IJRAR.ORG E-ISSN: 2348-1269, P-ISSN: 2349-5138

INTERNATIONAL JOURNAL OF RESEARCH AND ANALYTICAL REVIEWS (IJRAR) | IJRAR.ORG

An International Open Access, Peer-reviewed, Refereed Journal

Assessment of Biochemical Critical Alert Values In the patients visiting Ayurveda Hospital - A cross sectional study

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Abstract

Background: Laboratory critical alerts are values that indicate potentially life-threatening conditions, requiring urgent medical intervention. In institutions offering integrative care such as those following Ayurvedic principles recognizing and acting upon these alerts is vital for enhancing patient outcomes. **Aim:** This study aimed to examine the occurrence and distribution of critical alert values in the clinical biochemistry lab of ITRA Hospital and to interpret their relevance in the context of Ayurvedic diagnostic frameworks. **Materials and Methods:** A cross-sectional analysis was carried out using laboratory data collected over a 12-month period (June 2024 to May 2025). Records from the biochemistry lab were screened for results falling within predefined critical thresholds. Data processing and charting were done using Microsoft Excel and Patho Plus version 3.1.2. **Results:** A total of 11 lab tests were studied for critical alerts, including sugar, creatinine, TSH, CRP and others. Out of 57,734 results, only 343 (0.59%) were critical, showing they are rare but important. Most alerts were seen in April, January and March 2025, and the fewest in August 2024. Glucose had the most alerts (144), followed by creatinine (86) and CRP (36). In CKD cases, 0.45% were critical, in diabetic tests, 0.75% were critical. Males had more critical alerts for creatinine, glucose and CK-MB, while females had more for TSH. Most tests had only high alert levels. Calcium and Sugar had both low and high limits. The alerts were mostly related to kidney, heart, thyroid, sugar, liver and inflammation issues. **Conclusion:** This study emphasizes the importance of critical value alerts in identifying potentially life-threatening biochemical abnormalities, enabling prompt clinical intervention. Their frequent occurrence highlights areas requiring strict clinical vigilance. When interpreted through the lens of Ayurveda causing concepts like *Arishta Lakshana, Rogamarga* and *Dhatupaak* these markers can enhance prognostic evaluation in integrative care models. This study supports the inclusion of critical alert surveillance as a safety measure in traditional and modern medical practice.

Keywords:

Critical alerts, *Arishta Lakshana*, Ayurveda

Introduction

Modern lab medicine and traditional healing systems often seem very different. Lab medicine focuses on measurable test results and machine-based alerts, while traditional systems rely on overall observation, natural signs and personalized treatment for each patient. Yet both are ultimately oriented toward the same imperative timely recognition of danger and prompt action to protect life. A critical value alert is a laboratory test result so far outside the expected or physiologically tolerable range that it signals a potential immediate or life-threatening risk to the patient and therefore must be urgently communicated to the responsible clinician.[1] Classic examples include profoundly deranged electrolytes , severe hypo or hyperglycemia and other biochemical extremes that, if unrecognized, may rapidly progress to seizures, arrhythmia, coma, organ failure or death. critical value is not just the abnormal number itself, but helps in clinical decision making.

The modern laboratory critical value or panic value paralles the classical Ayurvedic notions of Fatal signs (*Arishta Lakshana*), disease staging (*Avastha Jnana*) and involvement of vital pathways (*Rogamarga, Marmas* and *Srotas*).[2] While terminology differs the principle of urgent recognition and response to life-threatening imbalance is shared.

Both indicate a condition that may lead to death or permanent damage if not treated immediately. This article introduces the concept of laboratory critical values, explains why rapid response systems built around them are central to patient safety and explores how analogous risk-signaling frameworks embedded in Ayurvedic texts can enrich integrative, patient-centered care.

While individual laboratories customize their critical limits based on patient population, instrumentation and clinician input, the importance of having a defined critical value system spans several domains: [3-4]

1.Early Detection: Critical limits act as safety alerts, identifying serious issues even before symptoms appear.

2. Fast Communication: Quick reporting helps doctors respond immediately, preventing delays in urgent care.

3. Quality & Compliance

Laboratories Accrediting and guideline bodies such as the College of American Pathologists (CAP), the Clinical and Laboratory Standards Institute (CLSI) and national programs including India's NABL require must follow set rules to ensure accurate, consistent and inspected practices.

4. Fewer Medical Errors

Alert systems help to make sure serious results are seen and acted on, reducing the chance of mistakes. Markedly abnormal results help triage urgency.

ISO 15189:2022 specifies requirements for quality and competence in medical laboratories.[5]

Classical Ayurvedic texts do not mention specific number based lab values like modern critical alerts. however, it provides rich clinical intelligence on signs that suggest danger, rapid deterioration or poor prognosis. Bringing these frameworks into dialogue with laboratory critical values can deepen risk recognition especially in integrative or resource-variable settings. *Arishta Lakshana* (Fatal Signs) catalogue clusters of signs considered indicative of impending death or extremely poor prognosis. Recognition of *Arishta Lakshanas* functions very much like responding to a laboratory panic value, both prompt urgent reassessment of goals, intensity or even appropriateness of intervention. *Rogamarga* & Involvement of vital structures When disease processes invade vital channels (*Srotas*), life-centers (*Marmas*) or critical pathways of systemic function (*Pranavaha, Raktavaha,* etc.) the clinical situation becomes high risk. Detecting such involvement early parallels the laboratory mandate to flag results that carry high immediate danger. Recognizing Disease Stage (*Avastha Jnana*) Ayurveda's dynamic staging sequence *Chaya, Prakopa, Prasara, Sthana Samshraya, Vyakti, Bheda* encourages the physician to intervene before the disease polarizes into complicated or destructive forms. When doshas are in *Sanchaya Awastha* there may not be changes in laboratory parameters. By the time of Diagnosis (*Vyakti*) moderate lab abnormalities can be found. Transition into *Bheda Avastha* , where disease become complicated or chronic can be viewed as an Ayurvedic "critical phase," analogous to a result that crosses a biochemical panic threshold. Like Uremia, lactic acidosis suggest extreme metabolic *Ama* condition. Hypoglycemia suggesting *Ojakshya. S*igns of depleted *Ojas* serve as qualitative alerts that demand immediate therapeutic action mirroring how modern systems respond to critical lab calls. Before *Panchakarma* or surgery, checking the patient's strength, age, digestion, mental health with respect to laboratory values helps avoid serious problems during the procedure. Ignoring these screening tests is like driving a car without checking the brakes , it might seem fine at first, but it can lead to serious trouble. According to Ayurvedic pathogenesis, *Dhatupaka* marks a significant and alarming phase, often correlating with critical or irreversible states of disease. It involves the rapid degeneration or destruction of tissues, which not only initiates various diseases but also weakens the immune system and reduces the body's overall strength (*Bala)*. This tissue destruction signifies a critical or threatening phase in the disease process. For instance, an elevated level of SGPT in the blood is indicative of *Dhatupaka* occurring in the liver tissues. Similarly, the

presence of ketone bodies in urine reflects *Dhatupaka* of *Medodhatu* (Adipose tissue) as seen in conditions like uncontrolled diabetes.[6] Physician can combine unusual lab results with signs seen in Ayurveda to better understand a patient's risk. This helps them watch for danger using both test reports and physical symptoms. This approach may be especially valuable in regions where both systems of care are practiced concurrently or where patients transition between biomedical hospitals and Ayurvedic centers.

Aim of This Article :
Define and operationally describe critical value alerts in the clinical biochemistry laboratory.

Material and Methods:
This was a cross-sectional observational study conducted in the biochemistry laboratory of an Institute of Teaching and Research in Ayurveda, jamnagar, Gujarat. The study was carried out over a period of one year from 1st June 2024 to 31st May 2025. Total patient number was 20573 among which 11098 were female and 9475 were male. A total of eleven biochemical parameters were analyzed in this study, including Total bilirubin, Calcium, Creatinine, Free T4, TSH, Sugar, CK-MB, Uric acid, HbA1c, CRP, and Troponin I. Universal precaution have been taken in collecting the primary sample collection. All above tests have been done in serum of freshly drawn blood. After the utmost care taken in analytical error, laboratory records were reviewed to identify test results falling within pre-defined critical alert value limits as per hospital policy and reference standard. Data were compiled in Microsoft Excel software and Patho Plus version 3.1.2.

Result:
Total Eleven parameters were searched. T.Bilirubin, Calcium, creatinine, free T4, TSH, Blood sugar, CK-MB, Uric Acid, HbA1c, CRP and troponin I.
As shown in Figure 1, Out of a total of 57734 test results, 57391 were classified as non-critical, while only 343 were marked as critical alerts. This indicates that critical alerts make up just 0.59% of all cases, highlighting that although rare, these instances are clinically significant and demand immediate attention.
As shown in Figure 2, The highest number of critical alerts was observed in April 2025 (38 cases), followed closely by January and March 2025 (33 each) , indicating peak months for critical lab values. In contrast, the lowest number of critical alerts occurred in August 2024 (21 cases), suggesting a possible seasonal or operational influence during that period.
As shown in Figure 3, Glucose recorded the highest number of critical alerts (144 cases), making it the most frequently deranged analyte. This was followed by Creatinine (86 cases) and CRP (36 cases). Moderate critical values were observed for CRP (36), TSH (26), and HbA1c (22),On the lower end, total bilirubin (18) and uric acid (6) show fewer critical alerts, while calcium (4) and CK-MB (1) recorded the least.
As shown in figure 4, The pie chart shows that out of 20224 cases, while 3805 were deranged alerts and 16327 were normal and only 92 were critical CKD alerts. The CKD alert data shows 79.1% normal, 18.4% deranged and 0.4% critical results, highlighting the need for early intervention in deranged cases.

As shown in figure 5, The pie chart indicates that out of 22016 diabetic profile tests, 17746 were normal, 4384 were deranged alerts and only 166 cases were flagged as critical alerts, .Diabetic alert data shows 78.7% normal, 19.8% deranged, and 0.7% critical results.
As shown in figure 6, The critical trend analysis across various analytes between males and females reveals significant gender-based variations. Total Bilirubin
showed higher critical alerts in males (14) compared to females (4). Calcium critical alerts occurred only in females (4). Critical thyroid levels were notably higher in females (20) than male (6). A single cardiac alert (CK-MB) was reported in male, none in females. Females (4) had double the critical uric acid cases compared to males (2). C-Reactive Protein (CRP), Inflammatory alerts were slightly higher in females(20) than males (16). Glycated hemoglobin (HbA1c) was slightly higher in males (12) than in females (10). Creatinine showed significantly higher critical alerts in males (62) than in females (24). Lastly, Glucose levels had the highest critical alerts overall with males (90) far exceeding females (53) .

As shown in table 1, Among the 11 analytes assessed, 9 have only high critical alert values, indicating that elevated levels are more commonly associated with life-threatening risks. 2 of the analytes calcium and blood sugar have both low and high alert thresholds, while none show low-only alerts. Among the 11 critical analytes, 18.18% each were related to cardiac, renal, endocrine, and glycemic profiles, while liver function, electrolyte balance, and inflammation each accounted for 9.09%, highlighting multisystem involvement in critical alerts.

Figure 1:Indicate total critical alerts

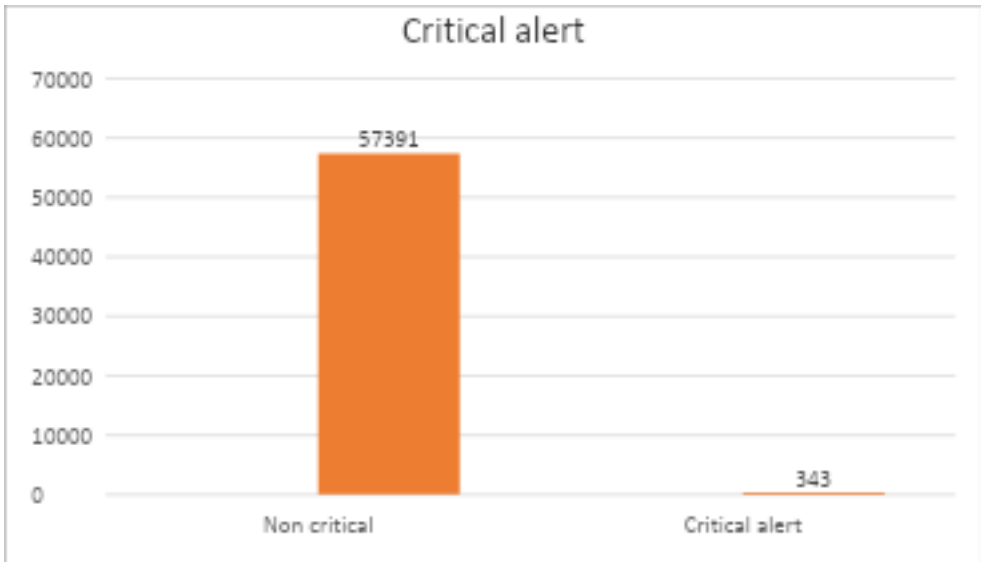

Figure 2: Indiates Month wise trends of critical alerts

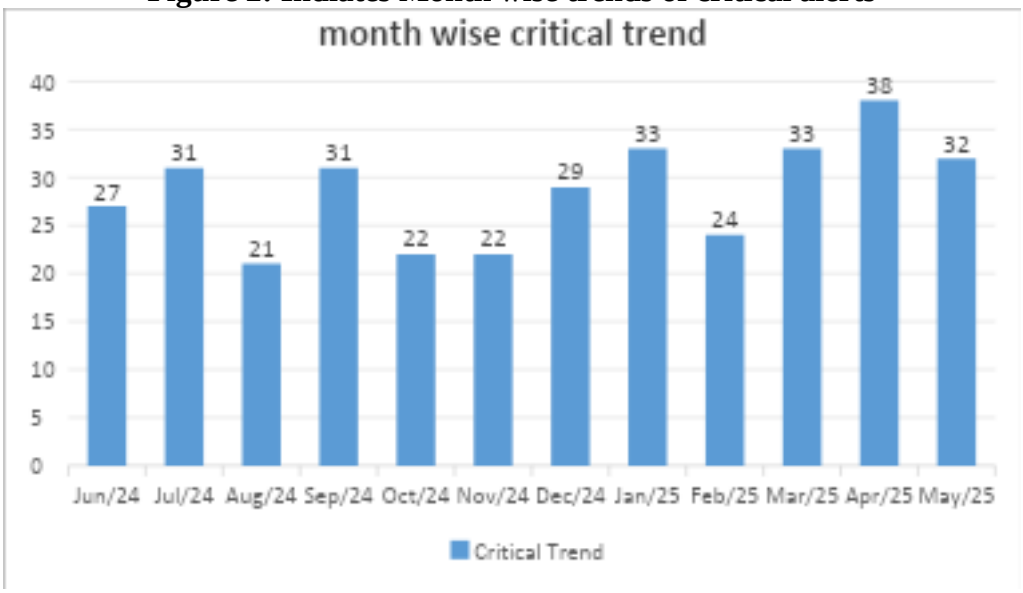

Figure 3: Indicates analyte wise critical alerts trends

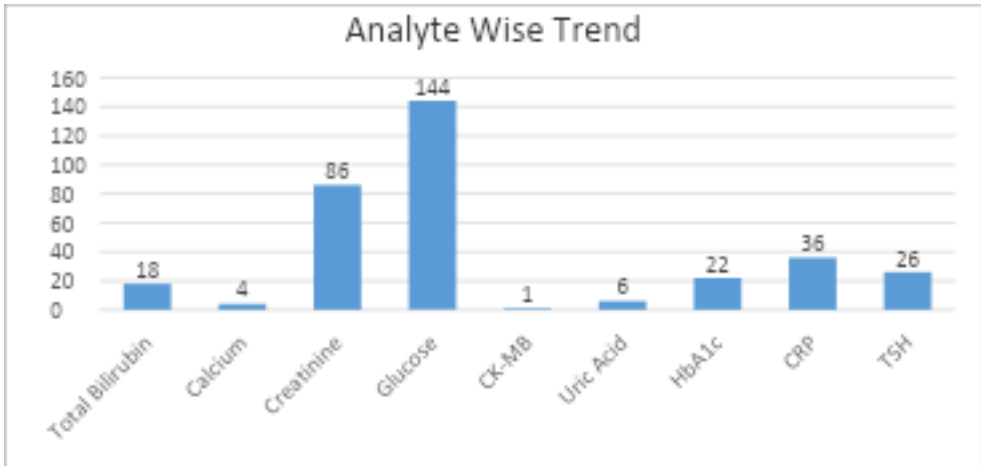

Figure 4:CKD critical alert

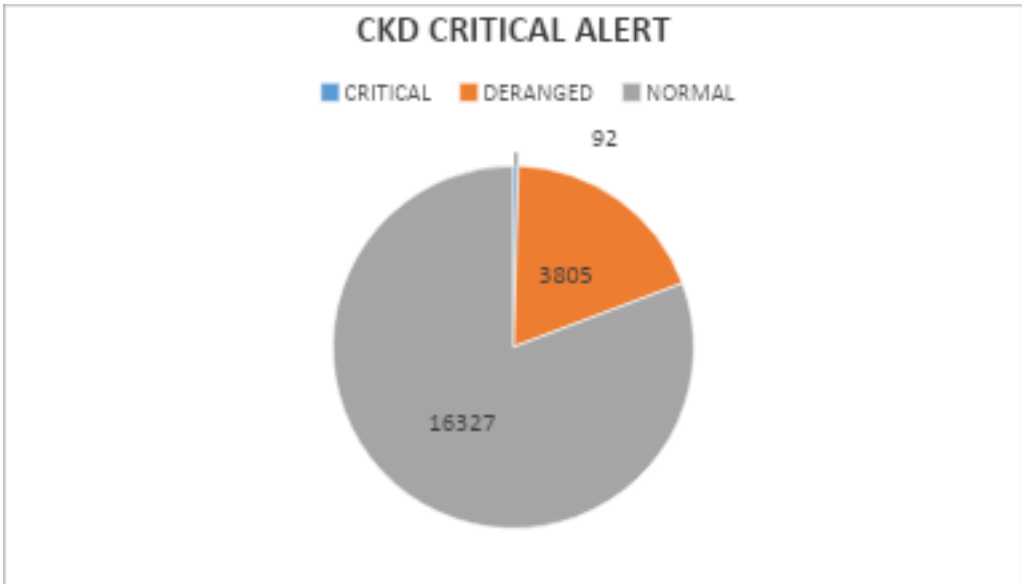

Figure 5: Diabetic critical alert

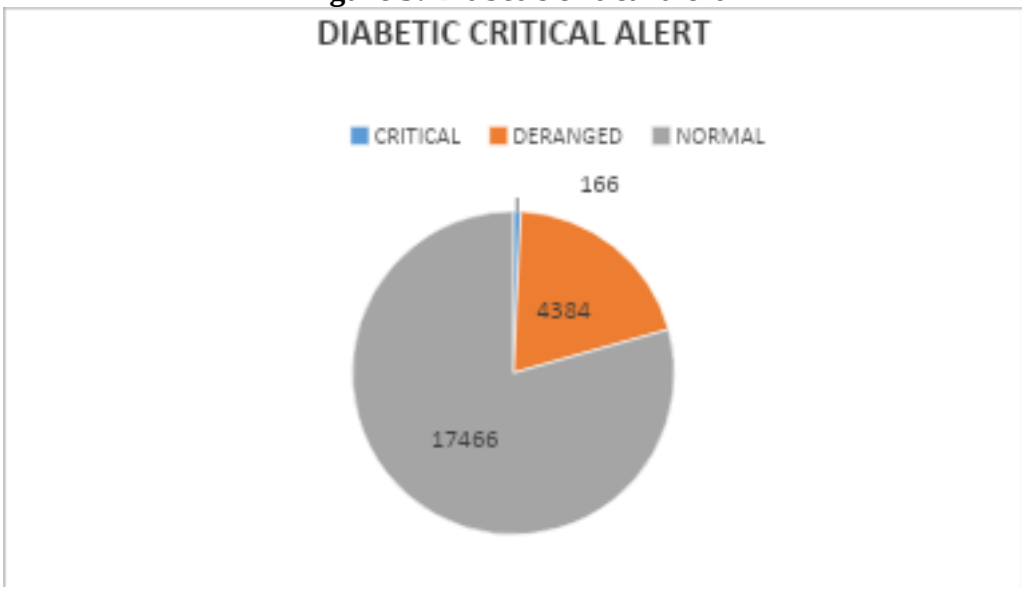

Figure 6: Critical trend in Male and Female

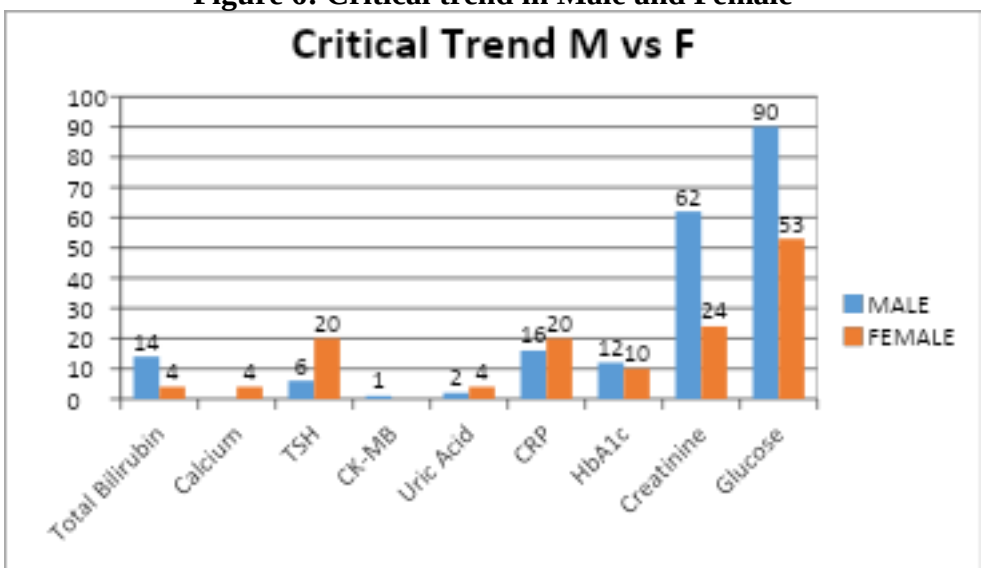

Table 1: Critical Alert scope for study duration

S.N	Analyte	critical Alerts		units
		Low	High	
	Total			
1	Bilirubin	_	≥15.0	mg/dL
2	Calcium	≤6.5	≥13.0	mg/dL
3	Creatinine	_	≥3.0	mg/dL
4	FT4	_	≥6.0	ng/dL
5	TSH	_	≥25.0	µIU/ml
6	Sugar	≤50	≥400	mg/dL
7	CK-MB	_	≥30	U/L
8	Uric Acid	_	≥13.0	mg/dL
9	HbA1c	_	≥12	%
10	CRP	_	≥30	mg/L
11	Trop-I	_	≥0.49	ng/mL

Discussion

The present analysis of critical alert values in a clinical biochemistry laboratory reveals essential insights into the prevalence, distribution, and clinical significance of various deranged biochemical parameters. Out of a total of 57,734 laboratory investigations, only 343 cases (0.59%) were flagged as critical, emphasizing that while such occurrences are relatively rare, they demand prompt clinical attention due to their potentially life-threatening implications.

Among the 11 analytes evaluated, glucose emerged as the most frequently deranged parameter, accounting for 144 critical alerts. This suggest that disturbances in blood sugar regulation whether elevated or decreased are commonly encountered and pose significant risks to patient safety. high blood sugar (high fasting plasma glucose) is one of leading risk factors for early death and poor health worldwide in 2021.[7] This underscores the clinical importance of continuous glycemic monitoring, especially in populations with diabetes or critical illnesses.

Creatinine, with 86 critical alerts indicates a considerable burden of renal impairment, which may be due to chronic kidney disease, acute injury. Elevated CRP levels (36 alerts) further highlight the role of systemic inflammation or acute infections contributing to critical states in patients.

The data shows that the number of critical alerts was highest in April, January, and March 2025. August 2024 had the fewest critical alerts, which might be due to fewer hospital visits or better control of chronic conditions during that period. This trend suggests that seasonal changes and hospital workload may influence the occurrence of critical lab values.

The male-to-female ratio among patients visiting the hospital was approximately 1 : 1.17. Male to female ratio breakdown offered additional insights. Males showed higher critical alerts in parameters related to renal, hepatic, and glycemic functions, such as creatinine (31 : 12), glucose (90 : 53), total bilirubin (7 : 2), HbA1c (6 : 5), and CK-MB (1 : 0) suggesting a higher prevalence of hepatic, renal, cardiac, and metabolic complications in the male population. From 2009 to 2019, the age-adjusted heart disease death rate was higher for males than for females.[8]

In contrast females to male ratio exhibited more critical alerts in calcium (4 : 0), TSH (10 : 3), uric acid (2 : 1), and CRP (5 : 4) indicating a greater prevalence of abnormalities in thyroid function, calcium balance and inflammatory markers in the female. Overall, the data suggests males are more prone to critical alerts in renal, cardiac and glucose-related parameters, while females showed slightly higher alerts in thyroid and uric acid levels. Female gender are found to have significant association with hypothyroidism.[9] Further subset analysis of chronic disease profiles showed a low proportion of critical alerts in both CKD (0.45%) and diabetic profile testing (0.75%), This indicates a low incidence of critical CKD, but those few cases still require urgent attention and monitoring.his suggests that although the majority of diabetic profiles are stable, a small but significant number require immediate clinical attention.

The critical analyte classification revealed that the majority (9 out of 11) had only high-alert thresholds, emphasizing the predominance of pathological elevations over depletions. Only Calcium and Blood Sugar demonstrated both high and low critical thresholds, reflective of their delicate homeostatic balance and vital physiological roles.

Categorically, the analytes represented a broad spectrum of systemic involvement: renal (Creatinine, Uric Acid), cardiac (CK-MB, Troponin I), endocrine (TSH, FT4), glycemic (Glucose, HbA1c), hepatic (Total Bilirubin), electrolyte (Calcium), and inflammatory markers (CRP). These findings highlight the multi systemic nature of critical illnesses and underscore the necessity of integrated and timely laboratory diagnostics for optimal clinical decision-making.
In conclusion, although critical alerts comprise a small fraction of total lab results, their occurrence points to serious underlying pathology. Strengthening hospital alert protocols, ensuring rapid clinician response, and integrating laboratory vigilance with clinical care pathways can significantly improve patient outcomes.

Conclusion:
This study highlights the crucial role of critical value alerts in identifying life-threatening biochemical abnormalities within a hospital setting. These alerts are vital in guiding timely clinical interventions. Gender-based patterns further underscore the need for personalized care, with males more prone to hepatic, renal, and cardiac derangements, while females exhibited more thyroid and metabolic alerts. The integrative perspective, drawing parallels between modern critical alerts and Ayurvedic concepts like *Arishta Lakshana* and *Dhatupaka*, enriches clinical risk recognition. Recognizing signs from both systems may enhance patient safety, especially in settings where both traditional and modern healthcare coexist. Overall, having a strong system to quickly detect and report critical lab results, along with better understanding between modern and traditional medicine, can help treat serious and long-term illnesses more effectively and improve patient health outcomes.

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