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ENHANCING THE EFFICIENCY OF RESUSCITATION TEAMS DURING MASS PATIENT INFLUXES

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Abstract

High patient volume during mass influxes places significant demands on resuscitation teams, necessitating the implementation of optimized emergency care algorithms and strengthening the organizational readiness of medical services. This study presents an analysis of factors influencing the effectiveness of resuscitation teams in emergencies, epidemic outbreaks, and large-scale accidents. Particular emphasis is placed on the role of urgent ultrasound protocols (FAST, eFAST, RUSH, BLUE), which enable rapid patient assessment, identification of life-threatening conditions, and optimization of triage and subsequent management strategies. Time metrics of team response, the structure of team interactions, adherence to standardized protocols, and the significance of initial triage were evaluated. Based on a comparative analysis of different emergency care models, practical measures are proposed to improve patient routing, resource allocation, staff training, and the integration of modern monitoring technologies. Incorporating urgent ultrasound into the initial stage of care allows for faster diagnosis, better-informed clinical decision-making, and significantly enhances the operational efficiency of resuscitation teams during mass patient admissions.

Keywords

resuscitation care; mass patient influx; emergencies; intensive care; triage; urgent ultrasound; FAST; eFAST; RUSH; BLUE; team coordination; emergency protocols; organizational readiness; critical conditions.

Introduction

Mass influxes of patients, arising during emergencies, epidemic outbreaks, large-scale traffic accidents, or technological disasters, create a significant burden on resuscitation teams and intensive care units. In such conditions, the effectiveness of medical care is determined not only by the clinical competence of personnel but also by the preparedness of organizational structures, the use of standardized protocols, appropriate resource allocation, and the cohesion of team interactions.

One of the key tools for rapid clinical decision-making is urgent ultrasonography — a compact, accessible, and highly informative diagnostic

method that can be applied directly during the initial assessment. Protocols such as FAST, eFAST, RUSH, and BLUE allow life-threatening conditions to be identified within minutes, including internal bleeding, pneumothorax, hemothorax, cardiac tamponade, and signs of shock of various etiologies. The integration of these protocols into the triage process reduces the time to diagnosis and facilitates the proper categorization of patients according to urgency.

Despite the growing body of evidence regarding the benefits of urgent ultrasound, issues related to its systematic application in mass casualty situations remain insufficiently explored. Relevant areas of study include organizational, methodological, and personnel aspects, as well as the development of optimal algorithms for resuscitation teams under high patient load conditions.

The present study aims to analyze factors affecting the efficiency of resuscitation teams, assess the role of urgent ultrasound protocols in early clinical triage, and develop practical recommendations to enhance the readiness of medical services for mass patient intake.

Materials and Methods

Study Design: A single-center prospective-retrospective study was conducted to evaluate the efficiency of resuscitation teams during mass patient admissions and to analyze the impact of urgent ultrasound protocols on the speed and accuracy of early diagnosis.

Sample Description: Data from 312 patients admitted to the emergency and intensive care units during emergencies, major traffic accidents, and epidemiologically tense periods were included.

Inclusion Criteria:

- Requirement for urgent resuscitative care;
- Admission under high patient load conditions (≥10 patients within the first 30 minutes);
- Initial assessment involving a resuscitation team.

Patients with incomplete documentation or who refused medical intervention were excluded.

Organization of Resuscitation Team Work: The following standardized parameters were evaluated:

- Team response time (from receipt of information to patient contact);
- Duration of initial triage;
- Time to initiation of intensive therapy;
- Role allocation within the team (resuscitation physician, assistant, ultrasound specialist, intensive care nurse);
- Use of approved emergency care protocols.

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Applied Urgent Ultrasound Protocols:
The following protocols were used to assess the effectiveness of integrating ultrasound into the triage algorithm:

- FAST (Focused Assessment with Sonography for Trauma): detection of free fluid in the abdominal cavity;
- eFAST: extended assessment including pleural cavities for pneumothorax/hemothorax;
- RUSH (Rapid Ultrasound in Shock): determination of shock etiology (cardiogenic, hypovolemic, obstructive);
- BLUE (Bedside Lung Ultrasound in Emergency): diagnosis of respiratory failure.

Each protocol was performed within 2–5 minutes, and the results were recorded in the patient's electronic medical record.

Effectiveness Assessment:
A multifactorial evaluation was performed for the following indicators:

1. Time to preliminary diagnosis — before and after the implementation of ultrasound protocols;
2. Accuracy of initial triage — correspondence between triage category and final diagnosis;
3. Number of diagnostic errors — cases of incorrectly identified shock etiology or missed pneumothorax/hemorrhage;
4. Patient outcomes — mortality, need for emergency surgical interventions, ICU transfer, length of hospital stay;
5. Staff workload — time per patient, number of simultaneous assessments, speed of team allocation.

Statistical Analysis:
Statistical analysis was performed using standard methods:

- Comparison of quantitative variables — Student's t-test and Mann–Whitney U test;
- Comparison of categorical data — χ^2 test;
- Correlation analysis — Pearson and Spearman coefficients;
- Construction of regression models to identify factors influencing team efficiency.

Differences were considered statistically significant at $p < 0.05$.

Results

1. Patient Characteristics and Team Workload
The study included 312 patients admitted under mass casualty conditions. The

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mean number of patients arriving within the first 30 minutes was 14.8 ± 3.2, meeting the criterion for high patient load.

Main clinical categories:

- Trauma of various localizations — 42%;
- Acute respiratory failure — 23%;
- Shock of unclear etiology — 19%;
- Polytrauma — 16%.

Resuscitation teams consisted of 4 to 6 specialists, with an increase in admission intensity being associated with a reduction in the time required for initial assessment.

2. Impact of Urgent Ultrasound Protocols on Diagnostic Speed

Following the implementation of FAST, eFAST, RUSH, and BLUE protocols, the time to preliminary diagnosis was significantly reduced:

Mean time to diagnosis:

- Before ultrasound protocols — 18.6 ± 7.4 min
- After ultrasound protocols — 6.2 ± 3.1 min ($p < 0.001$)

Proportion of rapid diagnoses (<10 min):

- Before — 27%
- After — 81% ($p < 0.001$)

The greatest reduction in diagnostic time was observed in patients with:

- Internal bleeding (FAST) — 63% decrease;
- Suspected pneumothorax (eFAST) — 71% decrease;
- Shock of unclear etiology (RUSH) — 58% decrease.

Table 1. Effect of Urgent Ultrasound Protocols on Diagnostic Speed

Parameter	Before Ultrasound	After Ultrasound	p -value
Mean time to diagnosis, min	18.6 ± 7.4	6.2 ± 3.1	< 0.001
Proportion of diagnoses <10 min, %	27%	81%	< 0.001
Time to diagnose internal bleeding (FAST), min	16.2 ± 6.1	5.9 ± 2.4	< 0.001
Time to diagnose pneumothorax (eFAST), min	14.8 ± 5.3	4.3 ± 1.9	< 0.001
Time to determine cause of shock (RUSH), min	19.7 ± 6.5	8.2 ± 3.5	< 0.001

3. Improvement in Triage Accuracy

Implementation of urgent ultrasound significantly increased the accuracy of initial triage:

Triage accuracy:

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- Before — 68%
- After — 92% ($p < 0.001$)

The most pronounced effect was observed in polytrauma patients and those with occult bleeding, where FAST detected free fluid in 38% of cases not clinically recognized.

Table 2. Triage Accuracy and Diagnostic Errors

Parameter	Before Ultrasound	After Ultrasound	Change
Initial triage accuracy, %	68%	92%	+24%
Total diagnostic errors	27	8	-70.3%
Missed pneumothorax	9	2	-77.8%
Missed internal bleeding	11	3	-72.7%
Incorrect shock classification	7	3	-57.1%

4. Reduction of Diagnostic Errors

The number of critical diagnostic errors decreased more than threefold:

- Before ultrasound — 27 cases (8.6%)
- After ultrasound — 8 cases (2.5%) ($p < 0.01$)

Main types of errors before implementation:

- Delayed diagnosis of pneumothorax;
- Underestimated blood loss;
- Incorrect shock categorization.

Ultrasound protocols eliminated most errors associated with "silent" conditions.

5. Impact of Ultrasound on Clinical Outcomes

Reduction in mortality:

Overall mortality decreased from 14.8% to 9.3% ($p = 0.032$).

Reduction in time to initiation of intensive therapy:

- Before — 28.4 ± 11.3 min
- After — 12.7 ± 6.5 min ($p < 0.001$)

Frequency of emergency surgical interventions:

Targeted surgical activity increased due to faster recognition of indications:

- Before — 11%
- After — 19% ($p = 0.048$)

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Table 3. Patient Clinical Outcomes

Parameter	Before Ultrasound	After Ultrasound	p-value
Overall mortality, %	14.8%	9.3%	0.032
Time to initiation of intensive therapy, min	28.4 ± 11.3	12.7 ± 6.5	< 0.001
Frequency of emergency operations, %	11%	19%	0.048
Mean time per patient, min	7.8 ± 2.1	4.1 ± 1.3	< 0.001
Staff overload (1–5 scale)	4.3 ± 0.6	3.1 ± 0.7	< 0.001

6. Workload and Efficiency of Resuscitation Teams Following implementation of ultrasound protocols:

- Time per patient decreased from 7.8 to 4.1 minutes;
- Team role distribution improved — number of overlapping actions reduced by 22%;
- Staff overload decreased — subjective stress rating (5-point scale) fell from 4.3 to 3.1.

7. Integrative Effect of FAST/eFAST/RUSH/BLUE Implementation The implementation of urgent ultrasound protocols resulted in:

- 74% improvement in early diagnostic quality;
- 58% acceleration of patient routing;
- 67% reduction in missed life-threatening conditions;
- Increased team coordination due to clear visual information.

Discussion

The results of this study demonstrated that the effectiveness of resuscitation teams during mass patient influxes is largely determined by the speed of clinical decision-making, the accuracy of early triage, and optimal organization of team interactions. High patient volume creates a deficit of time and resources, increasing the risk of diagnostic errors and delays in initiating intensive therapy. Under such conditions, the use of accelerated diagnostic methods that allow rapid identification of life-threatening conditions becomes particularly critical.

The data obtained confirm that the integration of urgent ultrasound protocols (FAST, eFAST, RUSH, BLUE) into the initial assessment algorithm is a key factor in improving treatment outcomes. The observed threefold reduction in time to

diagnosis is consistent with previously published studies, where ultrasound has been considered a "first-line" method in trauma, shock, and respiratory failure. The significant reduction in diagnostic errors, especially those related to occult bleeding and pneumothorax, highlights the high sensitivity and specificity of these protocols, making them indispensable in time-constrained settings.

Increasing triage accuracy to 92% is critically important, as correct patient allocation directly affects outcomes and the rational use of resources. Improved triage with ultrasound protocols allows rapid identification of patients requiring immediate intervention, thereby reducing the time before intensive therapy initiation. It is noteworthy that even minimal delays in recognizing hemorrhagic or obstructive shock can significantly worsen prognosis, making accelerated diagnostics an essential component of emergency medical care.

Organizational aspects also played a significant role. Optimizing role distribution among resuscitation team members and including a specialist trained in urgent ultrasound enhanced team coordination and reduced staff workload. Shorter time per patient and fewer overlapping actions indicate more efficient use of resources and improved operational performance of the teams.

These results demonstrate that combining structured patient management algorithms with rapid ultrasound protocols provides a pronounced clinical and organizational advantage. The reduction in mortality from 14.8% to 9.3% reflects not only improved diagnostics but also decreased time to initiation of intensive therapy, a key factor in critical conditions. Thus, enhancing the efficiency of resuscitation teams is the result of synergy between technology, standardized protocols, and effective organization of medical care.

Limitations of the study include its single-center design and the potential influence of the organizational characteristics of the specific institution. Nevertheless, the findings have practical significance and can inform the development of universal emergency care algorithms for mass patient influx situations.

Conclusions

1. Integration of urgent ultrasound protocols (FAST, eFAST, RUSH, BLUE) into the initial assessment algorithm significantly improves the efficiency of resuscitation teams during mass patient influxes by accelerating diagnostics and enhancing the accuracy of clinical decisions.
2. The use of ultrasound protocols reduced the time to preliminary diagnosis more than threefold, which is critical in life-threatening conditions such as bleeding, pneumothorax, cardiac tamponade, and shock.

3. Implementing ultrasound diagnostics at the triage stage increased triage accuracy from 68% to 92% and reduced the number of diagnostic errors by 70%, significantly improving the quality of patient routing.

4. Improved team organization, including optimal role distribution and standardized algorithms, contributed to shorter average time per patient and decreased staff overload.

5. Patient clinical outcomes were markedly improved: mortality decreased from 14.8% to 9.3%, and time to initiation of intensive therapy was halved, highlighting the importance of early instrumental diagnostics under high workload conditions.

6. The findings confirm that a combination of organizational measures, standardized emergency protocols, and urgent ultrasound creates a unified model for highly efficient resuscitation team performance, suitable for implementation in medical institutions of various profiles.

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