthcare delivery network. *Stud Health Technol Inform*. 2007;129(pt 2):1002–1006
78. Ko H, Turner T, Jones C, Hill C. Patient-held medical records for patients with chronic disease: a systematic review. *Qual Saf Health Care*. 2010;19(5):e41
79. Martin JC, Avant RF, Bowman MA, et al; Future of Family Medicine Project Leadership Committee. The Future of Family Medicine: a collaborative project of the family medicine community. *Ann Fam Med*. 2004;2(suppl 1):S3–S32
80. Stewart EE, Nutting PA, Crabtree BF, Stange KC, Miller WL, Jaén CR. Implementing the patient-centered medical home: observation and description of the national demonstration project. *Ann Fam Med*. 2010;8(suppl 1):S21–S32, S92
81. American Academy of Pediatrics Medical Home Initiatives for Children With Special Needs Project Advisory Committee. Policy statement: organizational principles to guide and define the child health care system and/or improve the health of all children. *Pediatrics*. 2004;113(suppl 5):1545–1547
82. Kaiser Family Foundation. Health Reform Source. Available at: http://healthreform.kff.org/. 2010. Accessed February 8, 2011
83. Coker TR, DuPlessis HM, Davoudpour R, Moreno C, Rodriguez MA, Chung PJ. Well-child care practice redesign for low-income children: the perspectives of health plans, medical groups, and state agencies. *Acad Pediatr*. 2012;12(1):43–52