SUPPLEMENT ARTICLE

Experiences Integrating Delivery of Maternal and Child Health Services With Childhood Immunization Programs: Systematic Review Update

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Background. The World Health Organization and the United Nations Children's Fund promote integration of maternal and child health (MCH) and immunization services as a strategy to strengthen immunization programs. We updated our previous review of integrated programs and reviewed reports of integration of MCH services with immunization programs at the service delivery level.

Methods. Published and unpublished reports of interventions integrating MCH and immunization service delivery were reviewed by searching journal databases and Web sites and by contacting organizations.

Results. Among 27 integrated activities, interventions included hearing screening, human immunodeficiency virus services, vitamin A supplementation, deworming tablet administration, malaria treatment, bednet distribution, family planning, growth monitoring, and health education. When reported, linked intervention coverage increased, though not to the level of the corresponding immunization coverage in all cases. Logistical difficulties, time-intensive interventions ill suited for campaign delivery, concern for harming existing services, inadequate overlap of target age groups, and low immunization coverage were identified as challenges.

Conclusions. Results of this review reinforce our 2005 review findings, including importance of intervention compatibility and focus on immunization program strength. Ensuring proper planning and awareness of compatibility of service delivery requirements were found to be important. The review revealed gaps in information about costs, comparison to vertical delivery, and impact on all integrated interventions that future studies should aim to address.

The Expanded Programme on Immunization (EPI), begun in 1974, is considered one of the world's most successful public health programs, as measured by equity and coverage of its intended target population, infants <12 months of age [1–3]. EPI is a platform from which it is possible to deliver additional health interventions, and this concept has received widespread support. In 2005, the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) introduced the Global Immunization Vision and Strategy, a 10-year framework for guiding immunization programs worldwide. The strategy promotes integration of primary healthcare services with immunization as a strategy to increase coverage with other maternal and child health (MCH) interventions and sustain immunization programs [4].

In 2005, we conducted a systematic literature review of experiences integrating additional services into immunization programs in order to document lessons learned for future integration activities [5]. Our review of 27 articles that were published prior to 2005 identified key benefits, such as quick scale-up of coverage for the linked intervention and increased user satisfaction, in addition to concerns about overburdening health workers and difficulty planning in the face of increased logistical requirements. Although reported outcomes were primarily positive across all studies, few used rigorous comparison groups or documented the costs associated with integration.

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This review provides an update on experiences integrating health interventions with immunization programs at the point of service delivery. We identify the linked interventions and the reported results by service delivery method and discuss implications for research and practice.

METHODS

Literature Search

We used the same methodology described in our previous review of experiences integrating health interventions with immunization services to conduct the literature search to preserve consistency and enable us to compare findings [5]. In our previous review, we reviewed gray and peer-reviewed literature from 1970 to 2005 on experiences in operationally integrating immunization services with other health interventions at the point of service delivery.

For this review, we used 48 keywords, alone and in combination, to search gray and peer-reviewed online literature databases and organizations' Web sites and to conduct Internet searches using Google (Table 1). Gray literature was defined as material not published in a peer-reviewed journal; it was collected through contact with field experts, Internet searches, and requests to organizations known to conduct integrated services projects. Organizations and individuals with experience conducting integrated projects were e-mailed with requests for information on projects they had conducted. We included articles published in English and Spanish from January 2001 through February 2011 that reported experiences operationally integrating immunization services with additional maternal or child health interventions at the service delivery level in any low- or middle-income country, as defined by the World Bank [6]. We purposely overlapped our review dates with the review dates of the previous review in the event that additional gray literature from the 2001–2005 time frame had become available since 2005. We excluded expert opinions, other systematic reviews, studies describing integration of immunization services with general primary healthcare, studies that did not focus on the operational impact of integrated service delivery, studies that focused primarily on the biological interactions of drugs administered rather than the operational aspects of integration interventions, and studies included in our previous review [5].

Systematic Review Method

We updated the data extraction form used in our previous review to systematically collect information from each article including intervention and evaluation details, outcomes, costs, and lessons learned. Two researchers extracted data from each article. Extractions were compared, and if there were discrepancies, the articles were discussed until both researchers reached agreement. To assist in interpretation of each study's results, the following scientific components were also extracted: (1) presentation of target population data, (2) use of a randomized study design, (3) presence of well-defined research outcomes, (4) extent of data analysis, (5) discussion of study limitations, and (6) comparison of findings to published literature. Articles were grouped according to the type of immunization service delivery. *Routine immunization* (RI) services were defined as those provided on an ongoing basis through fixed or outreach locations, and *immunization campaigns* were defined as time-limited events usually focused on specific disease elimination or eradication targets [3]. *Enhanced routine activities* (ERAs) include services such as child health weeks (CHWs), which are structured like campaigns but with the aim of increasing RI coverage. In many countries, ERAs occur at least 1–2 times each year [3]. Fully immunized coverage was defined as 1 dose of BCG vaccine, 3 doses of diphtheria-tetanus-pertussis (DTP) vaccine, 3 doses of polio vaccine, and 1 dose of measles vaccine.

RESULTS

The initial search yielded 86 articles, 32 of which met our criteria for inclusion in the review. Of these 32 articles, 24 (75%) were from peer-reviewed journals and 8 (25%) were from the gray literature. These 32 articles covered 27 distinct integration activities/studies. In some instances, articles reported on the same integration activity (Table 2). Of the 27 activities, 24 (89%) were based in African countries, 1 in India, 1 in Mexico, and 1 in the Philippines. Sixteen (59%) projects described integrated routine services, 5 (19%) enhanced routine activities, and 6 (22%) campaigns.

The articles reporting integration with RI programs were conducted in countries where WHO/UNICEF estimated that coverage with the third dose of DTP vaccine (DTP3) ranged from 68% (South Africa) to 99% (Malawi), with a nonweighted mean of 78% (Table 2) [7, 8]. In countries where integration occurred with enhanced routine activities, DTP3 coverage ranged from 72% (Ethiopia) to 91% (Mexico), with a nonweighted mean of 81%. Countries with integrated campaign studies had estimated DTP3 coverage ranging from 39% (Niger) to 90% (Tanzania), with a nonweighted mean of 70%. These integrated campaigns reached >85% coverage for vaccinations and other linked interventions, including in countries where DTP3 coverage was <50%, as measured by WHO/UNICEF coverage estimates. We identified no studies published on integration of interventions with routine services in countries where estimated DTP3 coverage was <68% (Table 2).

Characteristics of Methods

The 32 articles we reviewed reported a variety of methods to describe and assess integration activities. Twenty-six (81%) included a formal evaluation and 6 (21%) only provided a description of the integrated activity. Eighteen of the 26 evaluative articles used quantitative methods, 5 used qualitative methods, and 3 used mixed methods. Three (9%) of the 32 articles included control groups and 8 (25%) reported implementation

Table 1. Keywords and Data Sources Used for a Systematic Literature Review of Maternal and Child Health Interventions Integrated With Immunization Services in Developing Countries

Keywords (used singly or in combination)	Africa
	Asia
	Bednet
	Campaign
	Child health week
	Collaborate[a]
	Collaboration
	Combination
	Combine
	Deworming
	Disease[a]
	EPI
	Expanded Programme
	Family planning
	Filariasis
	Health
	Immunization plus
	Immunization[a]
	India
	Integrate
	Integration
	Intermittent preventative
	IPTi
	ITN
	Joint
	Link[a]
	Linkage
	Malaria
	Maternal
	Measles
	Net[a]
	Onchocerciasis
	Partner
	Partnership[a]
	Polio
	Reproductive
	Routine
	Shistosomiasis
	Synergies
	Synergy
	Trachoma
	Vaccination[a]
	Vitamin A
Literature databases used	Access UN
	AccessScience
	AGRICOLA
	Bioline International
	BioMed Central
	BIOSIS
	CAB Abstracts
	CHID Online
	CINAHL
	Cochrane Library
	CSA-Illumina Databases
	Dissertation Abstracts
	EMBASE
	Expanded Academic ASAP
	Global Health
	IBSS
	IndMed
	LexisNexis Academic
	LILACS
	Ovid MEDLINE
	PAIS
	POPLINE
	Population Index
	Proquest Research Library
	PubMed (Medline)
	SIGLE
	UNDP Project Reports
	Web of Science
	WHOLIS
Websites visited (using the Google search engine)	www.basics.org
	searchbeta.bl.uk
	www.care.org
	www.fhi.org
	www.filariasis.org
	www.gavialliance.org
	www.greynet.org
	www.hki.org
	www.ifrc.org
	www.msh.org
	www.nyam.org/library/greylitorgs.shtml
	www.paho.org
	www.path.org
	www.pathfind.org
	www.psi.org
	www.redcross.org
	www.savethechildren.org
	www.savethechildren.org.uk
	www.trachoma.org
	www.un.org
	www.undp.org
	www.who.int/library
Organizations contacted (by e-mail or telephone)	London School of Hygiene and Tropical Medicine
	International Federation of Red Cross & Red Crescent Societies
	World Health Organization
	Liverpool School of Tropical Medicine
	Centers for Disease Control and Prevention
	World Bank
	Rollins School of Public Health, Emory University

[a] Keyword search included singular and plural versions.

Table 2. Strategies and Characteristics of Activities Integrating Immunization Services With Additional Health Interventions Documented in 32 Reviewed Articles

Delivery Method	Country	Study Year	Linked Intervention(s)	Vaccine(s) Provided	Primary Integration Strategy	DTP3 Coverage[a]	Vaccine Coverage Assessed	Linked Intervention Coverage Assessed	Primary Indicator(s) Measured in Study	Literature Type and Citation
Routine	Ghana	2004	Infant malaria treatment	DTP, measles	IPTi delivered to infants at DTP2, 3, and measles vaccination visits	80	No	No	Cost-effectiveness of delivery strategy	Peer-reviewed [10]
Routine	Mozambique	2002	Infant malaria treatment	DTP, measles, polio	Infants at immunization visits were referred to IPTi services	72	No	No	Caretaker opinions of integrated delivery	Peer-reviewed [9]
Routine	Ghana	2006	Infant malaria treatment	DTP, measles, polio	IPTi delivered to infants at routine vaccination visits	84	No	Yes	Comparison of 2 delivery strategies for IPTi	Peer-reviewed [11]
Routine	Tanzania	2005	Infant malaria treatment	DTP, measles, polio	IPTi delivered to infants at routine vaccination visits	90	No	No	Description of how IPTi was integrated into routine services	Peer-reviewed [12]
Routine	Mozambique; Tanzania	2002; 1999	Infant malaria treatment	DTP, measles, polio	IPTi delivered to infants at routine vaccination visits	72; 76	No	No	Cost effectiveness of delivery strategy	Peer-reviewed [13]
Routine	Gabon, Ghana, Kenya, Malawi, Tanzania	NA	Infant malaria treatment	DTP, measles, polio	IPTi delivered to infants at routine vaccination visits	NA	No	No	Key stakeholder opinions of integrated delivery	Peer-reviewed [14]
Routine	Tanzania	2005	Infant malaria treatment	DTP, measles, polio	IPTi delivered to infants at routine vaccination visits	90	No	No	Key stakeholder opinions of integrated delivery	Peer-reviewed [15]
Routine	Zimbabwe	2001	HIV services	DTP, measles, polio	At immunization visits, HIV-positive mothers were referred for follow-up counseling	73	No	No	Description of utilization of EPI clinics for HIV services	Peer-reviewed [17]
Routine	South Africa	2004	HIV services	DTP, measles, polio	Mothers who brought child to immunization services were asked to participate in anonymous HIV testing	67	No	Post only	Utilization of immunization visits for linkage	Peer-reviewed [18]
Routine	South Africa	2007	HIV services	DTP, measles, polio	Mothers who brought child to immunization services were asked to participate in HIV testing	67	No	Post only	Acceptability of offer of infant HIV test during immunization visit	Peer-reviewed [19]
Routine	Nigeria	2005	Infant hearing screening	BCG	Vaccinator referred child to a hearing-screening team in separate testing room	76	No	Post only	Utilization of immunization visits for linkage	Peer-reviewed [23]
Routine	South Africa	2003	Infant hearing screening	DTP, measles, polio	Vaccinator referred child to a hearing-screening team in separate testing room	67	No	No	Utilization of immunization visits for linkage	Peer-reviewed [22]

Table 2 continued.

Delivery Method	Country	Study Year	Linked Intervention(s)	Vaccine(s) Provided	Primary Integration Strategy	DTP3 Coverage[a]	Vaccine Coverage Assessed	Linked Intervention Coverage Assessed	Primary Indicator(s) Measured in Study	Literature Type and Citation
Routine	India	1998	Complementary feeding practices	DTP, measles, polio	Health workers counsel mothers at multiple contacts including immunization visits on complementary feeding practices	74	Post only	Post only	Utilization of immunization visits for linkage	Peer-reviewed [20, 21]
Routine	Philippines	1999	Vitamin A, family planning promotion	DTP, measles, polio	Interventions were offered together at outreach sessions on immunization days	80	Pre and post	Pre and post	Coverage of interventions	Gray [24]
Routine	Zambia	2002–2006	Growth monitoring, vitamin A, deworming, family planning, health education	BCG, DTP, measles, polio	Interventions offered together as part of a package known as Growth Monitoring Programme Plus	84	Pre and post	No	Coverage of interventions	Peer-reviewed [26]
Routine	Malawi	2005	Bednet distribution	DTP, measles, polio	Bednets distributed at immunization visits when child completed third DTP dose	95	Pre and post	Pre and post	Coverage of interventions	Peer-reviewed [16]
ERA[b]	Ethiopia	2006	Vitamin A, deworming tablet, nutritional screening (for latter, only in certain districts)	Measles	Biannual multiday simultaneous distribution from fixed and temporary outreach posts	72	No	No	Cost effectiveness of child health weeks delivery strategy	Peer-reviewed [27]
ERA[c]	Mexico	1993	Deworming tablet	DTP, measles, polio	Deworming tablets integrated into biannual national health week	91	No	Pre and post	Coverage of interventions	Peer-reviewed [28]
ERA[c]	Cameroon	2005	Vitamin A, bednet retreatment, deworming tablet, nutrition promotion, malaria treatment for pregnant women	DTP, polio	Injectable vaccines were given from fixed site; polio vaccine and vitamin A given house to house	82	No	No	Description of intervention	Gray [29]
ERA[c]	Madagascar	2006	Vitamin A, deworming tablet, bednets, IPTi, IEC on breastfeeding, maternal nutrition and safe motherhood, FP counseling, HIV testing	DTP, measles, polio	Interventions simultaneously given at fixed posts	77	No	No	Impact of child health week on immunization coverage	Gray [30]

Table 2 continued.

Delivery Method	Country	Study Year	Linked Intervention(s)	Vaccine(s) Provided	Primary Integration Strategy	DTP3 Coverage[a]	Vaccine Coverage Assessed	Linked Intervention Coverage Assessed	Primary Indicator(s) Measured in Study	Literature Type and Citation
ERA[c]	Ethiopia, Madagascar, Tanzania, Uganda, Zambia, Zimbabwe	2006–2007	Country-dependent. interventions included vitamin A, deworming tablets, malnutrition screening, bednet promotion, supplementary feeding, and health education	DTP, measles, polio, tetanus-toxoid	Mix of methods; some interventions distributed from fixed posts and others distributed house to house	NA	NA[d]	No	Key stakeholder opinions of integrated delivery	Peer-reviewed [31]
Campaign	Republic of Congo	2005	Vitamin A, deworming tablets	Polio	Simultaneous delivery of interventions	56	No	Post only	Coverage of interventions	Gray [32, 41]
Campaign	Niger	2005	Vitamin A, bednets	Polio	Polio vaccine, vitamin A, and bednet voucher given house to house; voucher was redeemed later at fixed post for bednet	39	Post only	Pre and post	Coverage of interventions	Gray and peer-reviewed [33, 37, 40]
Campaign	Tanzania	2005	Bednets, vitamin A, deworming tablets	Measles	Interventions distributed at temporary and fixed posts	90	Pre and post	Pre and post	Coverage of interventions	Peer-reviewed [36]
Campaign	Zambia	2003	Bednets, bednet vouchers	Measles	Bednets were distributed at fixed posts; 1 district distributed bednet vouchers that were redeemed at local shops	80	No	Pre and post	Coverage of interventions	Peer-reviewed [38]
Campaign	Togo	2005	Bednets, deworming tablets	Measles, polio	Bednets distributed at fixed posts; polio vaccine and deworming tablets given house to house	71	Post only	Pre and post	Coverage of interventions	Gray and peer-reviewed [34, 35]
Campaign	Madagascar	2007	Vitamin A, deworming tablet, bednets	Measles	Interventions simultaneously given at fixed and mobile posts	84	No	Post only	Coverage of interventions; equity of coverage	Peer-reviewed [39]

Abbreviations: DTP, diphtheria-tetanus-pertussis vaccine; EPI, Expanded Programme on Immunisation; ERA, enhanced routine activity; FP, family planning; HIV, human immunodeficiency virus; IEC, information, education, communication; IPTi, intermittent preventative malaria treatment of infants; NA, not applicable.

[a] World Health Organization/United Nations Children's Fund national immunization coverage in the year of the study, or when available, the reported regional coverage from the Demographic Health Survey in the year of the study.

[b] Promoted as an enhanced routine activity; however, only measles vaccine was given.

[c] Promoted as an enhanced routine activity where routine injectable vaccinations (DTP, measles) were all given.

[d] Secondary data analysis on health intervention coverage conducted using demographic and health survey data before and after child health weeks.

Table 3. Classification of Integrated Interventions by Delivery Strategy from the 27 Activities Integrating Health Interventions With Immunization Programs in Developing Countries as Documented in a Review of 32 Articles, 2011

Intervention[a]	Routine	Enhanced Routine[b]	Campaign	Total
Total number of activities	16	5	6	27
Bednet distribution/malaria treatment	8	5	5	18
Deworming tablet administration	1	5	4	10
Family planning promotion	2	2	0	4
Hearing-screening referral	2	0	0	2
HIV testing/referral	3	2	0	5
Nutrition promotion	2	4	0	6
Vitamin A distribution	2	4	4	10
Growth monitoring	1	1	0	2

[a] In multiple activities, >1 intervention was delivered along with immunizations.

[b] In 1 article, an assessment of enhanced routine activities in multiple countries was documented; these are counted as a single activity in this table.

costs. Assessed immunization coverage data were reported by 9 (29%); 5 of these 9 reported coverage both before and after integration activities. Pre- and/or postcoverage of the linked intervention was reported in 20 (63%) articles; 6 (19%) reported this information before and after implementation of the integrated activity.

Interventions Integrated With RI Delivery

Sixteen (50%) studies documented integration of other MCH interventions with RI delivery. These interventions included intermittent preventative malaria treatment of infants (IPTi) (N = 7) [9–15], bednet distribution (N = 1) [16], human immunodeficiency virus (HIV) testing and counseling (N = 3) [17–19], promotion of infant feeding practices (N = 2) [20, 21], and referrals for infant hearing screening (N = 2) [22, 23]. Two articles documented assessments of packages of interventions delivered routinely with immunizations. In 1, vitamin A supplementation (N = 1) and family planning (N = 1) [23] were included; in the other, growth monitoring, vitamin A, deworming tablets, promotion of infant feeding practices, and family planning were included [24] (Tables 2 and 3).

Studies from Mozambique [9, 13], Ghana [10, 11, 14], Gabon [14], Kenya [14], Malawi [14], and Tanzania [12–15] reported linkage of IPTi with RI services. In 1 Ghana study, findings from a trial integrating IPTi with RI visits were used to estimate the impact on the prevalence of malaria in infants if integrated service delivery were to be scaled up across West African countries [10]. Due to low RI coverage in these countries, the authors estimated that only 10% of infant malaria cases would be averted using this strategy. In another Ghana study, integration of delivery of IPTi with RI visits was compared with delivery of IPTi by community volunteers. Coverage between the 2 delivery methods was similar, and authors felt that the community-based method could reach those infants who did not attend vaccination visits [11]. In a Tanzania study describing how IPTi was operationally integrated into routine services, IPTi implementers worked collaboratively with immunization and other health managers to develop communication strategies, use immunization management tools for forecasting IPTi drug supply, use immunization supply chain to deliver IPTi drugs, and use the immunization records system to monitor and record IPTi visits [12]. Qualitative results of integrating IPTi with immunization visits included no increases in health worker schedules and time and money savings to the health system versus creating another vertical delivery mechanism.

In a Mozambique study [9], a Tanzania study [15], and a multicountry study in Tanzania, Gabon, Ghana, Kenya, and Malawi [14], authors qualitatively documented community members' attitudes toward integrating IPTi with immunization services and saw similar results. The visible linkage between IPTi, a new service, and immunization, an existing and trusted service, aided acceptance of the new intervention. In the multicountry study [14], health workers at busy clinics had mothers administer the IPTi drug at the facility rather than the worker administering it at the immunization visit; 2% of the 1300 mothers interviewed said IPTi would discourage them from attending immunization visits. Last, in a study in Tanzania and Mozambique, authors found that IPTi was classified as highly cost effective when delivered through RI visits in these countries, at a cost per disability-adjusted life-year averted <$12 [13].

The integration of HIV services with immunization services was reported in studies from Zimbabwe [17] and South Africa [18, 19]. In Zimbabwe, vaccination visits were utilized to provide follow-up counseling to HIV-positive mothers [17]. However, because follow-up counseling was only available at the district hospitals, mothers who normally attended local immunization clinics needed to travel longer distances to get their children vaccinated. This highlighted the need to decentralize HIV follow-up counseling services to all health facilities. In South Africa, mothers and infants at 6 weeks of age who came for RI

were tested for HIV. The prevalence of HIV exposure among tested infants (37%) and among 20- to 29-year-old mothers (47%) was reported to be consistent with local estimates, suggesting that immunization visit integration could serve as a method for monitoring local Prevention of Mother-to-Child Transmission of HIV program performance [18]. In a second study from South Africa, mothers and infants who came for RI at 6, 10, and 14 weeks of age were offered infant HIV testing conducted by HIV counselors; 90% accepted the offer [19]. Of those 90%, 57% returned for test results. Most mothers reported comfort with infant HIV testing and reported its benefits as confirmation of HIV status and opportunity to start HIV treatment if needed. A quarter of mothers reported concerns the test could reveal their HIV status and that the HIV test was "frightening." HIV counselors were supportive of the intervention but felt space and privacy were insufficient.

Two studies, 1 from South Africa [22] and 1 from Nigeria [23], reported on the referral of infants seen at RI visits for hearing screening conducted at the same site in a separate room. In Nigeria, where only BCG vaccination visits were used, 88% of infants <3 months of age were screened; in South Africa, where all infant vaccination visits were used, 93% of infants <12 months of age were screened. These studies also examined the mean age at which hearing loss was confirmed; the Joint Committee on Infant Hearing benchmark is <3 months of age [25]. In the Nigerian study, the mean age was 17.7 days, and in South Africa, it was 105 days. The authors attributed the later age at diagnosis to the enrollment of infants 0–12 months of age.

Two articles described a study from India that examined the impact of training health workers in 1 district to provide infant nutrition counseling to mothers during immunization, home-based health education, and growth monitoring visits. The intervention districts were compared with a control district where no training about providing nutritional counseling was given [20, 21]. Although nutritional counseling was reportedly rare at any contacts before the start of the project, during implementation, immunization visits accounted for 80%–85% of all counseling contacts during the first 9 months of life. In the intervention district, 43% of immunization visits included nutritional counseling messages; in control districts, 0.5% of visits included such messages [20].

In the Philippines, a strategy known as EPI+ integrated family planning and vitamin A supplementation into RI services provided at outreach sites [24]. After 1 year, fully immunized coverage increased from 80% to 90%, utilization of any family planning services by mothers of infants increased from 70% to 80%, and infant vitamin A supplementation coverage increased from 70% to 90%. In a similar study conducted from 2002 to 2006 in 4 urban slums of Zambia, a package of growth monitoring, immunizations, vitamin A, deworming tablets, nutrition counseling, family planning, community referral, oral rehydration salt distribution, and child healthcare education were systematically delivered together during routine child health sessions [26]. Baseline, midterm (9 months postbaseline), and final (33 months postbaseline) surveys of immunization coverage and timeliness were conducted. Results indicated a significant change in baseline to final full immunized coverage at 12 months of age (53%–69%) in 2 slums and significant change in midterm to final full immunization coverage (43%–57%) in the other 2 slums. Timeliness improved from a baseline level of 25% DTP3 coverage to a final level of 63% DTP3 coverage at 5 months of age. Frequency of integrated health visit attendance was the only sociodemographic indicator associated with improved immunization coverage.

Interventions Integrated With Enhanced Routine Delivery

Five of the 32 (16%) articles described interventions integrated with enhanced routine activities. A report from Ethiopia described the cost of providing nutritional screening, vitamin A supplements, and deworming tablets [27]. The estimated total cost of 1 round of enhanced routine activities where measles vaccine, vitamin A, deworming tablet, and nutritional screening were included was $1.04 per eligible child; without the measles vaccine, the cost was half that [27]. In Cameroon, vitamin A, deworming tablets, DTP vaccine, and measles vaccine were provided as part of a district-level CHW [28]. At the end of the 5-day intervention, the number of DTP doses given reached 2 times the monthly administrative target. However, because no costs were reported, it was not possible to determine the cost-effectiveness of this strategy compared with routine services, nor were comparisons with administrative coverage without integrated activities provided [29]. During Mexico's CHW, deworming tablets have been provided along with vaccinations since 1993. Evaluation of parasite prevalence from 1993 to 1998 among all Mexican states' target populations showed prevalence had decreased by 26%–60%; however, no controls were available to determine impact [28]. The 2005 Madagascar health week integrated >9 interventions, including polio, DTP, and measles vaccines; HIV testing; nutrition promotion; family planning counseling; vitamin A supplementation; bednet distribution; and deworming treatment [30]. Program managers reported the length of time needed to deliver this package of interventions impeded the overall implemention of the 2005 CHW. They believed this challenge was a major factor behind the decrease in the number of districts which had vitamin A and deworming tablet coverage >90% from the previous CHW (106 of 111 districts) to the 2005 CHW (91 districts). In a 2006–2007 multicountry assessment of CHWs in Ethiopia, Madagascar, Tanzania, Uganda, Zambia, and Zimbabwe, held between 2000 and 2006, health providers were interviewed about CHW benefits and challenges, and demographic and health survey data were analyzed to compare pre- and post-CHW coverage of interventions [31]. A variety of interventions were given during each country's CHW (Table 2). Health workers viewed CHWs positively, and CHWs were also

seen to raise the profile of child survival among government officials. Key challenges included poor coordination and assignment of responsibilities between implementing agencies, issues with late arrival or lack of commodities, and interruption of routine services because CHW supervisors and workers also were responsible for managing routine healthcare. In some locations, CHW financial incentives were perceived to demotivate health workers into performing routine services.

Interventions Integrated With Campaigns

Ten studies (31%) reported on 6 immunization campaigns. In each campaign, a different package was provided (Table 2) [32–41]. The campaigns occurred in the Republic of the Congo [32, 41], Niger [33, 37, 40], Togo [34, 35], Tanzania [36], Zambia [38], and Madagascar [39]. Vaccinators used house-to-house delivery of polio vaccine to distribute vitamin A (Congo and Niger) and deworming tablets (Congo). The Niger campaign also included distribution of bednets to mothers of vaccinated children a few weeks after the campaign, using finger markings to verify receipt of polio vaccine. The Togo campaign used a 2-phase delivery strategy in which vaccinators provided deworming tablets during house-to-house polio vaccination and then distributed bednets in conjunction with measles vaccine at fixed posts. In Tanzania and Zambia, fixed post–based measles campaigns were utilized to distribute bednets (or vouchers for bednets) from local vendors; vitamin A and deworming tablets were also distributed in Tanzania. In Madagascar, a mix of fixed and mobile posts were utilized for measles vaccine, deworming administration, and vitamin A supplementation; half the country also received long-lasting insecticidal nets (LLINs) targeted at children <5 years of age and pregnant women.

In 4 campaigns, precampaign coverage with the nonimmunization intervention ranged from 5% to 67% (Table 4). One month to 5 months after the campaigns, polio vaccination coverage ranged from 87% to 94%; linked intervention coverage ranges were also high (90% received vitamin A, 90%–93% received deworming tablets, and 84%–91% of households with infants owned a bednet) (Table 4). One month to 5 months after the campaigns, however, bednet usage by children <5 years of age was reported to be markedly lower than postcampaign bednet ownership and/or immunization coverage levels (Table 4), except in Madagascar. In Madagascar, postcampaign household ownership of ≥1 LLIN was 77%, and in 95% of these households, children <5 years of age were using the LLIN. One week after the campaign, recipients were shown how to hang the nets [39]. In the Republic of Congo campaign [32], organizers initially identified weak support from parents, who believed that polio vaccine had few benefits because vaccine effects were not immediately visible to them. However, support and participation reportedly increased with the addition of deworming tablets, as community members reported immediate and visible effects following their receipt.

Reported Impact on Coverage

Two projects— 1 in India [21] and 1 in Malawi [16]—included comparison groups, which allowed for measurement of impact of the integrated service; in both projects, coverage with the intervention linked to immunization services increased markedly. In India, where health workers were trained to provide nutrition counseling during RI visits, the exposure of caregivers to counseling during vaccination visits was 42% higher in intervention locations compared with control locations [20, 21]. Because immunization coverage was not reported, changes to the immunization program could not be determined. In Malawi, where bednet distribution was integrated with RI, bednet usage by 12- to 23-month-olds doubled in intervention districts, from 25% to 28% at baseline to 52% to 69% 18 months later. However, the rate remained constant in the control district [16], although full immunization coverage by 1 year of age was not significantly different between the intervention (63%–79%) and control locations (68%). One explanation for this finding may be the introduction of a major initiative for strengthening the RI program, known as Reaching Every District, in the control location only [42]. In a study in Zambia linking immunization to multiple other child health interventions in a routine setting, fully immunized coverage significantly improved by 16 percentage points in 1 area 33 months after the start of integrated routine visits and improved significantly by 14 percentage points in another area starting from the midpoint (9 months after baseline) to the time of assessment (24 months later) [26].

Other articles contained information on the coverage with immunizations and the linked intervention to illustrate the differences in postintervention performance between the 2 services, although neither controls nor baseline data were available (Table 4). In 12 of 16 instances where postintervention coverage (or equivalent outcome indicator) for the linked intervention was measured and reported, this value was below the reported immunization coverage. In all instances where preintervention coverage was reported, coverage increased after the intervention. In 2 instances, both vitamin A coverage [24] and deworming tablet coverage [34] were equal to immunization coverage. In the remaining 2 instances, vitamin A coverage [36] and bednet ownership [16] were higher than immunization coverage.

Reported Lessons Learned

Authors documented a variety of lessons learned from implementing integrated services. For example, in the Madagascar CHW, HIV testing and family planning counseling, both time-intensive interventions, resulted in noticeable increases in the time for service delivery compared with that required for vaccination delivery alone, which slowed the CHW approach [30]. Logistical issues were noted in multiple integrated activities; for example, in Ethiopia's CHW, 58% of locations reported that campaign supplies did not arrive on schedule and 66% reported

supply shortages [27]. In the multicountry assessment of CHWs, authors felt that CHWs could be most effective in places with weak routine systems, whereas in countries with stronger routine systems, targeted CHWs conducted only in areas with weak systems should be considered due to concern about how CHWs disrupted the routine system [31]. In 2 studies on integrating bednets with routine services, anecdotal reports suggested distribution of bednets disrupted the supply chain and service delivery sites, resulting in lower coverage of other services (eg, immunizations, vitamin A) in at least 1 location [16, 27]. In a polio campaign in Niger, one-third of mothers who had not received a bednet reported that the delivery site had no bednets [33]. Authors in a Tanzania IPTi study noted general issues with IPTi drug stockouts as a key challenge to implementation; however, vaccine stockouts were also a noted problem [9].

Efforts to link provision of insecticide-treated bednets to measles vaccination suggested that such linked interventions may require additional education to change community behavior [38]. For example, although postcampaign bednet ownership and immunization coverage were similar in integrated campaigns, postcampaign bednet usage by children <5 years of age was 17–48 percentage points lower than ownership, and authors described the need for social mobilization activities to increase bednet usage [36, 38, 40].

The impact of low immunization coverage and incomplete overlap of the target populations for immunizations and linked interventions drew concern around efficiency of resource use [10, 34, 40]. An analysis from Ghana concluded that due to malaria seasonality and poor overlap of target age groups between RI services (0–12 months) and IPTi (4–24 months), as well as low immunization coverage (<80% DTP3) in many West African countries, scaling up the linkage between these interventions could lead to inefficient use of IPTi resources [10]. Stakeholder concern that high immunization coverage could be adversely affected may also pose a barrier to linking programs, as seen in India during preparation for a linked nutrition education initiative [21]. Similarly, based on concerns by immunization program managers that the addition of vitamin A and deworming tablets might jeopardize the immunization campaign, a decision was made in Republic of Congo to add only 1 intervention per campaign round [41]. Conversely, in multiple IPTi studies, authors attributed success of integrating IPTi and immunizations to active engagement of key stakeholders through a collaborative partnership between immunization and malaria decision makers to develop and determine how to integrate IPTi into RI visits [12, 15]. In a multicountry study on the acceptance of IPTi alongside immunization visits, the main determinants of acceptance of the approach were mothers' familiarity of the IPTI drug prior to integration, simplicity of delivering the IPTI drug, and caretakers' perceptions that the intervention has a perceived benefit that outweighs any downsides [14].

DISCUSSION

In this review of integration of immunization and other primary healthcare services, we found that the spectrum of interventions linked to immunization delivery increased since our 2005 review [5] and now includes 2 new interventions studied for integration: newborn hearing screening and HIV counseling and treatment services. An indication of the increased interest in integration since our 2005 review was the volume of literature on the topic: The number of reports published during the past 5 years alone was similar to the number published during the previous 20 years, which were covered in the 2005 review. Despite this growth in the number of reports, knowledge gaps identified in the 2005 review are still evident in this review, most notably the absence of comparisons of integrated activities with nonintegrated activities. Without this information, stakeholders cannot measure impact, which in turn limits their ability to appreciate the potential benefits of integration. This may result in ongoing concern over how integration impacts existing immunization programs. Whether resources are more efficiently used in an integrated delivery setting or 2 separate vertical delivery systems is a critical question that was raised in the 2005 review and has yet to be answered by the review of studies included here. Among all studies included in this and our 2005 review, only 1 reported data on resources saved through integration [34]. Rigorous evaluations on the impact and cost of integrated interventions would be useful to filling key knowledge gaps in integrated service delivery.

A number of characteristics of success in integrated service delivery were identified in the reviewed studies. How well a linked intervention's target age group and resource needs (eg, supplies, equipment, and appropriately trained health workers) were compatible with immunization services emerged as an important consideration about whether and how to integrate. In campaigns where immunization service delivery requirements were similar to those of the linked intervention (eg, vitamin A and deworming tablets), coverage for all interventions was similar. Bednet ownership levels also reached the same levels as immunization coverage in both integrated campaigns and routine service delivery; however, the use of bednets by children <5 years of age lagged behind immunization coverage and the need for additional education was frequently recommended. Using immunization programs as a mechanism for referring mothers and infants for additional services such as hearing screening or HIV testing also appeared to be successful, provided that additional health workers were available to offer the referred service. Ensuring the supply chain was sufficient to carry commodities for both immunization and services such as bednets or HIV treatment may have also contributed to successful integrated delivery.

The primary concerns about integration with immunization services we identified were related to immunization programs

Table 4. Reported Outcome Indicators From Studies With Evaluations Where Maternal and Child Health Interventions Were Linked to Immunization Services in Developing Countries

Project Country [Reference]	Delivery Method	Intervention Location Data						Comparison Location Data			Post-intervention Coverage Difference[b]
		Linked Intervention Indicator	Pre[a]	Post[a]	Immunization Indicator	Pre[a]	Post[a]	Indicator	Pre[a]	Post[a]	
South Africa [22]	Routine	Proportion of infants screened in hearing test		95%							
		Mean infant age at hearing screening		105 days							
Nigeria [23]	Routine	Proportion of infants screened in hearing test		88%							
		Mean infant age at hearing screening		17.7 days							
Philippines [24]	Routine	Family planning utilization	70%	80%	Fully vaccinated coverage[c]	80%	90%				−10
		Vitamin A coverage	70%	90%							0
India [20, 21]	Routine	Proportion immunization visits where mother received nutrition counseling		43%	Vaccination card retention rate[c]		87%	Vaccination card retention rate[c]		74%	−44
Malawi [16]	Routine	Bednet ownership[d]	39%	83%	Fully vaccinated coverage[c]	49%	68%	Fully vaccinated coverage[c]	47%	79%	15
		Bednet ownership[d]	65%	86%	Fully vaccinated coverage[c]	33%	63%	Bednet ownership[d]	50%	52%	23
		Slept under bednet previous night[d]	25%	52%				Slept under bednet[d]	29%	28%	−11
		Slept under bednet previous night[d]	28%	69%							7
Ghana [11]	Routine	Coverage of malaria intervention treatment of infants		87%							
South Africa [19]	Routine	Proportion of mothers accepting offer of infant HIV test		90%							
Zambia [26]	Routine				Fully vaccinated coverage[c]	52%	69%				
					Fully vaccinated coverage[c]	48%	57%				
Mexico [28]	Enhanced routine	Geohelminth infection prevalence rate[e]	20%	8%							
Republic of Congo [41]	Campaign	Vitamin A coverage[e]		>90%							
		Deworming tablet coverage[e]		>90%							
Niger [40]	Campaign	Bednet ownership[e]	5%	70%	Polio vaccine coverage[e]	NA	87%				−17
		Slept under bednet previous night[e]		22%							−65
Tanzania [36]	Campaign	Deworming tablet administration[e]	39%	86%	Measles vaccine coverage[e]	77%	91%				−5
		Vitamin A coverage[e]	67%	93%							−2
		Bednet ownership[e]	61%	91%							0
Zambia [38]	Campaign	Bednet ownership[e]	21%	88%							
		Slept under bednet previous night[e]		56%							

Table 4 continued.

Project Country [Reference]	Delivery Method	Intervention Location Data						Comparison Location Data			Post-intervention Coverage Difference[b]
		Linked Intervention Indicator	Pre[a]	Post[a]	Immunization Indicator	Pre[a]	Post[a]	Indicator	Pre[a]	Post[a]	
Togo [34, 35]	Campaign	Bednet ownership[e]	8%	63%	Measles vaccine coverage[e]		93%				−30
		Slept under bednet previous night[e]		44%	Polio vaccine coverage[e]		94%				−49
		Deworming tablet coverage[e]		93%							0
Madagascar [39]	Campaign	Household bednet ownership		84%							
		Slept under bednet previous night[e]		85%							

[a] Time of data collection for postintervention data varies by study, ranging from 1 week to 6 months.

[b] Postintervention linked-intervention indicator minus the postintervention immunization coverage indicator.

[c] Target age group: <1 year.

[d] Target age group: 1–2 years.

[e] Target age group: <5 years.

with low coverage, time-consuming interventions in campaigns, interventions requiring behavior change, and interventions with different target age groups from immunization services. Because campaigns are designed to deliver vaccines quickly and efficiently, any activity that slows delivery may affect overall performance. During campaigns, service integration suffered in situations where substantial time and interaction between provider and patient were required. A number of linked services (eg, hearing screening, HIV services) have unique resource requirements, such as the need for a private room, which may also be limiting simultaneous delivery with vaccinations. This was addressed in some of the reviewed studies by having the vaccinator refer the mother or child to another health worker who delivered the linked service. However, this could pose logistical hurdles and require the need for more cross-worker coordination. Integrating other health interventions with immunization services can result in rapid increases in coverage of the second intervention. However, the integrated method appears to inherit the same challenges that immunization services were likely already faced with prior to integration. For example, challenges often mentioned related to systemic issues such as poor supply chains, infrequent supportive supervision, insufficient planning, and inadequate engagement of community leaders. In integrating a new intervention, a useful preintegration activity may be to identify the key challenges already facing the system and to incorporate strategies to address them rather than only focus on how to integrate.

This review was limited to literature databases we could access by computer and to experts we contacted by e-mail or telephone. Including sources in languages other than English and Spanish and conducting field visits to interview program managers experienced in integrated service delivery may provide additional information. Few reviewed studies reported pre- and postintervention coverage data for all integrated services from both intervention and comparison settings; this information would help strengthen our understanding of various integration strategies.

In this review, the most successful integration efforts appeared to be those that included an easy-to-administer intervention, such as malaria treatment, vitamin A, and deworming tablets, which were added to existing immunization services with little additional effort. Due to challenges identified in integrating complex interventions that require time or behavior change, such as HIV and family-planning services, more data are needed from programs that have first outlined the resource needs for each intervention to ensure that commodities are consistently available. In light of the recent WHO policy to identify all HIV-exposed infants by 6 weeks of age and subsequent calls for using immunization visits to do so, further research linking HIV care to immunizations visits is vital [43, 44]. A comprehensive approach to integrated service delivery that ties together researchers with programmatic implementers and provides evidence across multiple countries on community impacts, biologic impacts, cost effectiveness of different delivery approach, and best practices for planning of integrated service delivery as exemplified by the work of the IPTi consortium may be a critical model for yielding substantial data for each major intervention that uses immunization services [45]. Reviewing integration strategies outside immunization services can also be beneficial; these include reviews of packages of maternal and child health services and expert opinions proposing frameworks for integrated services [46–50]. Although gaps remain, the acceleration of research and the diversity of interventions linked to immunization indicate a strong interest in identifying successful ways to link services and to determine best practices for integrated services involving immunization programs.

Notes

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