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Improving Quality of Basic Newborn Resuscitation in Low-resource Settings: *A Framework for Managers and Skilled Birth Attendants*

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This framework was developed in consultation with the Newborn Resuscitation Working Group of the Newborn Technical Reference Team of the United Nations Commission on Life-Saving Commodities by Kathleen Hill and P. Annie Clark of University Research Co., LLC (URC), Indira Narayanan, Linda L. Wright of the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development, and Donna Vivio of the United States Agency for International Development (USAID) under the leadership of the USAID Applying Science to Strengthen and Improve Systems (ASSIST) Project. The work of the USAID ASSIST Project is made possible by the generous support of the American people through USAID and its Office of Health Systems, Bureau for Global Health.

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A Framework for Managers and Skilled Birth Attendants

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Acronyms

ASSIST	USAID Applying Science to Strengthen and Improve Systems
BMGF	Bill and Melinda Gates Foundation
ENAP	Every Newborn Action Plan
GDA	Global Development Alliance
HBB	Helping Babies Breathe
NICHD	National Institute for Child Health and Human Development
NR	Newborn resuscitation
PDSA	Plan-Do-Study-Act cycle
QI	Quality improvement
SBA	Skilled birth attendant
UN	United Nations
UNCoLSC	United Nations Commission on Life-Saving Commodities
UNICEF	United Nations Children's Fund
URC	University Research Co., LLC
USAID	United States Agency for International Development
WHO	World Health Organization

I. Introduction

This framework highlights common health system and quality of care gaps impeding provision of life-saving basic newborn resuscitation (NR) services in low-resource settings and describes how quality improvement and health system strengthening approaches can help overcome these gaps. It is intended to help managers and skilled birth attendants (SBAs) at all system levels to understand common quality gaps and promising approaches for improving NR services. The focus of this framework is on newborn resuscitation; however effective NR improvement efforts must address newborn resuscitation as one element of a broader package of essential services for newborns and must also address management of adverse intra-partum events [1]. This brief focuses on quality of NR services provided by SBAs in facilities. In low resource settings many births occur outside of facilities where it may be difficult to deliver best practices to reduce and manage asphyxia; these issues, however, are beyond the scope of this framework.

The brief was developed by the authors for and in consultation with the Newborn Resuscitation working group of the Newborn Technical Reference Team of the United Nations Commission on Life-Saving Commodities (UNCoLSC) for Women and Children under the leadership of the USAID Applying Science to Strengthen and Improve Systems (ASSIST) Project. An initial draft developed by the authors was reviewed and revised during a one-day technical meeting with stakeholders and experts on January 3, 2013 and a follow-on half day quality session during the annual meeting of the Newborn Resuscitation working group of the Newborn Technical Reference Team of the UNCoLSC.

A. The Worldwide Death Toll from Newborn Asphyxia

Newborn mortality represents approximately 44% of under-five child deaths, and newborn asphyxia is responsible for a quarter of newborn deaths worldwide [1]. Because under-five child mortality has decreased at a faster rate than neonatal mortality, newborn deaths constitute an increasing proportion of all under-five deaths. Nearly one half of all newborn deaths occur during the first 24 hours after birth, and 700,000 (roughly a quarter of newborn deaths) result from intra-partum-related events, also termed birth asphyxia [2]. In practical terms, asphyxia can be defined as failure to establish or sustain effective breathing at birth. Most cases of birth asphyxia can be successfully managed if the newborn baby is immediately and thoroughly dried, assessed for breathing, and stimulated, if not breathing. In some cases, neonatal resuscitation using a bag and mask for ventilation is required [3]. Newborn resuscitation should always be provided as part of a package of high-impact interventions, including subsequent essential newborn care for every baby.

B. Escalating Global and Country Advocacy and Implementation Efforts

Recent years have seen an unprecedented focus on prevention and management of newborn asphyxia as part of global and country efforts. In 2012, the World Health Organization issued updated guidelines for evidence-based Basic Newborn Resuscitation based on rigorous expert technical consultation review of a rapidly expanding body of evidence [4]. There has been a concurrent proliferation of global initiatives focused on the mother and newborn in recent years including Every Woman Every Child [5] with the United Nations (UN) Commission on Information and Accountability and the UN Commission on Life Saving Commodities for Women and Children [6], Born Too Soon [7], A Promise Renewed [8], and most recently, the Every Newborn Action Plan (ENAP) [9] endorsed by all 194 member states of the World Health Assembly on May 24, 2014.

In 2008, the American Academy of Pediatrics began development of the user-friendly Helping Babies Breathe (HBB) newborn resuscitation training program, and in 2010 the public private HBB Global Development Alliance (GDA) was formed to facilitate scale up of HBB. The HBB GDA partnership has propelled country-level newborn resuscitation policy and training efforts by providing a curriculum, training materials, equipment, and a website for HBB activities, courses, and resources, including an HBB implementation guide [10,11]. In 2013, a consortium of partners, including the World Health Organization (WHO), United Nations Children's Fund (UNICEF), United States Agency for International Development (USAID) and the Bill and Melinda Gates Foundation (BMGF), launched a consultation for a global Every Newborn Action Plan (ENAP) to accelerate advocacy, policy, and implementation efforts to improve newborn survival.

II. Why Training and Commodities Are Not Enough: Tackling Quality of Care and System Gaps

Despite monumental gains in training and commodities distribution, persistent system and quality of care gaps continue to prevent many newborns, even when delivered in facilities, from receiving effective resuscitation services in low-resource countries [12].

Major categories of health system and quality gaps impeding provision of effective basic resuscitation services include:

- **Governance and policy:** Inconsistent national policies, leadership and accountability mechanisms; lack of prioritization of high-burden conditions
- **Health information systems:** Lack of available standardized quality of care data and use of data to improve NR services.
- **Provider competencies:** Emphasis on knowledge rather than skills and inadequate development/maintenance of skills after training
- **Essential commodities:** Lack of functional supplies in delivery areas
- **Organization of care processes:** Poor organization of care processes, weak management support and inertia due to "practice as usual"
- **Improvement capacity within health system:** Lack of quality improvement (QI) capacity throughout health system

Health information systems: Many facilities in low-resource settings do not routinely monitor newborn resuscitation or have robust mechanisms to hold managers and providers accountable for consistent implementation of NR best practices. The importance of collecting and using standardized local data to measure and improve quality of care is discussed further below.

Provider competencies: Sustaining provider NR competence and standards-based performance after initial training presents unique challenges as compared to the provision of routine care interventions such as thermal protection and cord care. This challenge is particularly acute in peripheral facilities that manage a smaller volume of births and high-risk pregnancies, although adverse events are devastating when they do occur in such settings. The simulation-based HBB program helped to change the landscape of newborn resuscitation training. Providers trained prior to HBB and the advent of other simulation-based curriculums may not have received adequate skills training nor had the opportunity to practice skills.

However, there is limited evidence on whether simulation-based resuscitation training alone is sufficient to maintain SBA skills and performance without ongoing mentoring, monitoring and practice in real-life settings. A study published in 2013 found that sustained improvements in simulated performance seven months after a one-day HBB training course did not translate into improved clinical management of neonates; in fact observed clinical management actually declined [13]. However, there is evidence that training, followed by regular refresher training, supervision, and mentoring methods that employ a mix of simulated and real-life resuscitation, can change practice and sustain provider competence and performance [14]. There is evidence from a large study in Tanzania that repeated simulated practice and refresher trainings provided by designated senior midwives resulted in a sustained 47% reduction in 24-hour neonatal mortality and a 24% reduction in fresh stillbirths after two years [15]. It is unclear that this level of reduction in perinatal mortality rates will be achieveable in a global roll-out of HBB training.

Resuscitation commodities: In many countries in recent years, birth attendants train using donated or purchased low-cost resuscitation devices and infant mannequins and then take the mannequins and equipment back with them to their health centers. This stands in contrast to past efforts in which expensive mannequins were often available only as part of specialized training. Providing relatively low-cost "training kits with mannequins and resuscitation equipment" that trainees can carry back to their health facilities has proven an important innovation for equipping facilities with resuscitation equipment and with the infant mannequins necessary for regular practice of skills as part of informal or structured simulations. Provider motivation for continued practice may be an important factor influencing use of the mannequins for routine practice.

It is important that countries design and implement strategies to procure, supply and maintain functional resuscitation devices at the point of care beyond training strategies alone. Key components of resuscitation commodities procurement and maintenance strategies include: advocacy, inclusion in the national list of essential medical devices, market shaping and forecasting (global and local), regulatory efficiency, cost, technical specifications, product quality, sustaining demand/supply and maintenance, and product innovation. These components are being addressed by the Newborn Resuscitation working group of the Newborn Technical Reference Team of the UN Commission for Life Saving Commodities for Women and Children (see https://lifesavingcommodities.org/colsc/technicalrefgroups/resuscitation).

Within countries, it is important that management of commodities and service delivery be closely aligned to ensure availability of clean and functional resuscitation devices in all delivery areas. The UN Commission for Life Saving Commodities specifies three main resuscitation items: 1) a self-inflating ventilation bag and mask; 2) a training mannequin; and 3) suction devices. Other essential commodities are also important for comprehensive essential care of the newborn and should be readily available in a designated area in every delivery area, including a source of warmth during resuscitation, stethoscope, thermometer, cloths for drying and wrapping, and a weighing scale.

Organization of care processes: Poor organization of care processes often poses simple but major barriers to provision of effective NR services. For example, the lack of an equipped

area for resuscitation and competent SBA backed by qualified staff available 24/7 in the immediate delivery area may prevent both baby and mother from receiving life-saving emergency care. Realistic patient: staff ratios also are essential to deliver quality care. Documentation of care provided at birth is limited in many facilities, but can enhance clinical communication and assessment.

Capacity for continuous improvement within health system: SBAs and managers at all levels of the health system often do not have the basic skills to assess quality of newborn care, identify critical quality of care gaps and design, and support and monitor quality improvement and health system strengthening efforts to improve outcomes for newborns.

III. Common Quality and System Gaps and Potential Solutions

Table 1 summarizes common service-delivery quality of care gaps impeding provision of high-quality newborn resuscitation services in facilities, along with examples of specific solutions that may help close these gaps. Table 2 highlights common health system gaps upstream to facilities and provides examples of potential solutions to strengthen health system functions that are essential for delivery of high-quality NR services. Subsequent sections address principles of improving quality of NR, including quality indicators and measurement.

Table 1: Examples of facility-level newborn resuscitation service delivery gaps and solutions

Category of Quality Gap	Common Gaps	Illustrative Solutions
Monitoring and improving outcomes using local **health information system**	Facility records and registers do not capture essential quality of care process and outcome data SBAs and managers do not collect and act on standardized quality measures	Standardization of perinatal medical records and registers to capture essential data for each birth Regular staff monitoring and discussion of standard structural, quality (process) NR and newborn outcome indicators (e.g., posting of monthly results in delivery area with action plan)
Activities to support **provider and manager competencies (QI and clinical)**	Lack of regular clinical resuscitation training (pre-service, initial & refresher) Lack of supportive supervision Lack of QI competencies among facility and district staff (managers and SBAs) to set improvement aims, test changes to processes of care, conduct structured audits, and collect, calculate and interpret standardized quality measures.	Regular schedule of pre-service and in-service skills-based clinical and QI training (initial/refresher) Regular supportive supervision using checklist; systematic monitoring of individual SBA NR competence Regular simulated resuscitation practice (e.g., peer-to-peer observation) Integrated on-site clinical, quality improvement, and data management capacity-building reinforced during supervision Staff sets improvement aims and targets; tests changes and monitors quality measures Same-day debriefing after every resuscitation Structured audit of every maternal and perinatal death Regular staff discussion of structural, quality and outcome measures, linked to action
Clean and functional commodities in all delivery areas	No NR spaces with clean, functional neonatal bag and mask ready 24/7 No routine maintenance or cleaning of commodities No standardized procedure for avoiding stock-outs	Daily equipment maintenance and cleaning with verification Designate and equip NR space in each delivery room Protocol for maintenance of equipment with verification Standardized protocol for inventory and procurement of equipment and supplies
Efficient organization of care processes	Poor recognition and referral of high-risk pregnancies to appropriate centers Lack of recognition of complications arising during labor in previously normal pregnancies Lack of designated SBA present in delivery area 24/7 No designated equipped NR area in delivery room available 24/7 Lack of clear staff roles Lack of effective team-work	Routine staff capacity-building on recognition and referral of high-risk pregnancies Routine monitoring of labor Staffing schedule with designated NR-competent SBA on-site every shift, including call schedule Designated equipped NR area maintained and checked daily by point person Resuscitation action plans/protocol posted prominently in delivery rooms Define staff roles/tasks and post in delivery area On-site training and supervision/mentoring of NR is done as a team

Table 2: Examples of system gaps and solutions to strengthen system functions

Health System Function (National, Regional and District Management)	Health System Gaps	Illustrative Solutions
Policy and leadership	Weak leadership, governance and accountability (national/local) No required certification/re-certification of providers and licensing of facilities Out-of-date newborn care standards Lack of policy on provider cadres authorized to provide NR No standards and guidelines for commodity inventory, procurement, distribution, and maintenance	Strengthen accountability via national newborn strategy with specific aims and targets, designated budget, work-plans and responsible staff (national/local) National facility and provider certification/re-certification requirements with enforcement mechanism Update newborn care standards tailored to facility level; engage obstetric, midwifery and pediatric professional associations Issue clear policy on provider cadres authorized to perform NR Develop commodity management guidelines
Financing	Health policymakers not always included in appropriation of funding for health sector (e.g., Ministry of Health, Ministry of Finance and Planning)	Designated budget for health service, delivery, and equipment
Routine health information systems	No national vital registries Lack of standard essential newborn care/NR quality measures in facility and national routine health information systems Poor quality and/or inconsistent use of available data Weak data management skills among SBAs, managers and facilities	Require and support standardized national vital registries Incorporate sentinel NR and care of the newborn from birth until discharge quality measures (input, process and outcome) into facility and routine information systems Build data management capacity among designated staff (district, regional, national) to collect, analyze and act on regular aggregated quality measures across system Adopt electronic medical records and health information technologies to increase efficiency of data tracking across system
Human resources management	Lack of oversight and accountability for SBA NR competence Poor pay, incentives, and professional development opportunities for SBAs and managers. Challenges retaining staff (e.g., poor pay, limited professional development opportunities.) Weak supervisor management skills Weak staff commodities maintenance skills Weak staff data collection and management skills	Enforced schedule of pre-service/in service and refresher NR training integrated with essential newborn care Explicit schedule/structure for supportive supervision with observation of simulated NR Institute incentives and regular professional development opportunities (e.g., for newborn resuscitation quality improvement champions) Build management capacity of Regional and District Health Management Teams to supervise NR functions Build staff commodities procurement and management skills Build staff data management capacity
Commodities and logistics support	Out-of-date definitions for standard essential medical devices Poor oversight of product quality and technical specifications Weak regulatory environment for requiring efficient inventory and procurement of NR medical devices Lack of standardized forecasting, procurement, distribution, and tracking of NR commodities	NR commodities guidelines Build capacity to forecast resuscitation equipment needed Follow best practice standards for procuring high-quality economical resuscitation devices and assuring their continuous availability
System capacity for continuous improvement	Lack of manager capacity (district/regional) and motivation to improve their own work processes and to support QI efforts all system levels	Build capacity of managers to support improvement efforts all levels of health system

IV. Improvement Approaches Can Help Overcome Common System and Service Delivery Quality of Care Gaps to Improve NR Services in Resource-poor Settings

Quality improvement approaches can help overcome many of the common gaps summarized in Tables 1 and 2 to improve newborn resuscitation services, even in very resource-constrained settings. Improvement approaches expand on traditional inputs (e.g., guidelines/standards, supplies, and training) to engage providers and managers to change health care and management processes to achieve reliable implementation of evidence-based best practices for high-burden conditions for every patient in need.

There is no single best "method" for improving quality. Improvement is not a noun or a goal but rather an iterative process to deliver effective, safe patient-centered care in complex, messy, real-life health care delivery systems. Despite the lack of a single best quality improvement method, several principles and conceptual models can help managers and providers design improvement efforts and are described briefly below.

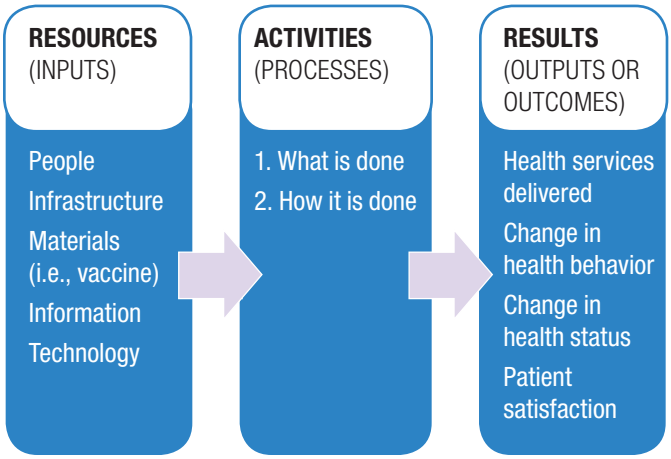
Core principles of improvement: Several principles underpin much of the improvement work implemented in both high- and low-resource settings. These include:

- Effective teamwork (at all relevant system levels) that engages managers, providers, staff, patients, and relevant stakeholders to achieve a common improvement aim
- An understanding of how processes of care function within a health system and the critical bottlenecks that impede reliable health care processes
- Use of data (tailored to each system level) to continuously measure and track progress toward an explicit improvement aim
- An understanding and focus on patient needs
- Regular shared learning

The Donabedian conceptual model proposes three main categories from which information about quality of care can be drawn (see Figure 1): 1) Structure (or "inputs"), 2) Process and 3) Outcomes. **Structure** describes the context in which care is delivered, including policies and procedures, infrastructure, staff, financing and equipment. **Process** denotes the actions that make up health care as reflected in the transactions between patients and providers throughout the delivery of health care. Processes can be further classified as technical processes, how care is delivered, and interpersonal processes, the manner in which care is delivered. **Outcomes** refer to the effects of health care on the status of patients and populations [16]. These categories are addressed further as part of the discussion on NR quality indicators below.

To date, efforts to scale up NR services in low-resource settings have focused primarily on the structures necessary to provide NR services, including distribution of essential commodities and training of providers. This emphasis has been understandable, given the significant structural deficits in many birthing facilities in low-resource settings. Going forward, however, it will be important that global, country, and local efforts incorporate a complementary focus on the processes of newborn care. Ultimately, quality of NR care (adherence with best practices) can only be addressed through close scrutiny of actual resuscitation practices for newborns with asphyxia.

Figure 1: Inputs, processes, and outcomes



Source: Donabedian 1966 [16]

A. The Model for Improvement

The Model for Improvement is a strategy to manage change for improvement that stems from the work of W. Edwards Deming [17]. The model includes three basic questions to help structure improvement, which can be addressed in any order:

1) What are we trying to accomplish?

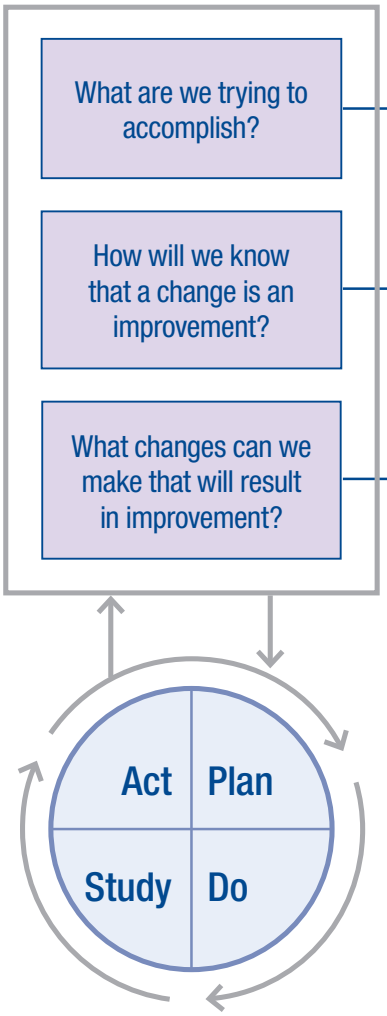
2) How will we know that a change is an improvement?

3) What changes can we make that will result in improvement?

All improvement begins with clear aim(s) as depicted in Figure 2. Defining measurable improvement aim(s) and indicators to measure progress against aims is essential for supporting the work of local improvement teams (whether a facility-based team or a District Health Management Team). In turn, developing the capacity of managers and providers at all system levels to define measurable improvement aims is essential for building a system capable of continuous improvement. Improvement aims should be focused on quality gaps for high-burden conditions linked to regular tracking of indicators to measure progress (or lack of progress) toward identified aims.

A key tenet of improvement is that making care better always requires change, although not all change necessarily leads to improvement. Without change, every system will continue

Figure 2: The Model for Improvememt



Setting Aims
Improvement requires setting aims. The aim should be time-specific and measurable; it should also define the specific population of patients that will be affected.

Establishing Measures
Teams use quantitative measures to determine if a specific change actually leads to an improvement.

Selecting Changes
All improvement requires making changes, but not all changes result in improvement. Organizations therefore must identify the changes that are most likely to result in improvement.

Testing Changes
The Plan-Do-Study-Act (PDSA) cycle is shorthand for testing a change in the real work setting: by planning it, trying it, observing the results, and acting on what is learned. This is the scientific method used for action-oriented learning.

Source: Adapted from the Institute for Healthcare Improvement and US Department of Health and Human Services.

to produce the same results it has always produced. In other words, "every system is perfectly designed to achieve the results it produces." Managing change is central to improvement efforts, whether or not such efforts are prospective (e.g., defining aims and proactively testing changes to processes of care to try to reach the aim) or retrospective (e.g., auditing and examining adverse events to identify and correct root problems contributing to poor quality).

B. The Plan-Do-Study-Act Cycle

One approach to managing change in complex local health systems is the Plan-Do-Study-Act (PDSA) cycle shown in the "Testing Changes" part of Figure 2. The PDSA cycle guides tests of change to determine if change is an improvement. Teams new to improvement need ongoing support to identify and test changes to processes of care to improve adherence with best practices. Ideally, team support includes integrated clinical, QI, and data-management capacity-building over time. Improvement teams are typically made up of managers, front-line health care workers, and other staff who possess the necessary deep knowledge of their local systems to be able to identify and test *feasible and sustainable changes* to "usual processes" to improve care in their own setting.

C. Feasible and Sustainable Changes

While context has a strong influence on which changes may be most feasible and effective for overcoming gaps in a specific setting, categories of quality and system gaps and effective changes (solutions) are often common across settings. Diverse settings can learn from each other to overcome common quality and system gaps. Increasingly, many improvement approaches (e.g., collaborative improvement) mobilize teams to work together across health system levels and geographic sites to identify, test, and share successful changes for

overcoming important quality and system gaps, e.g., weekly simulated resuscitation practice using structured peer-to-peer observation to maintain provider competence. Promoting regular shared learning among teams helps to accelerate and scale up improvement efforts.

D. Resuscitation Debriefing and Death Audits

One promising approach to improve quality of NR services is to involve all birth attendants in regular debriefing of every newborn resuscitation incident and in audits of every infant (and maternal) death. Debriefing can be introduced as part of a neonatal resuscitation training program; debriefing should take place as soon as possible after the event (for maximum recall, before the end of the shift) and include personal reflection by the skilled birth attendant on what went well, what did not go well, and what he/she might do differently the next time. Debriefing should be non-judgmental, with guidance and facilitation by a knowledgeable supervisor. Ideally the results of such debriefings and case audits are summarized anonymously and reviewed and discussed by the delivery room staff on a biweekly or monthly basis. Debriefings and audits frequently identify systems issues; the staff supervising these activities should have authority to pursue issues to resolution. Such reviews can be enhanced by graphic display of progress on NR quality of care process measures; e.g., percent of neonates who didn't breathe spontaneously after immediate drying and were resuscitated by stimulation alone.

Whether NR improvement approaches include prospective (e.g., model for improvement), retrospective (e.g., audits), or combinations of prospective and retrospective approaches, all such efforts must define clear aims and quality measures and be closely aligned with efforts to strengthen structural inputs (e.g., SBA competency-based training and distribution of essential commodities).

V. Using Data to Improve and Sustain Effective Newborn Resuscitation Services at Scale: Opportunities and Challenges

Regular measurement and analysis of health outcome and quality of care measures are central to all improvement work. Measuring the clinical quality (adherence with standards) of the management of high-risk pregnancies, abnormal labor, and newborn resuscitation presents unique challenges because these processes are non-routine, highly skill-dependent, time-sensitive, and often not documented in low-resource health information systems. Early recognition and prompt management of abnormal labor is essential to prevent life-threatening intra-partum adverse fetal events. Successful resuscitation of a newborn depends on the immediate recognition of a newborn in need of help to establish breathing linked to administration of clinical interventions that must be tailored in real-time to a clinical evaluation/decision/action cycle based on the respiratory status of the newborn. The evaluation/decision/action cycle propels high-quality resuscitation, much as the PDSA cycle propels quality improvement. Defining feasible quality of care process measures that capture adherence with NR best practices is much more complicated than defining a quality measure for a simple routine intervention such as immediate breastfeeding.

In the Donabedian model to evaluate quality of care [16] indicators are classified as structural/input, process or outcome; the organization of Tables 3 and 4 mirrors the Donabedian classification model [16]. It is important to note that *outcome indicators* are the ultimate measure of the performance of a health system and the quality of care that it delivers. However, process and structural indicators can provide important interim measures of quality of care and system performance, particularly for care processes whose outcomes may be distal to the point of care and/or influenced by factors outside of the health service delivery system (e.g., patient delays in seeking care for prolonged labor).

A. Indicators to Support QI and Health System Strengthening Interventions to Achieve Effective Coverage of Newborn Resuscitation

Tables 3, 4, and 5 present a flexible menu of "core" and optional additional indicators for use in **facility-based** NR quality improvement efforts (Tables 3, 4) and aligned **district and regional system strengthening** efforts (Table 5) to achieve effective coverage of newborn resuscitation services. As expected, there is some overlap between facility and system indicators. Indicators in Tables 3, 4, and 5 can be adapted by Ministries of Health, program managers, facility QI teams, SBAs, and partners to support and monitor NR system strengthening and improvement activities. Core indicators

proposed in Tables 3, 4 and 5 are expected to be relevant for most NR improvement efforts and research activities. The degree to which optional "additional" indicators will be relevant for QI interventions and associated research will depend on the specific context and the needs of individual programs. Generally, it is preferable to select and track the smallest number of indicators necessary to support effective improvement work.

Table 3 proposes core and additional newborn *health outcome indicators* to inform facility-based improvement efforts and results-based management. Table 4 proposes core and additional input, process, coverage and referral indicators for use by facility QI teams (SBAs, managers, all relevant staff) and district supervisors (when appropriate) as part of ongoing facility-level QI efforts. Table 5 core and additional indicators of essential health system functions are intended to help district and regional health managers to support provision of high-quality NR services in every district facility.

Not every quality of care process, health outcome and coverage indicator can or should be included in a national health information system. Table 5 proposes a sub-set of Table 3 and 4 core and optional indicators along with other indicators of system performance for incorporation into national routine information systems for use by managers and decision-makers to strengthen results-based management.

Proposed indicators in Tables 3, 4 and 5 reflect the ongoing work of many partners, including the Inter-agency Newborn Indicators Technical Working Group, the HBB Planning Group, the Newborn Resuscitation Working Group of the Newborn Technical Reference Team of the UNCoLSC, the ENAP monitoring framework, and a WHO Consultation on Quality of Maternal, Newborn and Child Health Care. Every Newborn Action Plan and WHO core MNH global indicators are highlighted in bold in Tables 3, 4 and 5. Several country programs are currently testing the feasibility and usefulness of selected indicators in Tables 3, 4, and 5 for quality improvement and district health system strengthening efforts.

B. Measuring Quality: Challenges in Low-resource Settings

In low-resource settings, routine health information systems and facility data collection and routine information systems often do not capture minimum data for calculation of meaningful clinical quality (process) and health outcome indicators (Tables 3, 4 and 5). Although observation and client/provider interviews and knowledge tests may be useful as part of informal or periodic independent quality of care assessments, they are not sustainable as routine measurement approaches in most low-resource settings. Rather, routine measurement of clinical quality and specific health outcomes usually requires adaptation of local records and registers to permit capture of needed data; adaptation of records will be a necessary element of most NR improvement efforts. However, even when such data are available in local records, they are often inconsistent and of poor quality. Building staff capacity to capture and extract data to calculate quality measures is a huge part of supporting improvement efforts in low-resource settings [18].

Table 3: Flexible menu of core and additional outcome indicators to support facility-based NR improvement efforts*

Core Outcome Indicators	Additional Outcome Indicators
Total number of babies delivered per month	**Intrapartum stillbirth rate *(ENAP impact additional indicator)***
Number/percent of fetuses whose fetal heart rate counted and recorded on maternal admission	Number/percent of live births who didn't cry after immediate drying
Number/percent of newborns who do not establish spontaneous breathing at birth *(continued debate about how best to formulate this indicator)*	Number/percent of neonates who didn't cry after immediate drying, but responded to additional stimulation only
Number/percent neonates resuscitated *(ENAP core coverage indicator; needs standard definition of numerator and denominator)*	Number/percent of live births who didn't cry after immediate drying and additional stimulation but responded to bag-mask ventilation
Stillbirth rate *(ENAP core impact indicator)*	Number/percent neonates surviving to 24 hours after resuscitation
Number/percent of neonates who are macerated	Number/percent of fresh stillbirths who had a death audit *(% facilities conducting maternal death audits is a WHO MNCH core indicator)*
Number/percent fresh stillbirths *(WHO core indicator)*	Number/percent of neonatal resuscitations that were audited.
Number/percent of live births surviving to 24 hours	Number/percent live births that transition from delivery room to postpartum area
	Perinatal mortality rate

**WHO and ENAP global indicators highlighted in bold.*

Table 4: Flexible menu of core and additional input, process, coverage and referral indicators to support facility-based NR improvement efforts

Core Input, Process and Coverage Indicators	Additional Input, Process and Coverage Indicators
Number/percent of facility SBAs who received initial or refresher training within past 6 months	Funds mobilized and earmarked for maintaining NR competency of SBAs *(large health care centers/hospitals-training and supervision; regular practice using simulation)*
Number/percent of SBAs supervised in past quarter with observation of simulated NR	Number/percent of deliveries attended by a NR-trained SBA/month *(related to ENAP core coverage indicator—skilled birth attendance)*
Staff assigned to monitor, check and maintain clean, functional equipment and supplies for resuscitation in delivery areas (including emergency room, labor area)	Number/percent of providers demonstrating simulated NR competence at least every X time-period *(e.g., peer-to-peer observation using checklist)*
Posted 24/7 schedule of NR-trained SBAs for 24/7 delivery room coverage (call schedule, etc.)	Number/percent of days/nights per month when NR -trained SBA present (or assigned) in delivery room
Referral Indicators:	Equipped NR space with clean/functional NR bag and mask available 24/7 in delivery area
Number/percent of women transported to a higher level facility for late pregnancy and labor complications, including abnormal labor	Equipped NR space with neonatal mannequin (to permit simulated resuscitation practice)
Number/percent of live newborns requiring advanced care who were transported to a higher level facility	Number/percent of days per month when NR equipment/supplies checked for presence, cleanliness, and function in all delivery areas (standard daily checklist)
	Percent of women with prolonged labor in the facility *(WHO MNCH core indicator: # women undelivered 12 hours or more after admission to labor and delivery ward.)*
	Percent of facilities conducing neonatal death audits/reviews to defined standard *(% facilities conducting maternal death audits is a WHO MNCH core indicator)*
	Referral Indicators:
	Number/percent of live births transferred to another facility before birth/after birth
	Number/percent of fetuses with an auscultated heart rate on arrival at transport facility
	Measures of perinatal transport system

Standardized patient records that capture essential clinical data serve two functions: 1) they support real-time clinical decision-making at the point of care; 2) they permit data extraction for calculation, aggregation, and analysis of quality and outcome measures across different units of the systems to support continuous QI and system strengthening efforts.

Building capacity of SBAs to enter and use data in patient medical records is important for optimizing and measuring quality of care. Equally important are medical record storage systems that permit efficient retrieval of individual patient records for patient care and chart review purposes. Likewise, building capacity of managers and SBAs to collect, retrieve, aggregate, and analyze quality measures extracted (or automatically generated) from patient records and registers is a crucial element of building local improvement capacity. The emergence of electronic health records and electronic health information systems in many countries is likely to transform the feasibility and efficiency of capturing quality of care and outcome measures; however, electronic health records and registries are not without challenges, as is being learned in high-resource settings.

Table 5: Core and additional indicators of essential system functions for delivery of high-quality NR services, to inform sub-national/district results-based management*

Core Indicators to Support Information Systems, Commodities Management, and Human Resources	Additional Indicators to Support Information Systems, Commodities management, and Human Resources
<u>Policy and Financing</u> National Newborn Policy includes resuscitation Designated budget for resuscitation commodities, provider/manager NR training/supervision, NR QI activities National standard for a minimum data set for all facility births <u>Routine Information System</u> National and regional/district vital registry Number/percent of fresh stillbirths per facility administrative unit per month Number/percent of macerated stillbirths per facility administrative unit per month Number/percent newborns who do not establish spontaneous breathing at birth *(continued debate about how best to formulate this indicator)* **Number/percent neonates resuscitated *(ENAP core coverage indicator; needs standard numerator and denominator)*** <u>Human Resources and Routine Information System</u> Number/percent of SBAs trained in NR (initial or refresher) within past 6 months Number/percent SBAs demonstrating NR competence by observation or simulation within the past 6 months <u>Commodities</u> **Percent of health facilities with the presence of bag & mask (neonatal mask size) in labor and delivery wards *(WHO core MNCH indicator)*** <u>Regulation</u> National standards/indicators to track NR certification and licensing of staff and facilities	<u>Routine Information System</u> National standard for a minimum data set for all facility births *(see also under policy)* **Intra-partum stillbirth rate (district level) *(ENAP core additional impact indicator)*** Number/percent of live-born deaths in first 24 hours in district (facility and community) per month Number/percent neonates surviving to 24 hours after resuscitation Agreed set of standard indicators to track quality of care and outcomes for newborns (specified by national, district and facility level) <u>Human Resources</u> Number/percent of deliveries attended by a NR-trained birth attendant per month *(related to ENAP core SBA coverage indicator)* Density of midwife (N of midwife actually deployed/1,000 births per district) *(WHO Core MNCH Indicator. Alternative for facilities: Midwife: birth ratio)* <u>Commodities</u> Number/percent of delivery rooms with an equipped NR space available 24/7 Number/percent facilities with a neonatal mannequin to permit practice of simulated resuscitation <u>Regulation</u> Facility NR certification system and indicators Staff NR certification/licensure system/indicators linked to sanctions for non-compliance

**WHO and ENAP global indicators highlighted in bold*

VI. Conclusion and Recommendations

Persistent quality of care and system deficits prevent many newborns with asphyxia from receiving effective life-saving resuscitation in low-resource settings. Health system strengthening and quality improvement efforts can overcome critical gaps in the delivery of effective resuscitation services to prevent asphyxia and to improve survival and health outcomes for newborns with asphyxia.

Measurement of quality is a core principal of all improvement work. Emerging measurement frameworks, such as that of the Every Newborn Action Plan, will help to refine and to standardize the definition of indicators proposed in this framework. Regular shared learning across sites monitoring common quality measures can help accelerate improvements in newborn resuscitation care.

Although still in the early phases, several countries and research projects are implementing QI interventions and health system strengthening efforts to improve and sustain quality of basic resuscitation for newborns, often as part of an essential newborn care package. It is important to learn from these efforts going forward. In particular, there is a need to develop and test feasible and affordable approaches to improving quality of essential newborn care and resuscitation services in low-resource settings. Implementation efforts in low- and middle-income countries will benefit from rigorous research of strategies to improve, scale up and sustain high-quality essential newborn care and resuscitation services for every newborn.

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