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Clinical Information Network

CIN INSIGHTS BRIEF 1, FEBRUARY 2025

Laying the foundations for better care: transforming hospital practices through tools, guidelines, and information systems

Key points

- Kenyan hospitals have faced persistent challenges in delivering paediatric care, including poor adoption of evidence-based practices and limited information systems for monitoring and improving outcomes.
- Over the past 20 years, collaboration between researchers, government, and practitioners has focused on improving care through the development of standardised documentation tools, clinical guidelines and training to support the use of recommended practices.
- In 2013, these efforts were formalised with the establishment of the Clinical Information Network (CIN), which introduced a system for collecting and analysing hospital data and providing feedback to hospitals, enabling data-driven improvements in care and fostering continuous learning.
- This system has also served as a platform for conducting research at scale, enabling real-world testing of interventions, validation of clinical guidelines, and the generation of evidence to inform policy and practice.

ABOUT THIS SERIES

This is **Brief 1** in a series exploring the evolution, implementation, and impact of the Clinical Information Network (CIN) in Kenya. Each brief focuses on a distinct aspect of CIN's work.

Laying the foundations for better care: Developing tools, guidelines, and information architecture to support learning and improvement in Kenya's hospitals

A theory-informed approach: Applying theoretical frameworks to guide the development of CIN and its interventions

Transforming care in Kenyan hospitals: Showcasing CIN's progress in improving care processes and outcomes

Assessing quality of care at scale: Demonstrating research contributions, including validating tools, evaluating guidelines, clinical trials

System influences and interventions: Presenting research on health system barriers and system interventions to improve care

Exploring behavioural and organisational dynamics: Investigating the human and organisational factors shaping care practices

Background

Over the past two decades, Kenya has made progress in reducing child and neonatal mortality, but rates remain high, particularly for newborns.[1] Preventable deaths from conditions such as pneumonia, diarrhoea, and neonatal complications are exacerbated by poor hospital care. County and sub-county hospitals (many formerly District hospitals*), the primary providers of inpatient care, have limited capacity to provide appropriate interventions and adopt recommended practices.[2] These issues have been compounded by unreliable documentation and poorly functioning information systems, which hinder effective health care planning and evidence-based decision making.[3]

Since 2002, the Health Services Unit at the Kenya Medical Research Institute – Wellcome Trust Research Programme (KEMRI-Wellcome) has collaborated with the Ministry of Health (MoH) and other partners to address these issues. Efforts have focused on improving paediatric and neonatal care through tools – such as admission and monitoring forms – clinical guidelines, and information systems to inform better decision making and improve the quality of care.

These initiatives provided the foundation for the CIN in 2013 as a collaborative platform uniting KEMRI-Wellcome, the MoH, the Kenya Paediatric Association, and 24 hospitals (as of 2025). CIN uses standardised clinical data to identify areas for improvement, drive better practices, and foster continuous learning across hospitals.

This brief describes the development and implementation of tools, guidelines, training programmes, and information systems designed to equip frontline clinicians with the resources needed to improve health outcomes.

Tools to improve clinical documentation

Standardised clinical forms are essential for improving the quality of documentation and supporting clinical decision-making. Over the past 20 years, KEMRI-Wellcome researchers have collaborated with health managers and frontline workers to develop a range of tools including the Paediatric Admission Record (PAR) (2004), Neonatal Admission Record (NAR) (2013), discharge records, treatment charts, the Newborn Monitoring Chart (2019), and the Small and Sick Newborn Clinical Audit Tool (2021). These tools were designed with simple, structured formats to accommodate rotating staff who may be less experienced, and to support busy clinicians managing a high number of patients.

Example

Paediatric Admission Record (PAR)

The PAR is a structured form that was developed to improve the quality and completeness of documentation during the admission of sick children in hospitals. It was introduced to support inexperienced clinicians by prompting the assessment of key symptoms and signs. Additionally, it aimed to systematically capture data on common childhood illnesses such as malaria, pneumonia, and dehydration, establishing the foundation for large-scale, routine data collection and monitoring.

The form streamlines documentation with checkboxes and yes/no options, enabling clinicians to capture essential information quickly and efficiently, and serving as a precursor for the effective design of electronic medical records. Its development followed an iterative process, incorporating feedback from hospital sites to ensure usability and relevance.

A 2004 pilot study evaluated the PAR's effectiveness in improving the quality of documentation.[4] The findings showed high acceptability with 84% of children admitted using the PAR by the end of the trial. The study also demonstrated significant improvements in recording clinical features, such as pallor and level of consciousness, as well as in documenting the severity of illnesses.

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* In 2013, Kenya adopted a devolved system of government, reclassifying public hospitals from district and sub-district hospitals to county and sub-county hospitals. We will use the term "district hospitals" when referring to periods before 2013 and "county hospitals" when discussing periods after. In global contexts, "District Hospitals" may be used generically.

Newborn care

More recently, several tools have been developed to improve the documentation of inpatient care for newborns including monitoring and treatment charts, discharge records, and audit tools. Neonatal mortality in Kenya remains persistently high, with over 30,000 deaths recorded in 2022.[1] Most of these deaths stem from preventable and treatable conditions such as preterm birth complications, birth asphyxia and neonatal sepsis.[5]

The tools were developed using a Human Centred Design (HCD) approach, which focuses on understanding the contexts, behaviours and the needs of end-users throughout the design process.[6] HCD involves active engagement with users and feedback cycles to ensure the tools are practical for the demanding routines of nurses and clinicians.

Newborn Monitoring Chart

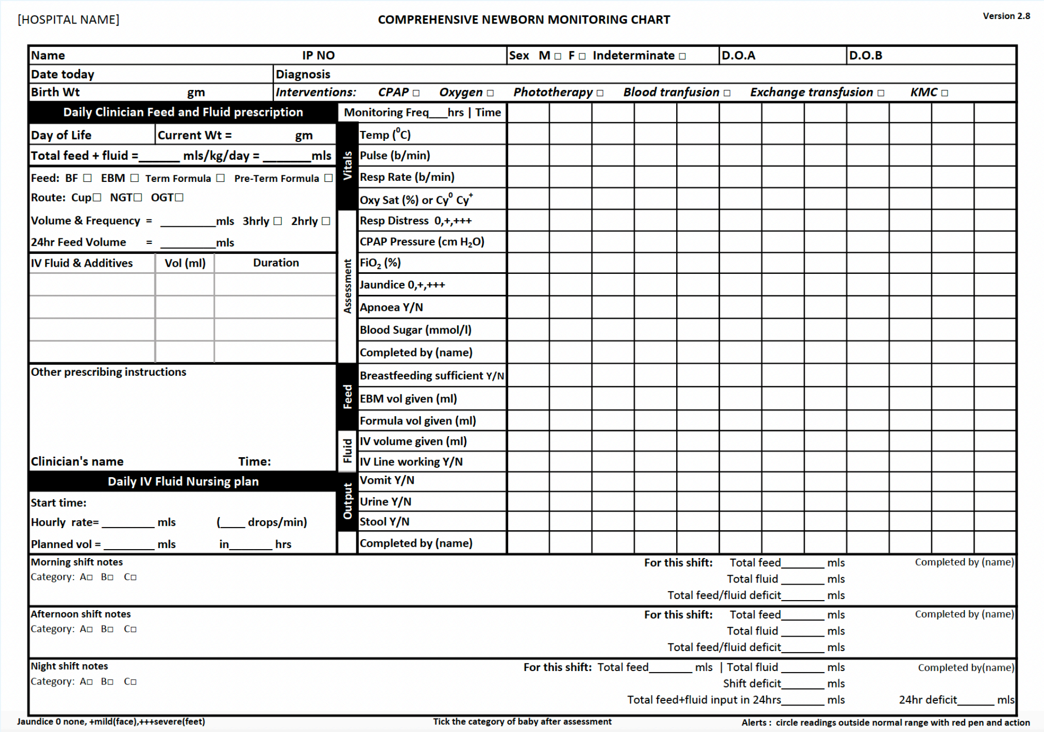
In 2019, a comprehensive newborn monitoring chart was developed to track newborn progress and enable timely interventions.[6] It consolidates key aspects of care – such as vital signs, feeding, fluid prescriptions, and clinical assessments – into a single, streamlined document (see figure 1). The chart was co-designed with input from nurses, doctors, and clinical officers from 14 hospitals during a series of workshops. Two prototype versions were piloted in four hospitals between 2019 and 2020 and refined based on feedback. After demonstrating benefits such as improved usability and reduced documentation workloads, the final chart was implemented across CIN hospitals in July 2020. Following its implementation, an evaluation conducted between 2019 and 2021 in 16 hospitals showed that the proportion of newborns without any complete sets of vital signs documented in the first 48 hours of admission decreased from 50% to 37%.[7]

Small and Sick Newborn Clinical Audit tool and implementation guide

A Small and Sick Newborn Clinical Audit tool was developed between 2020 and 2021 to review the quality of care provided to newborn babies and help health care teams identify areas for improvement. It covered the continuum of care from immediate newborn care (resuscitation after birth) to post-resuscitation and ongoing care in newborn units (NBUs). Using the HCD approach, the tool was developed in three phases: understanding the context and user needs, prototyping and testing, and refinement based on feedback. An accompanying implementation guide provided practical steps for conducting audits and integrating the tool into routine practice. Research conducted at Pumwani Maternity Hospital in 2021 found that the tool effectively captured gaps across the continuum of newborn care including delays in admission, incomplete resuscitation efforts, and missed opportunities for adequate monitoring, enabling teams to identify and address modifiable factors that could have prevented adverse outcomes.[5]

Figure 1

Comprehensive Newborn Monitoring Chart (v 2.8)



[HOSPITAL NAME]
COMPREHENSIVE NEWBORN MONITORING CHART
Version 2.8

Name
IP NO
Sex M ☐ F ☐ Indeterminate ☐
D.O.A
D.O.B
Date today
Diagnosis
Birth Wt gm
Interventions: *CPAP* ☐ *Oxygen* ☐ *Phototherapy* ☐ *Blood tranfusion* ☐ *Exchange transfusion* ☐ *KMC* ☐

Daily Clinician Feed and Fluid prescription

Day of Life
Current Wt = gm
Total feed + fluid =______ mls/kg/day = _______mls
Feed: BF ☐ EBM ☐ Term Formula ☐ Pre-Term Formula ☐
Route: Cup☐ NGT☐ OGT☐
Volume & Frequency = _________mls 3hrly ☐ 2hrly ☐
24hr Feed Volume = _________mls

IV Fluid & Additives	Vol (ml)	Duration

Other prescribing instructions

Clinician's name Time:

Daily IV Fluid Nursing plan

Start time:
Hourly rate= _________ mls (____ drops/min)
Planned vol = _________ mls in_______ hrs

Monitoring Freq___hrs | Time

Vitals
Temp (^{0}C)
Pulse (b/min)
Resp Rate (b/min)
Oxy Sat (%) or Cy^0 Cy$^+$

Assessment
Resp Distress 0,+,+++
CPAP Pressure (cm H_2O)
FiO_2 (%)
Jaundice 0,+,+++
Apnoea Y/N
Blood Sugar (mmol/l)
Completed by (name)

Feed
Breastfeeding sufficient Y/N
EBM vol given (ml)
Formula vol given (ml)

Fluid
IV volume given (ml)
IV Line working Y/N

Output
Vomit Y/N
Urine Y/N
Stool Y/N
Completed by (name)

Morning shift notes
Category: A☐ B☐ C☐
For this shift: Total feed_______ mls
Total fluid _______ mls
Total feed/fluid deficit_______ mls
Completed by (name)

Afternoon shift notes
Category: A☐ B☐ C☐
For this shift: Total feed_______ mls
Total fluid _______ mls
Total feed/fluid deficit_______ mls
Completed by (name)

Night shift notes
Category: A☐ B☐ C☐
For this shift: Total feed_______ mls | Total fluid _______ mls
Shift deficit_______ mls
Total feed+fluid input in 24hrs_______ mls
Completed by(name)
24hr deficit______ mls

Jaundice 0 none, +mild(face),+++severe(feet)
Tick the category of baby after assessment
Alerts : circle readings outside normal range with red pen and action

Co-design of clinical practice guidelines and training

In 2005, the Health Services Unit at KEMRI-Wellcome, in collaboration with the MoH, senior paediatricians, university medical schools and teaching hospitals, the Kenya Paediatric Association, and other stakeholders, launched an initiative to develop clinical practice guidelines (CPGs) for the management of children with severe illness in district hospitals. This collaboration aimed to address high mortality rates from treatable conditions like pneumonia, diarrhoea, and severe malnutrition, often exacerbated by inadequate care during the critical first 24–48 hours of admission. At the time, international and national guidelines were not widely used in hospitals and many clinicians responsible for admission lacked adequate training and support to manage critically ill children effectively.[8]

Development of Clinical Practice Guidelines (CPG)

The development of the CPGs was informed by systematic reviews of relevant evidence, including World Health Organization (WHO) recommendations, to identify interventions that were both life-saving and feasible for health care workers with limited paediatric training. A key component was the Child Health Evidence Week (2005), which brought together stakeholders to evaluate evidence and adapt recommendations to local needs. Participants refined the guidelines through structured discussions and consensus building. This inclusive approach fostered local ownership, a critical factor for successful implementation. These efforts culminated in the publication of the first edition of Basic Paediatric Protocols; a 31-page booklet issued in 2006 that provided evidence-based guidance for managing common paediatric conditions in hospitals in Kenya.

Development of ETAT+ training programme

To support the implementation of the guidelines, a training programme was developed, expanding on the WHO's Emergency Triage Assessment and Treatment (ETAT) course. The enhanced ETAT+ curriculum included newborn resuscitation and the management of severe illness and linked the guidelines with the standardised PAR to align documentation and clinical practices. Piloted in 2006, the training was subsequently rolled out to district hospitals, medical training colleges, and major provincial and national hospitals.

Implementation of the guidelines and training

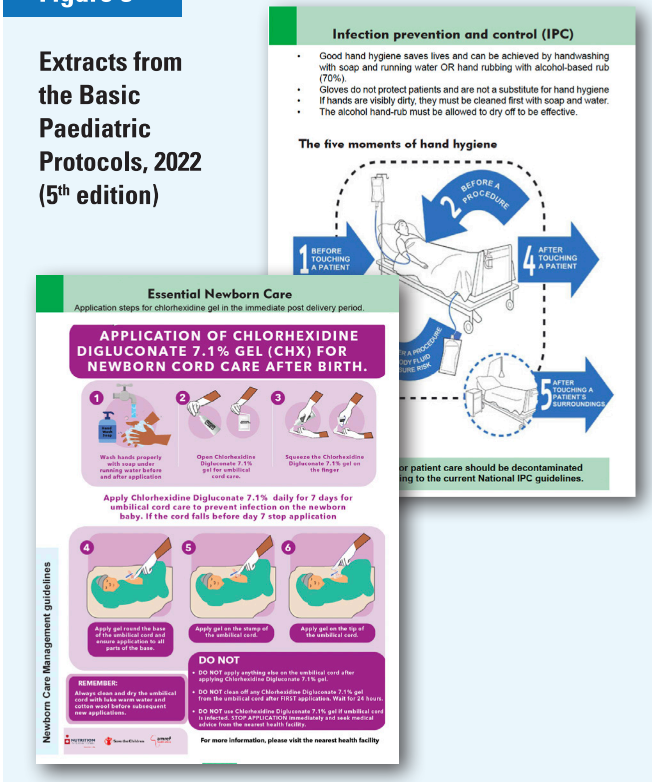
Initial observations from four district hospitals in 2006 indicated positive outcomes from the training: 80% of participants passed practical assessments, demonstrating enhanced competence in managing critically ill children.[8] Training efforts also motivated clinicians by equipping them with practical skills and fostered a positive attitude towards adopting evidence-based practices.

Despite strong demand from health care workers, funding constraints initially limited the widespread dissemination of the guidelines and the expansion of ETAT+ training. However, between 2006 and 2016, efforts gradually scaled up through collaborations with government and academic institutions. Training courses were expanded to all major district hospitals, and the guidelines were incorporated into Kenya's Annual Operating Plans and undergraduate medical curricula in 2008 (see figure 2).

The Basic Paediatric Protocols were also adopted by neighbouring countries, including Uganda and Rwanda, marking a significant milestone in regional impact. In 2013, a more formalised approach to guideline development was introduced, involving systematic evidence reviews and transparent discussions by expert panels, supported by international facilitation. The most recent 5th edition of the protocols was published in 2022, led by the MoH with contributions from the University of Nairobi and the Kenya Paediatric Association, marking a transition to local ownership (figure 3).

Figure 3

Extracts from the Basic Paediatric Protocols, 2022 (5th edition)



Infection prevention and control (IPC)

- Good hand hygiene saves lives and can be achieved by handwashing with soap and running water OR hand rubbing with alcohol-based rub (70%).
- Gloves do not protect patients and are not a substitute for hand hygiene
- If hands are visibly dirty, they must be cleaned first with soap and water.
- The alcohol hand-rub must be allowed to dry off to be effective.

The five moments of hand hygiene

or patient care should be decontaminated
ing to the current National IPC guidelines.

Essential Newborn Care

Application steps for chlorhexidine gel in the immediate post delivery period.

APPLICATION OF CHLORHEXIDINE DIGLUCONATE 7.1% GEL (CHX) FOR NEWBORN CORD CARE AFTER BIRTH.

1. Wash hands properly with soap under running water before and after application
2. Open Chlorhexidine Digluconate 7.1% gel for umbilical cord care.
3. Squeeze the Chlorhexidine Digluconate 7.1% gel on the finger

Apply Chlorhexidine Digluconate 7.1% daily for 7 days for umbilical cord care to prevent infection on the newborn baby. If the cord falls before day 7 stop application

4. Apply gel round the base of the umbilical cord and ensure application to all parts of the base.
5. Apply gel on the stump of the umbilical cord.
6. Apply gel on the tip of the umbilical cord.

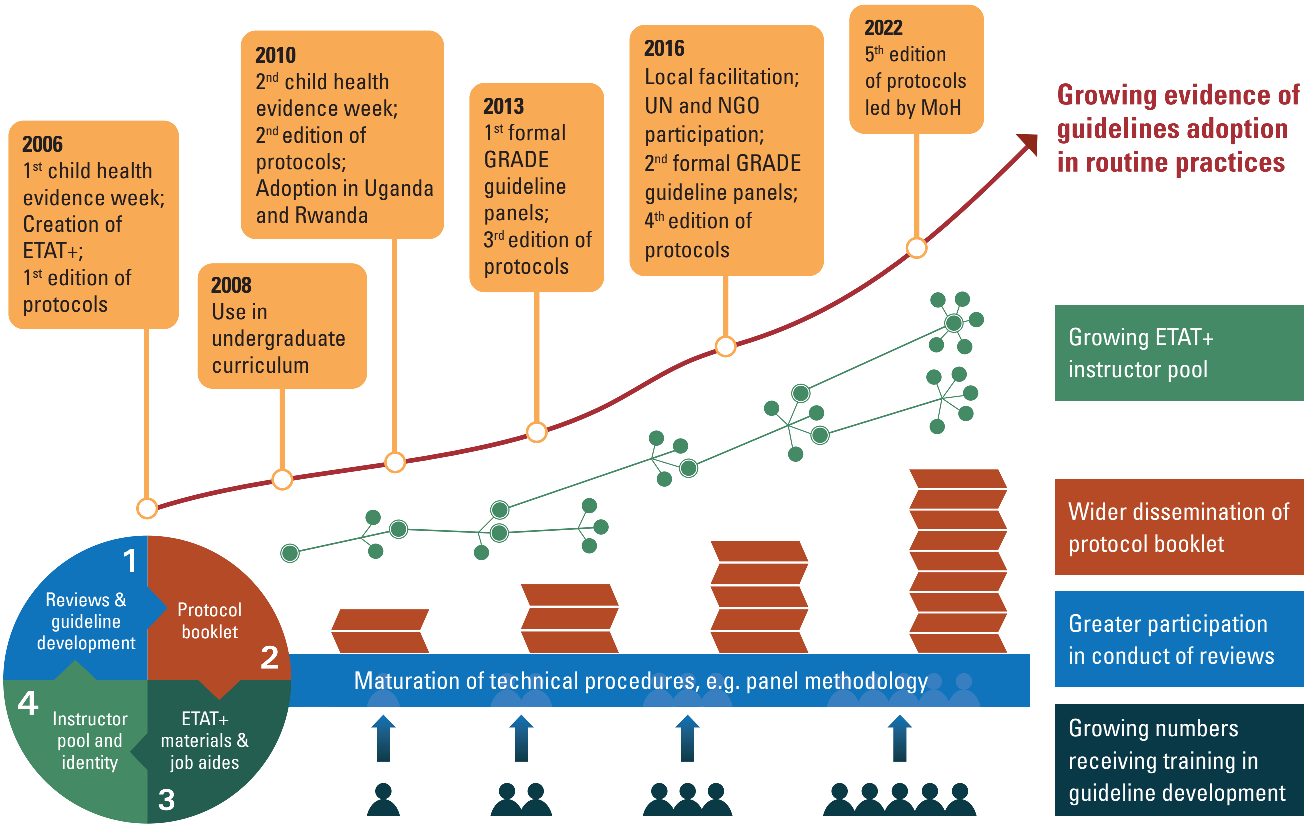
REMEMBER:
Always clean and dry the umbilical cord with luke warm water and cotton wool before subsequent new applications.

DO NOT

- DO NOT apply anything else on the umbilical cord after applying Chlorhexidine Digluconate 7.1% gel.
- DO NOT clean off any Chlorhexidine Digluconate 7.1% gel from the umbilical cord after FIRST application. Wait for 24 hours.
- DO NOT use Chlorhexidine Digluconate 7.1% gel if umbilical cord is infected. STOP APPLICATION immediately and seek medical advice from the nearest health facility.

For more information, please visit the nearest health facility

Figure 2 The evolution of the Clinical Practice Guidelines and ETAT+ training



Research insights: Progress and obstacles in adopting clinical guidelines

Research examining the adoption of the guidelines and basic technologies in 22 Kenyan hospitals between 2002 and 2012 highlighted both progress and persistent barriers.[9]

- **Improved adherence:** There was notable progress in adherence to the guidelines, particularly after 2006. Correct dosing for malaria treatments and adherence to hydration protocols for severe dehydration improved significantly.
- **Resource gaps:** Despite these improvements, hospitals continued to face shortages of essential resources. For example, while availability of specific feeds for severe malnutrition and vitamin K prophylaxis improved, low-cost and essential technologies such as pulse oximetry remained underutilised. By 2012, pulse oximetry was available in only 3 of 22 surveyed hospitals.
- **Data gaps:** Reliable data on hospital-based outcomes, such as mortality rates, were often unavailable.

Key publications about the guidelines

Developing and introducing evidence-based clinical practice guidelines for serious illness in Kenya (Irimu G, et al. 2008)[8]
Highlights the collaborative process of creating CPGs tailored to Kenya's needs, emphasising evidence-based approaches and local adaptation.

The Child Health Evidence Week and GRADE grid may aid transparency in guideline development (Opiyo N, et al. 2012)[10]
Details how systematic reviews and the GRADE framework enhanced transparency in developing recommendations during the 2005 workshop.

Implementing locally appropriate guidelines and training to improve care of serious illness in Kenyan hospitals (English M, et al. 2011)[11]
Describes the adaptation of WHO's ETAT training into ETAT+ and the challenges of scaling up.

Developing guidelines in low-income and middle-income countries: lessons from Kenya (English M, et al. 2017)[12]
Provides a detailed timeline of guideline development in Kenya between 2005 and 2015.

Adoption of recommended practices and basic technologies in a low-income setting (English M, et al. 2014)[9]
Presents research findings from a study on the adoption of evidence-based practices and technologies in Kenya hospitals.

Establishing information and feedback systems

The introduction of standardised forms like the PAR, linked to the CPG, provided a strong foundation for generating reliable hospital data and enabling the systematic collection of patient information across hospitals.

In 2013, this process was digitised as part of the CIN to streamline workflows and improve data analysis.[13] Trained data clerks at county hospitals extracted information from paper-based records, including the PAR, laboratory investigations, treatments, and discharge plans, which was then entered into REDCap (Research Electronic Data Capture) – a secure, web-based platform.

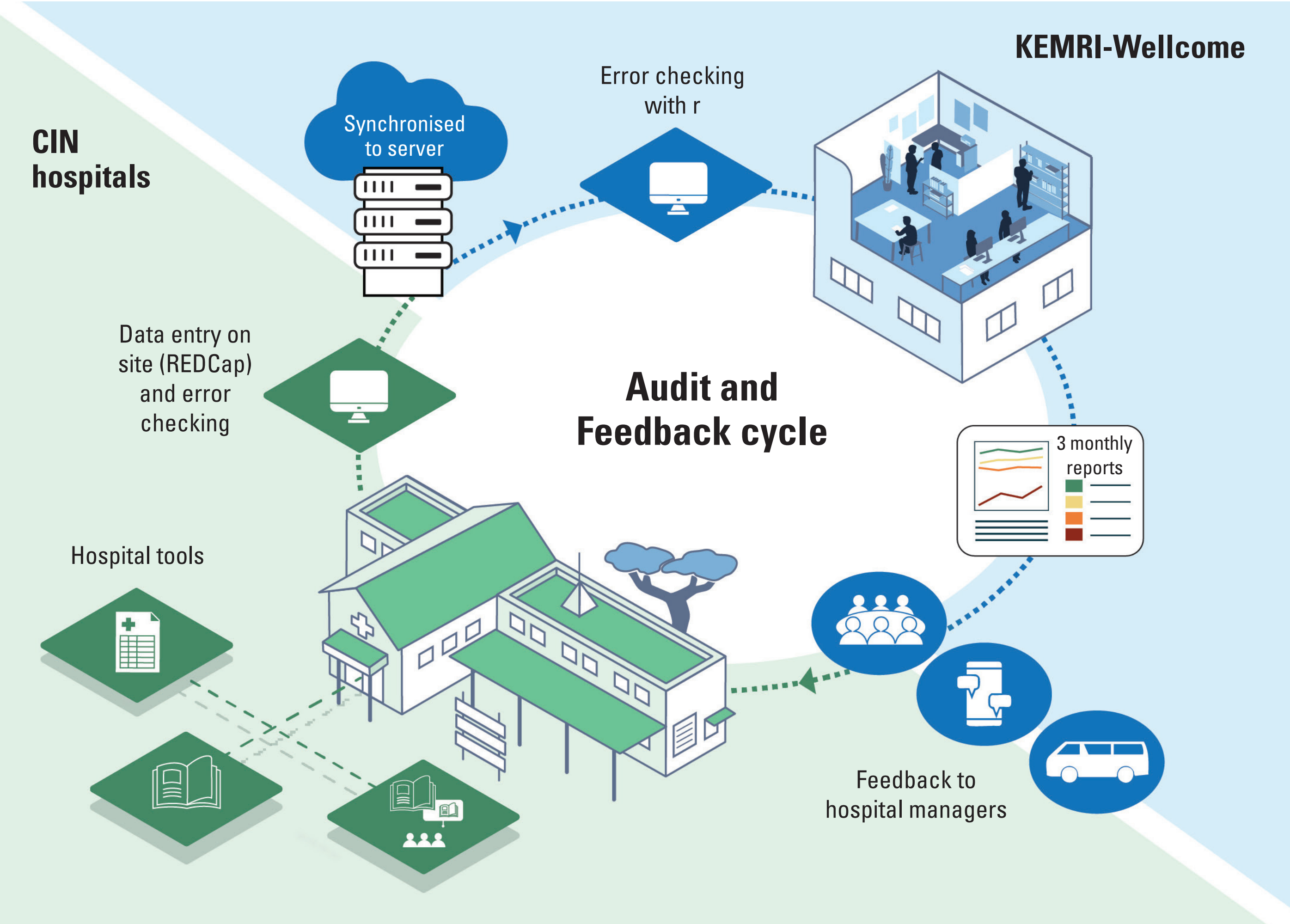
To ensure accuracy, robust validation and error-checking protocols were applied at each hospital before the data were uploaded daily to a centralised database. This system enabled the secure and efficient collection of detailed hospital records across multiple sites.

In the first phase of the CIN, it captured anonymised data on more than 65,000 paediatric admissions, creating a foundation for data-driven feedback and care improvements.[14] By January 2025, the network had expanded to 24 sites, amassing data from approximately 650,000 hospital admissions.

Audit and Feedback cycles

The data collected were used to generate audit reports tailored to each hospital and shared every 2–3 months – forming an Audit and Feedback (A&F) cycle (see figure 4). These reports evaluated performance across a range of indicators, focusing on the completeness of clinical documentation and adherence to the CPGs. The approach was informed by feedback intervention theory,[15] which highlights the importance of delivering timely, specific, and actionable feedback to encourage reflection and drive changes in practice. Feedback enabled hospitals to identify care gaps, monitor progress over time, and benchmark progress against other hospitals in the network. It was delivered in tailored formats including printed documents, email presentations, and face-to-face discussions, fostering reflection and collaboration among hospital teams.

Figure 4 **Clinical Information Network Audit and Feedback cycle**



Impacts of Audit and Feedback

Improvements in paediatric care

An observational study examined the effects of repeated A&F cycles on adherence to recommended practices outlined in the CPGs.[16] The study involved 14 county hospitals between 2013 and 2016, encompassing over 60,000 paediatric admissions. It assessed 34 indicators of clinical care, finding significant improvements in adherence to recommended practices.

- Indicators related to documentation showed the most progress, with all 12 indicators improving significantly over time.
- More complex tasks, such as diagnosis and prescribing, showed moderate gains, with 6 of 14 indicators improving.
- Use of the PAR was linked to marked improvements in documentation during the initial eight months of feedback cycles.

Improvements in neonatal care

A retrospective cohort study analysed data from more than 80,000 neonatal admissions across 20 government NBUs between 2018 and 2021.[17] One key objective was to examine whether the quality of clinical documentation improved in hospitals participating in the A&F processes as part of the neonatal-focused CIN-N initiative. Hospital-specific neonatal reports were provided as feedback to NBU teams, enabling them to identify gaps and drive improvements in care.

The research found:

- Documentation completeness was already strong when NBU joined CIN-N, likely due to their prior use of the Neonatal Admission Record through the CIN. Notably, domains such as admission information, discharge information, and demographics consistently achieved over 95% completeness.
- Modest but significant month-to-month improvements were observed across all documentation domains, including a 7.6% increase in vital signs monitoring and a 2.4% improvement in discharge information.
- Prescribing accuracy improved for feeds (2.8% increase per month) and fluids (1.4%), though no significant change was seen for antibiotics.

Testing and scaling interventions

Data generated by hospitals participating in the CIN holds value beyond improving local practices through A&F. The standardised and comparable nature of this data, supported by the CIN's robust information architecture, has created a foundation for research at scale. This infrastructure has enabled extensive research, including testing interventions in real-world settings and evaluating the relevance of international (WHO) guidelines for the Kenyan context.

While many studies have been conducted using this platform, the examples highlighted below illustrate its practical applications, with further examples provided in Brief 4.

Real-world validation of RCT findings

Two studies using CIN data from six Kenyan hospitals demonstrated how real-world data can validate the generalisability of randomised controlled trial (RCT) findings. An RCT tested oral amoxicillin versus benzyl penicillin for chest-indrawing pneumonia and confirmed that oral amoxicillin was noninferior, meaning it was as effective as benzyl penicillin in terms of treatment success.[18] A complementary cohort study compared children treated in routine hospital care to those enrolled in the RCT.[19] The results showed comparable patient characteristics and mortality rates between the two groups, further validating the applicability of the trial findings to everyday care settings in Kenya. Together, these studies highlight the practical value of using hospital data to bridge the gap between trial results and clinical practice.

Evaluating the effectiveness of treatment protocols

Kenyan paediatric treatment protocols recommend zinc supplementation for all children with diarrhoea, despite limited evidence of benefit for children aged 1-5 months and those who are well-nourished. A study using CIN data evaluated the effectiveness of zinc supplementation for children admitted with diarrhoea, examining different age groups (1–5 and 6–59 months) and nutritional statuses (severely-moderately undernourished or well-nourished).[20] The research found that zinc treatment reduced discharge time across all groups, including well-nourished children and those under six months. The findings suggest zinc may reduce discharge time for children who are alert, have normal pulse, no convulsions, and no signs of severe illness, irrespective of nutritional status. These results reinforce Kenya's current guidelines of universal zinc supplementation for diarrhoea, providing evidence to support its use even in children under six months and those who are well-nourished.

Conclusion

The initiatives outlined in this brief demonstrate how standardised tools, evidence-based clinical guidelines, and robust information systems can improve documentation, enhance clinical practices, and ultimately improve the quality of care for children at admission.

By involving frontline health workers through co-production and HCD, these tools and guidelines have been tailored to the needs of inexperienced and time-constrained clinicians, ensuring practicality, effectiveness, and widespread adoption.

These efforts laid the foundation for the CIN, a system for collecting and analysing standardised hospital data that not only supports data-driven local improvements through A&F, but also provides a platform for large-scale research, real-world testing of interventions, and adaptation of clinical guidelines to the Kenyan context.

Collaboration with government agencies, hospital managers, and other stakeholders has been critical to the sustainability of these interventions, fostering local ownership and building a pathway for long-term improvements in health care delivery.

References

1 UNICEF. “Country Data: Kenya.” 2022. Accessed January 24, 2025. https://data.unicef.org/country/ken/.

2 English M, Gathara D, Mwinga S, et al. Adoption of recommended practices and basic technologies in a low-income setting Archives of Disease in Childhood 2014;99:452-456.

3 Tuti T, Bitok M, Malla L, et al. Improving documentation of clinical care within a clinical information network: an essential initial step in efforts to understand and improve care in Kenyan hospitals. BMJ Glob Health. 2016 May 24;1(1):e000028. doi: 10.1136/bmjgh-2016-000028.

4 Mwakyusa, S., Wamae, A., Wasunna, A. et al. Implementation of a structured paediatric admission record for district hospitals in Kenya – results of a pilot study. BMC Int Health Hum Rights 6, 9 (2006). https://doi.org/10.1186/1472-698X-6-9

5 Ogola M, Wainaina J, Muinga N, et al. Development of a small and sick newborn clinical audit tool and its implementation guide using a human-centred design approach newborn clinical audit process and design. PLOS Glob Public Health. 2023 Feb 23;3(2):e0001577. doi: 10.1371/journal.pgph.0001577. PMID: 36963070; PMCID: PMC10021839.

6 Muinga, N., Paton, C., Gicheha, E. et al. Using a human-centred design approach to develop a comprehensive newborn monitoring chart for inpatient care in Kenya. BMC Health Serv Res 21, 1010 (2021). https://doi.org/10.1186/s12913-021-07030-x

7 Muinga N, Tuti T, Mwaniki P, et al. (2023) Evaluating the documentation of vital signs following implementation of a new comprehensive newborn monitoring chart in 19 hospitals in Kenya: A time series analysis. PLOS Global Public Health 3(11): e0002440. https://doi.org/10.1371/journal.pgph.0002440

8 Irimu G, Wamae A, Wasunna A, et al. Developing and introducing evidence based clinical practice guidelines for serious illness in Kenya. Arch Dis Child. 2008 Sep;93(9):799-804. doi: 10.1136/adc.2007.126508. PMID: 18719161; PMCID: PMC2654066.

9 English M, Gathara D, Mwinga S, et al. Adoption of recommended practices and basic technologies in a low-income setting Archives of Disease in Childhood 2014;99:452-456.

10 Opiyo N, Shepperd S, Musila N, et al. The “Child Health Evidence Week” and GRADE grid may aid transparency in the deliberative process of guideline development. J Clin Epidemiol. 2012 Sep;65(9):962-9. doi: 10.1016/j.jclinepi.2012.03.004. Epub 2012 Jun 27. PMID: 22742914; PMCID: PMC3413881.

11 English M, Wamae A, Nyamai R, et al. Implementing locally appropriate guidelines and training to improve care of serious illness in Kenyan hospitals: a story of scaling-up (and down and left and right) Archives of Disease in Childhood 2011;96:285-290.

12 English M, Irimu G, Nyamai R, et al. Developing guidelines in low-income and middle-income countries: lessons from Kenya. Arch Dis Child. 2017 Sep;102(9):846-851. doi: 10.1136/archdischild-2017-312629. Epub 2017 Jun 5. PMID: 28584069; PMCID: PMC5564491.

13 Tuti T, Bitok M, Paton C, et al. Innovating to enhance clinical data management using non-commercial and open source solutions across a multi-center network supporting inpatient paediatric care and research in Kenya. J Am Med Inform Assoc. 2016 Jan;23(1):184-92 doi: 10.1093/jamia/ocv028. Epub 2015 Jun 10. PMID: 26063746; PMCID: PMC4681113.

14 Tuti T, Bitok M, Malla L, et al. Improving documentation of clinical care within a clinical information network: an essential initial step in efforts to understand and improve care in Kenyan hospitals. BMJ Glob Health. 2016 May 24;1(1):e000028. doi: 10.1136/bmjgh-2016-000028. Erratum in: BMJ Glob Health. 2016 Jun 3;1(1):bmjgh-2016-000028corr1. doi: 10.1136/bmjgh-2016-000028corr1. PMID: 27398232; PMCID: PMC4934599.

15 English M, Ayieko P, Nyamai R, et al. What do we think we are doing? How might a clinical information network be promoting implementation of recommended paediatric care practices in Kenyan hospitals? Health Res Policy Syst. 2017 Feb 2;15(1):4. doi: 10.1186/s12961-017-0172-1. PMID: 28153020; PMCID: PMC5290627.

16 Gachau S, Ayieko P, Gathara D, et al. - Does audit and feedback improve the adoption of recommended practices? Evidence from a longitudinal observational study of an emerging clinical network in Kenya: BMJ Global Health 2017;2:e000468.

17 Tuti T, Aluvaala J, Chelangat D, et al. (2022) Improving in-patient neonatal data quality as a pre-requisite for monitoring and improving quality of care at scale: A multisite retrospective cohort study in Kenya. PLOS Global Public Health 2(10): e0000673. https://doi.org/10.1371/journal.pgph.0000673

18 Agweyu A, Gathara D, Oliwa J, et al. Severe Pneumonia Study Group. Oral amoxicillin versus benzyl penicillin for severe pneumonia among kenyan children: a pragmatic randomized controlled noninferiority trial. Clin Infect Dis. 2015 Apr 15;60(8):1216-24. doi: 10.1093/cid/ciu1166. Epub 2014 Dec 30. PMID: 25550349; PMCID: PMC4370168.

19 Agweyu A, Oliwa J, Gathara D, et al. Comparable outcomes among trial and nontrial participants in a clinical trial of antibiotics for childhood pneumonia: a retrospective cohort study. J Clin Epidemiol. 2018 Feb;94:1-7. doi: 10.1016/j.jclinepi.2017.10.016. Epub 2017 Oct 31. PMID: 29097339; PMCID: PMC5808926.

20 Malla L, Perera-Salazar R, Akech S, et al. Examining the effectiveness of zinc treatment in children admitted with diarrhoea in Kenya’s public hospitals: an observational comparative effectiveness study. J Glob Health. 2019 Dec;9(2):020416. doi: 10.7189/jogh.09.020416. PMID: 31555441; PMCID: PMC6748787.

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