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The value of rapid diagnostics in pediatric care: a stewardship-based framework informed by a multidisciplinary meeting in Rome

Venere Cortazzo,[1] Gianluca Vrenna,[1] Paola Bernaschi,[1] Alberto Villani,[2] Carlo Federico Perno[1]

[1]Microbiology and Diagnostic Immunology Unit, [2]Pediatrics Clinical Unit, Bambino Gesù Children's Hospital, Rome, Italy

Summary

Rapid syndromic diagnostics are increasingly used in pediatric acute care to provide early etiologic information and broaden pathogen detection. Their value, however, does not rely on speed alone. By simultaneously testing for multiple pathogens and, in selected settings, antimicrobial resistance determinants, these assays may help clinicians interpret complex infectious syndromes earlier than conventional or sequential strategies. This distinction between "rapid" and "syndromic" is particularly relevant in pediatrics, where clinical presentations are often non-specific and decisions on antibiotics, admission, isolation, escalation, or discharge are frequently made before conventional microbiology results are available.

Rapid results improve care only when embedded in clinical pathways that define patient selection, specimen collection, result interpretation, and consequent actions. This manuscript combines a pathway-oriented narrative synthesis with key messages from the multidisciplinary conference "The value of rapid diagnostics in child care," recently held in Rome. Across emergency, inpatient, intensive care, infectious disease, microbiology, and health-system perspectives, a consistent message emerged: rapid syndromic diagnostics improve decision-making when broad, timely results are linked to predefined actions, including treatment initiation or discontinuation, escalation or de-escalation, isolation or de-isolation, disposition decisions, and confirmatory testing.

We translate these concepts across pediatric emergency department, ward, and intensive care settings, focusing on respiratory syndromes, suspected sepsis, severe pneumonia, and central nervous system infections. In these scenarios, rapid syndromic results may anticipate conventional microbiology and support earlier therapeutic optimization. Nevertheless, they should complement rather than replace culture-based confirmation and phenotypic antimicrobial susceptibility testing. Implementation requires governance, education, communication, and measurable indicators.

Riassunto

La diagnostica rapida sindromica è sempre più utilizzata nell'assistenza pediatrica acuta per ridurre il tempo tra il sospetto clinico e l'informazione eziologica e, allo stesso tempo, ampliare lo spettro dei patogeni identificabili e, in alcuni contesti, dei determinanti di resistenza antimicrobica. Il suo valore clinico non deriva quindi soltanto dalla rapidità analitica, ma anche dalla capacità di inquadrare precocemente sindromi infettive complesse attraverso una prospettiva microbiologica più ampia rispetto ai test convenzionali o mirati a singoli patogeni.

La traduzione del risultato rapido in un beneficio clinico richiede tuttavia l'integrazione di questi test in percorsi strutturati, in grado di definire quali pazienti testare, quale campione raccogliere, come interpretare il risultato nel contesto clinico e quali azioni intraprendere. Questo manoscritto integra una sintesi narrativa orientata all'implementazione con i principali messaggi emersi dal convegno multidisciplinare "Il valore della diagnostica rapida nella cura del bambino", tenutosi a Roma, che ha coinvolto prospettive di pediatria d'urgenza, microbiologia clinica, infettivologia pediatrica, terapia intensiva pediatrica e governance sanitaria.

Il principio emerso trasversalmente è che la diagnostica rapida sindromica migliora il processo decisionale quando risultati rapidi e ampi sono collegati ad azioni cliniche predefinite, quali avvio o sospensione della terapia, escalation o de-escalation antimicrobica, isolamento o de-isolamento, decisioni di ricovero o dimissione e test di conferma.

L'articolo traduce questi concetti nei principali scenari pediatrici acuti, inclusi pronto soccorso, degenza e terapia intensiva pediatrica, con particolare riferimento alle sindromi respiratorie, alla sepsi e alle infezioni del sistema nervoso centrale. La diagnostic stewardship viene proposta come infrastruttura necessaria per governare indicazioni, qualità del campione, interpretazione, comunicazione e audit. In conclusione, la diagnostica rapida sindromica può essere implementata come servizio clinico ad alto valore, purché supportata da percorsi condivisi, formazione, comunicazione rapida e indicatori misurabili.

Key words: rapid diagnostics, pediatric acute care, diagnostic stewardship, syndromic panels, emergency department, antimicrobial stewardship.

Correspondence to: Venere Cortazzo, Microbiology and Diagnostic Immunology Unit, Bambino Gesù Children's Hospital, Rome, Italy.
Tel. +39-06-6859-2205. E-mail: venere.cortazzo@opbg.net

Introduction

Acute infectious syndromes remain among the most common drivers of visits and hospital admissions at the pediatric Emergency Department (ED), yet many high-stakes decisions, such as antimicrobial initiation, admission versus discharge, isolation, and escalation to intensive care, are made under diagnostic uncertainty. Predictable downstream consequences of this uncertainty include unnecessary antibiotic exposure, delayed targeted therapy in severe infections, prolonged length of stay, avoidable ancillary testing, and suboptimal infection-prevention measures [7,19,20]. **These elements highlight the need for diagnostic approaches able to fill practical clinical gaps and support earlier, more informed decision-making.**

A key conceptual distinction should be made between rapid diagnostics and rapid syndromic diagnostics. While "rapid" primarily refers to the reduction of analytical turnaround time, "syndromic" refers to the ability to investigate, within a single diagnostic workflow, a broad panel of pathogens and, in some settings, antimicrobial resistance determinants potentially responsible for the same clinical presentation. This distinction is central to the clinical value of these assays. **Multiplex syndromic panels do not simply accelerate conventional microbiology; they broaden the diagnostic frame by combining speed, expanded target coverage, and increased diagnostic yield** [1,3,7,16].

This is particularly relevant in pediatric acute care, where infectious syndromes are often clinically non-specific, empirical decisions are frequently made before etiologic confirmation, and conventional diagnostic strategies may focus only on the most common or expected pathogens. By identifying both expected and less frequently suspected pathogens, rapid syndromic panels can support earlier etiologic attribution, risk stratification, infection prevention, antimicrobial stewardship, and admission or discharge decisions. Their value is therefore both temporal and qualitative: they provide clinically meaningful information earlier and offer a more comprehensive view of the infectious syndrome than sequential or pathogen-targeted testing [1,3,7,16].

Over the last decade, rapid diagnostics in pediatrics have expanded from cultures and antigen assays to multiplex syndromic molecular panels, including respiratory, pneumonia, meningitis/encephalitis, and bloodstream infection panels, as well as point-of-care platforms and host-response biomarkers. These technologies can sharply decrease the interval from specimen collection to etiologic information from days to hours. However, their greatest potential is reached when results are delivered within the clinical decision window and embedded into "result-to-action" workflows. Diagnostic stewardship frameworks emphasize that test ordering should be triggered by a clinical question and that interpretation should account for pre-test probability, specimen quality, target coverage, and known limitations such as colonization, prolonged shedding, detection of non-viable nucleic acids, and multiple detections [7].

These implementation issues were the explicit focus of the multidisciplinary conference "The value of rapid diagnostics in child care", held recently in Rome [20]. In the session dedicated to ED workflows, the pediatric emergency setting was described as a high-volume environment, where infectious syndromes represent a leading cause of access and where rapid, governed decision support is essential [20]. Across talks and the concluding round table, the meeting converged on a pragmatic conclusion: **rapid syndromic diagnostics create remarkable value when they are integrated into pathways that link indication, specimen, assay selection, interpretation, and pre-specified clinical action**. **In other words, their clinical impact depends not only on technology, but also on diagnostic algorithms capable of regulating and translating rapid syndromic information into practice** [20].

This article provides a pathway-oriented framework for rapid syndromic diagnostics in child care, integrating conference-derived implementation messages with stewardship-oriented evidence. The aim is not to exhaustively summarize diagnostic accuracy, but to clarify how the combined value of speed and syndromic breadth can be translated into concrete clinical benefit through governance, communication, and measurable indicators.

Materials and Methods

This manuscript is an implementation-oriented narrative synthesis anchored to the Rome conference "The value of rapid diagnostics in child care" [20]. The scientific program covered rapid diagnostics across key pediatric settings and syndromes, including the emergency department, pediatric intensive care, respiratory infections, suspected sepsis, health-care-associated pneumonia, and central nervous system infections. It also addressed sustainability, appropriateness, and the development of algorithms for pediatric syndromic diagnostics [20].

Conference notes were organized by setting (ED; inpatient wards; Pediatric Intensive Care Unit, PICU), by syndrome (respiratory infections; suspected sepsis; Central Nervous System, CNS infection), and by diagnostic modality (syndromic panels, point-of-care platforms, host-response biomarkers, and conventional microbiology). Themes were reformulated into actionable statements linking results to downstream actions (therapy initiation/withholding/stop, escalation/de-escalation, isolation/de-isolation, disposition, and confirmatory testing).

Supporting evidence was selected to anchor implementation statements to peer-reviewed studies, meta-analyses, and guideline documents relevant to pediatric acute care, with a focus on syndromic diagnostics, stewardship, and workflow rather than an exhaustive review of analytic performance [1-22]. No individual patient-level data were collected for this work.

Results

This section synthesizes the core implementation themes that emerged from the Rome meeting and aligns them with stewardship-oriented evidence to provide a pathway framework for rapid diagnostics in child care [7,20].

From rapid result to rapid decision in the Emergency Department

In pediatric ED workflows, rapid testing is most valuable when it supports time-sensitive decisions such as disposition (discharge *versus* admission), isolation and cohorting, and targeted therapy (e.g., antivirals) while reducing inappropriate antibiotic exposure. The conference repeatedly emphasized that this value is pathway-dependent: the same assay can be high-impact or low-impact depending on whether clinicians receive results within the relevant time window and whether actions are pre-defined [20].

Evidence in ED respiratory testing illustrates this heterogeneity. Meta-analytic data and randomized trials show variable effects on antibiotic use and other outcomes, with more consistent benefit when rapid testing is tied to explicit decision rules, stewardship support, and reliable reporting/communication processes [2,10,11,19]. In practice, an ED algorithm begins at triage (including infection prevention triggers), proceeds through risk stratification and appropriate sampling, and ends with a documented action plan linked to the result. When this linkage is absent, testing risks becoming a "label" rather than decision support.

Respiratory syndromes: stewardship, shifting epidemiology, and prevention

The meeting highlighted how post-pandemic epidemiologic shifts have altered the seasonality and burden of pediatric respiratory infections, reinforcing the need for adaptive diagnostic pathways rather than fixed seasonal rules [20]. **In this context, rapid syndromic respiratory panels have a specific value because they do not simply accelerate the detection of a limited number of expected pathogens, but broaden the diagnostic perspective within the same clinical syndrome**. This is particularly relevant in the ED, where respiratory presentations are frequent, clinical signs are often overlapping, and disposition, isolation, and antimicrobial decisions are frequently made before conventional or sequential testing can provide a complete etiologic picture.

The added value of rapid syndromic testing extends beyond the faster detection of classical high-impact respiratory viruses, such as RSV, influenza viruses, and SARS-CoV-2. **Its clinical utility lies in detecting a broader range of viral and, depending on the assay, bacterial pathogens that may otherwise remain undetected or require sequential testing.** Recent evidence on flexible respiratory syndromic panels supports this concept: among symptomatic patients testing negative for SARS-CoV-2, influenza, and Respiratory Syncytial Virus (RSV), extended testing identified additional respiratory pathogens in 31% of cases, most frequently rhinovirus/enterovirus. In the same study, the authors showed that local respiratory pathogen prevalence could guide target selection in customized panels, with inclusion of high-prevalence targets increasing the estimated likelihood of diagnosis from 12% to nearly 30% [13].

This may be clinically relevant when the panel identifies an unexpected pathogen, particularly in infants, fragile children, immunocompromised patients, or children requiring hospital evaluation. At the same time, the detection of pathogens generally associated with a milder clinical course, such as rhinovirus in an otherwise stable child, may contribute to risk stratification when interpreted together with clinical assessment, inflammatory markers, age, comorbidities, and exclusion of more severe bacterial or viral etiologies. **In this setting, the result does not act as a standalone discharge criterion, but as one element of a broader clinical assessment that may support safer antibiotic avoidance, reduced ancillary testing, appropriate cohorting, and discharge from the ED when the overall clinical context is reassuring.**

Expanded or flexible respiratory panels may also reduce duplicated testing and repeated sampling, particularly when they are designed around local epidemiology and institutional needs [13]. However, their increased diagnostic breadth also increases interpretive complexity. For this reason, governance on indications, target selection, reporting, and clinical interpretation remains essential. The purpose of stewardship is not to limit the value of syndromic testing, but to ensure that its expanded diagnostic capacity is used in patients and time windows in which the result can influence management.

A parallel theme emerging from the meeting was that prevention strategies, including vaccination and passive immunization options such as monoclonal antibodies for RSV, should be considered as part of the same clinical value proposition: fewer severe infections and fewer admissions reduce diagnostic pressure and antibiotic exposure [20]. **Rapid syndromic diagnostics therefore contribute most when they support immediate and clinically meaningful decisions, including cohorting, isolation or de-isolation, antiviral use when appropriate, antibiotic withholding or discontinuation, reduced ancillary testing, and safe disposition, rather than merely providing etiologic detail after the key clinical decision has already been made.**

Severe pneumonia and sepsis in the Pediatric Intensive Care Unit: complementarity and "anticipate, don't replace"

In critically ill children, delayed etiologic attribution can prolong broad-spectrum antimicrobial exposure and delay targeted therapy. This is particularly relevant in severe pneumonia, hospital-acquired pneumonia, ventilator-associated pneumonia, and suspected sepsis, where the first therapeutic decisions are often empirical and must be taken before conventional microbiology becomes available. **In these settings, rapid syndromic diagnostics provide a clinically relevant example of the dual value of this approach: they can accelerate pathogen detection and, at the same time, broaden etiologic assessment to include bacterial, viral, atypical, and selected antimicrobial resistance targets.**

Lower respiratory tract syndromic panels are therefore most valuable when the result can influence early management, particularly in severe community-acquired pneumonia requiring intensive care, hospital-acquired or ventilator-associated pneumonia, immunocompromised patients, treatment failure, or cases in which broad-spectrum empirical therapy has been started and early optimization is clinically relevant. In such scenarios, **the syndromic pneumonia panel may support earlier escalation, de-escalation, or discontinuation of empirical therapy by providing microbiological information within a time frame compatible with clinical decision-making** [4,5,7].

Their impact, however, depends on specimen quality and representativeness. Distal lower respiratory tract samples, such as bronchoalveolar lavage or high-quality tracheal aspirates, provide more clinically meaningful results than poorly representative specimens. When semi-quantitative reporting is available, organism burden may help clinicians distinguish high-burden detections more suggestive of true infection from low-burden findings that may represent colonization, particularly when interpreted together with Gram stain, sample quality, radiology, inflammatory markers, and clinical severity [4,5,7]. This is especially important because molecular methods may detect nucleic acids from viable and non-viable organisms, and

because increased analytical sensitivity can increase detection of colonizing flora if results are not contextualized.

For these reasons, **rapid syndromic results should anticipate and guide early management, but should not replace culture, organism recovery for epidemiology, and phenotypic antimicrobial susceptibility testing, particularly when resistance-marker coverage is incomplete or when genotype–phenotype discordance is possible**. Concomitant culture remains necessary to detect off-panel pathogens, confirm organism viability, obtain full susceptibility data, and support surveillance or outbreak investigation. An integrated reporting approach, including interpretive comments and multidisciplinary discussion with infectious disease and antimicrobial stewardship teams, may help reduce both undertreatment and overtreatment.

For suspected sepsis, the same principle applies: the value of rapid diagnostics depends on whether implementation actually shortens time to appropriate therapy. This requires coordinated ED-PICU-laboratory communication, rapid result notification, and stewardship-supported decisions. In this framework, **rapid syndromic diagnostics are not an alternative to conventional microbiology, but an essential complement that can move the first phase of management from empirical coverage toward earlier microbiologically informed therapy** [6,17].

Central Nervous System infections: pathway engineering when minutes change prognosis

CNS infection was framed as the paradigmatic time-critical syndrome: prognosis is influenced not only by assay runtime, but by delays across the entire clinical pathway, including recognition, triage, imaging or consultation processes, lumbar puncture logistics, and time to antimicrobials [20]. **In this setting, rapid syndromic diagnostics have a particularly strong rationale because a single Cerebrospinal Fluid (CSF) sample can simultaneously interrogate the most relevant bacterial, viral, and fungal causes of community-acquired meningitis and encephalitis within a time frame compatible with early clinical decision-making** [3,7,8,18].

This syndromic approach may support earlier etiologic attribution, targeted antiviral or antibacterial therapy, discontinuation of unnecessary treatment in selected cases, and timely infection prevention measures. **Its value is especially relevant in children already exposed to antimicrobials, in whom culture yield may be reduced, and in clinical scenarios where rapid distinction between bacterial and viral etiologies can influence treatment intensity, hospitalization decisions, and downstream resource use** [3,8,9,18].

However, rapid molecular CNS testing should be implemented without delaying empiric therapy when this is clinically indicated. The result should be interpreted together with CSF chemistry and cytology, Gram stain, culture, blood cultures when appropriate, clinical presentation, immune status, prior antimicrobial exposure, and local epidemiology. **It should be noted that negative results do not exclude all CNS infections, particularly when the suspected pathogen is not included in the panel, and positive results may require contextual interpretation, especially for targets with potential bystander detection or uncertain clinical significance.**

For this reason, rapid syndromic CNS panels should be considered as tools that anticipate and refine the diagnostic pathway, rather than replace the conventional workup. Culture remains necessary for organism recovery, antimicrobial susceptibility testing, epidemiology, and confirmation of pathogens not covered by the molecular panel. In parallel, advanced approaches such as clinical metagenomic sequencing may provide additional diagnostic yield in selected complex cases, but require expert governance, cautious interpretation, and clear criteria for use [20,22].

Practical implementation should therefore focus on engineering the entire pathway around early recognition, appropriate sampling, rapid communication, integration with conventional microbiology, and safety nets for high-risk clinical scenarios. **In CNS infections, the value of rapid syndromic diagnostics is maximized when the test is not treated as an isolated result, but as part of a time-critical clinical algorithm designed to convert earlier etiologic information into earlier and safer patient management.**

Governance and sustainability: appropriateness as the operational endpoint

Across talks, "sustainability" was reframed as appropriateness and pathway-level value rather than per-test cost. High-cost testing becomes defensible when utilization is governed, interpretation is supported by laboratory expertise, and outcomes are measurable - time to appropriate therapy, antibiotic days of therapy, isolation days, ED length of stay, and safety balancing metrics such as revisits or late Intensive Care Unit (ICU) transfer [7,20].

The meeting also emphasized that governance must anticipate common pitfalls: multiple detections, detection of nucleic acids from non-viable organisms, and resistance gaps that require rapid phenotypic Antimicrobial Susceptibility Testing (AST). In the round table, incomplete resistance-mechanism coverage (with examples such as Pseudomonas resistance pathways) was cited as a reason to accelerate phenotypic susceptibility testing rather than over-trust genotypic markers [20].

Host-response biomarkers: uncertainty reducers, not standalone decision tools

Host-response biomarkers were repeatedly discussed as tools to reduce uncertainty when the key decision is the likelihood of bacterial *versus* viral infection, especially in stable ED presentations where safe antibiotic avoidance is the intended action [14,15,20,21]. Multi-protein signatures and interferon-driven markers such as Myxovirus Resistance Protein A (MxA) can support decision-making when embedded into explicit thresholds, decision rules, and follow-up safety nets.

A recurring limitation is overlap between viral infection and viral-bacterial co-infection, which can degrade discriminatory performance and must be communicated in reporting and clinician education [14,15,20,21]. In stewardship terms, these assays function best as supportive tools to reduce unnecessary antibiotic initiation or to support early discontinuation in low-risk children, rather than as substitutes for clinical assessment.

A practical summary of the main pediatric scenarios in which rapid diagnostics are most likely to change management, together with the corresponding stewardship implications, is provided in Table 1. The table distinguishes targeted rapid tests from syndromic molecular approaches, since these methods differ in diagnostic breadth, clinical value, limitations, and stewardship requirements. Beyond the scenario-specific applications summarized in Table 1, rapid syndromic diagnostics require a common diagnostic stewardship layer to ensure appropriate use and clinical impact. This layer links patient selection, specimen quality, pre-test probability, local epidemiology, result interpretation, predefined clinical action, and audit across the main pediatric acute care pathways discussed above (Figure 1)

Discussion

The main message emerging from this synthesis is that rapid syndromic diagnostics should not be viewed merely as faster versions of conventional tests. **Their distinctive contribution lies in the combination of short turnaround time, broad target coverage, and the capacity to generate an early etiologic framework for complex infectious syndromes.** This concept is supported by the growing literature on syndromic molecular panels, which highlights their potential to improve clinical decision-making, laboratory workflow, infection control, antimicrobial stewardship, and patient outcomes when thoughtfully implemented and carefully interpreted [1,3,7,16].

Table 1. Rapid diagnostic approaches in pediatric acute care: clinical value, limitations, and stewardship implications.

Clinical context	Rapid diagnostic approach	Added clinical value	Main limitations	Appropriate use / stewardship implication
Pediatric ED - acute respiratory syndrome	Rapid antigen tests for selected respiratory viruses	Low-cost, rapid, near-patient detection of a limited number of high-impact pathogens, particularly when the clinical question is narrow and time-sensitive	Restricted target coverage; sensitivity than molecular methods in some settings; no syndromic differential diagnosis; limited value when non-classical or lower co-circulating pathogens are clinically relevant	Useful for targeted questions during high-prevalence periods or when the result directly informs immediate decisions. They should not be considered equivalent to syndromic molecular panels when broader etiologic information is needed
Pediatric ED - acute respiratory syndrome	Multiplex syndromic respiratory PCR on upper respiratory samples	Combines rapid turnaround with broad pathogen detection; supports etiologic attribution, cohorting, infection prevention, antiviral decisions, antibiotic avoidance, reduced ancillary testing, and admission/discharge decisions	Higher cost; increased interpretive complexity; possible detection of prolonged shedding, colonization, or multiple targets; clinical significance may vary by age, immune status, and epidemiology	Best used when broader etiologic information may change management within the ED decision window, especially in infants, fragile or immunocompromised children, severe presentations, or uncertain clinical syndromes
Pediatric ED - suspected CNS infection	Molecular syndromic testing on CSF, alongside standard CSF chemistry/cytology, Gram stain, culture, and blood cultures when appropriate	Enables earlier etiologic attribution from a single CSF sample; may support targeted antibacterial or antiviral therapy, discontinuation of unnecessary treatment in selected cases, and timely infection prevention measures	Limited target coverage; negative results do not exclude all CNS infections; positive results require clinical correlation; culture remains necessary for organism recovery and phenotypic AST	Should be integrated into a time-critical CNS infection pathway. Molecular testing may preserve diagnostic yield after antimicrobial pretreatment, but must not delay empiric therapy when clinically indicated or replace culture-based workup
PICU - severe pneumonia, HAP/VAP, treatment failure	Syndromic pneumonia panels on representative lower respiratory tract samples	Rapidly detects bacterial, viral, atypical, and selected resistance targets; may support earlier escalation, de-escalation, or discontinuation of empirical therapy; semi-quantitative information may help contextualize organism burden	Requires high-quality representative samples; risk of detecting colonization or non-viable nucleic acids; incomplete resistance-marker coverage; culture and phenotypic AST remain necessary	Most useful in severe pneumonia, HAP/VAP, immunocompromised patients, treatment failure, or broad-spectrum empirical therapy requiring early optimization. Specimen representativeness and integrated interpretation are essential
Suspected sepsis - ED/PICU	Blood cultures integrated with rapid identification, resistance detection, and accelerated AST workflows where available	Supports earlier pathogen identification, earlier recognition of MDR pathogens, and faster therapeutic optimization	Molecular or rapid methods do not replace blood culture; resistance-marker coverage may be incomplete; genotype–phenotype discordance is possible; impact depends on rapid communication and action	Value depends on protocolized ED–PICU–laboratory communication, rapid result notification, and stewardship-supported action within the clinical decision window
Stable or moderately ill child with uncertain bacterial *versus* viral infection	Host-response biomarkers	Support antibiotic avoidance or early discontinuation when bacterial infection is unlikely; may reduce diagnostic uncertainty in selected ED presentations	Cannot identify the etiologic agent; performance may be reduced by viral–bacterial co-infection or inflammatory overlap; requires validated thresholds and safety-netting	Should be used as uncertainty reducers within clinical algorithms, not as standalone arbiters. Results should support, not replace, clinical assessment and follow-up planning

AST, Antimicrobial Susceptibility Testing; CNS, Central Nervous System; CSF, Cerebrospinal Fluid; ED, Emergency Department; HAP, Hospital-Acquired Pneumonia; MDR, Multidrug-Resistant; PCR, Polymerase Chain Reaction; PICU, Pediatric Intensive Care Unit; VAP, Ventilator-Associated Pneumonia.

Figure 1. Diagnostic stewardship layer for rapid syndromic diagnostics in pediatric acute care. The figure summarizes the key stewardship elements that should accompany rapid syndromic testing across different pediatric scenarios, including acute respiratory syndromes, severe pneumonia or suspected sepsis, and central nervous system infections. Patient selection, specimen quality, pre-test probability, local epidemiology, result interpretation, predefined clinical action, and audit represent sequential and interconnected steps required to translate rapid microbiological results into clinically meaningful decisions.

In pediatric acute care, this added value is particularly important because initial therapeutic, isolation, and disposition decisions are often made before conventional microbiology becomes available. By expanding the range of detectable pathogens within a clinically meaningful timeframe, rapid syndromic panels can support earlier targeted therapy, safer antibiotic withholding or discontinuation, more appropriate cohorting, and more informed admission or discharge decisions. Diagnostic stewardship should therefore not be interpreted as a restriction to the use of rapid syndromic diagnostics, but as the operational framework required to ensure that broader and faster microbiological information is translated into timely clinical action.

The Rome meeting reinforced an implementation message that is consistent with the diagnostic stewardship literature: **the clinical endpoint of rapid syndromic diagnostics is not simply a faster report, but an earlier, safer, and more appropriate decision** [7,20]. In pediatrics, where pre-test probabilities vary sharply by age, season, immune status, and clinical setting, and where sampling quality may be variable, this principle is amplified. A pathway must therefore begin before the test is ordered, with appropriate indication and patient selection, continue through the pre-analytical phase, with attention to specimen quality and representativeness, and end with rapid, contextual interpretation and a documented clinical action.

Figure 2 complements the stewardship layer shown in Figure 1 by illustrating the broader iterative cycle through which rapid diagnostics are translated into clinical action and outcome monitoring. In practice, effective implementation also depends on shared protocols, rapid communication between laboratory and clinical teams, clinician education, and iterative audit-and-feedback loops to ensure that results translate into timely management changes.

In the ED, evidence has shown heterogeneous effects of rapid respiratory testing on antibiotic exposure and other outcomes [2,10,11,13,19]. The conference provided a practical explanation for this variability: impact depends on whether results return within the disposition window, whether clinicians trust and act on

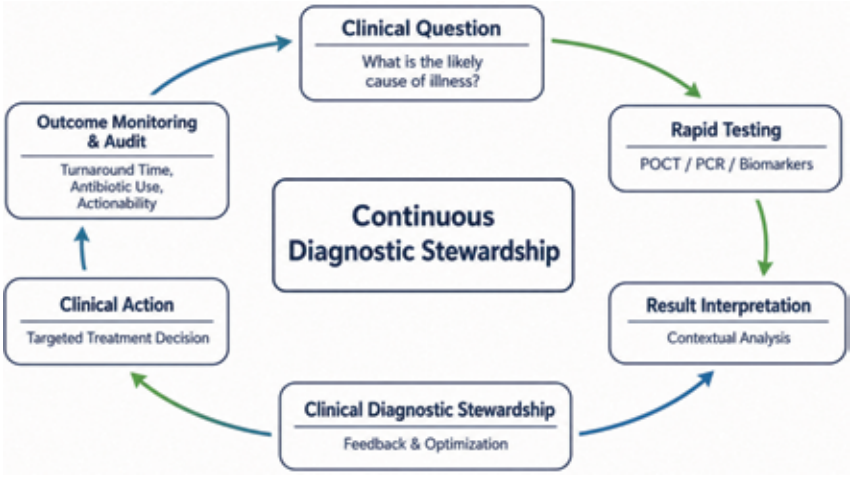

Figure 2. Diagnostic stewardship cycle for rapid diagnostics in pediatric care. The figure illustrates the continuous, iterative pathway linking the clinical question, appropriate test selection, rapid testing, contextual interpretation, diagnostic-driven clinical action, and outcome monitoring/audit, supporting ongoing optimization of patient management and diagnostic pathways.

results, and whether a stewardship framework exists, including interpretive support, predefined result-to-action pathways, and safety nets. The respiratory setting also illustrates why the syndromic component is crucial. **Broader respiratory panels can identify pathogens beyond RSV, influenza viruses, and SARS-CoV-2, thereby supporting more refined etiologic attribution, cohorting, infection prevention, antibiotic avoidance, and safe discharge decisions when the overall clinical context is reassuring**. Without a link between result and action, however, even rapid and broad testing risks adding information without changing the decision that matters most.

In severe infections, the meeting reinforced the complementarity of molecular and conventional microbiology. **Rapid syndromic panels can meaningfully accelerate early optimization by anticipating pathogen identification and, in some settings, selected resistance information**. This is particularly relevant in severe pneumonia, hospital-acquired or ventilator-associated pneumonia, suspected sepsis, and critically ill or immunocompromised children, where broad-spectrum empirical therapy is common and early optimization may have substantial clinical value [3-5,7]. Nevertheless, culture and phenotypic antimicrobial susceptibility testing remain essential for comprehensive resistance characterization, organism recovery, epidemiology, surveillance, and resolution of genotype–phenotype discordance, particularly when resistance-marker coverage is incomplete or local epidemiology includes mechanisms not captured on panels.

For CNS infections, the meeting's "minutes change prognosis" framing emphasizes that the most relevant turnaround time is the entire clinical pathway, not the assay runtime alone [20]. **Rapid syndromic testing on cerebrospinal fluid can be a valuable tool when it accelerates etiologic attribution, supports targeted antibacterial or antiviral therapy, enables discontinuation of unnecessary treatment in selected cases, and contributes to infection prevention measures** [3,7,8,18]. However, its value depends on protocols that reduce avoidable delays while preserving early empiric therapy when clinically indicated and ensuring correct specimen handling, integration with CSF chemistry/cytology, Gram stain, culture, and blood cultures when appropriate. Advanced sequencing-based methods may be valuable in selected complex cases, but should be deployed under expert governance, with careful interpretation and defined criteria for use [12,22].

Finally, the sustainability discussion highlighted that appropriateness is measurable. **The value of rapid syndromic diagnostics should not be assessed only through per-test cost or analytical turnaround time, but through pathway-level indicators such as time to appropriate therapy, antimicrobial days of therapy, isolation days, ED length of stay, admission or discharge decisions, and safety balancing measures, including revisits, delayed treatment escalation, or late ICU transfer** [7,20]. When implemented as a clinical service rather than as an isolated laboratory result, rapid syndromic diagnostics can translate analytical speed and expanded diagnostic breadth into patient-centered outcomes.

This manuscript is an implementation-oriented narrative synthesis anchored to a multidisciplinary meeting and selected supporting literature. Accordingly, some recommendations may be most readily applicable to centers with established microbiology support, mature antimicrobial stewardship infrastructures, and rapid communication pathways between laboratory and clinical teams. It does not constitute a systematic review, and effect sizes may vary across assays, syndromes, patient populations, clinical settings, and workflow maturity.

Conclusions

Rapid syndromic diagnostics offer an important opportunity for pediatric acute care because they combine faster reporting with broader etiologic detection. In emergency, intensive care, and other time-critical settings, this information can support earlier targeted therapy, antimicrobial optimization, infection prevention measures, reduced ancillary testing, and safer disposition decisions.

Their impact, however, depends on implementation. Rapid syndromic testing should be embedded in clinical pathways that identify appropriate candidates, ensure specimen quality, provide rapid and interpretable results, and link those results to predefined clinical actions.

The relevant measure of performance is therefore not turnaround time alone, but the ability to convert early microbiological information into safer and more appropriate patient management. Achieving this requires diagnostic stewardship, communication between laboratory and clinical teams, education, and continuous audit.

The Rome meeting reinforced this implementation-oriented perspective by highlighting that the value of rapid syndromic diagnostics depends on shared clinical pathways, multidisciplinary communication, and predefined actions following test results. In this sense, the meeting provided a practical framework for moving rapid diagnostics from isolated laboratory outputs to integrated clinical decision-support tools in pediatric care, helping to translate their diagnostic potential into measurable patient-centered value.

Proposed implementation principles for rapid syndromic diagnostics in pediatric care

The following principles summarize the implementation-oriented messages that emerged from the Rome multidisciplinary meeting and are proposed as a practical framework for integrating rapid syndromic diagnostics into pediatric acute care pathways.

- Rapid syndromic testing is most useful when broad and timely etiologic information is likely to influence management within the relevant decision window.
- These panels combine analytical speed with expanded diagnostic coverage, particularly when conventional or sequential testing may miss clinically relevant pathogens.
- Specimen quality and representativeness are essential determinants of clinical value. When the biological relevance of the sample is uncertain or compromised, recollection or conventional microbiological workup should be prioritized.
- Results should be interpreted according to pre-test probability, clinical presentation, local epidemiology, assay target coverage, and the possibility of colonization, prolonged shedding, detection of non-viable nucleic acids, or multiple detections.
- For each clinically relevant result, the expected management action should be defined in advance, including therapy initiation, discontinuation, escalation or de-escalation, isolation or de-isolation, patient disposition, and confirmatory testing when appropriate.
- Rapid syndromic results should be used to anticipate and guide early management, while maintaining culture, organism recovery, epidemiology, and phenotypic antimicrobial susceptibility testing whenever clinically required.
- The impact of rapid syndromic diagnostics should be assessed across the clinical pathway, using indicators such as time to appropriate therapy, antimicrobial exposure, emergency department length of stay, isolation days, admission or discharge decisions, and safety outcomes.

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