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Community-Based Disaster Preparedness Programs: A Systematic Review of Their Effectiveness in Reducing Emergency Care Burden

برامج التأهب للكوارث المجتمعية: مراجعة منهجية لفعاليتها في تقليل العبء على خدمات الرعاية الطارئة

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Abstract:

Background: Disasters and extreme weather events generate sudden surges in emergency medical services (EMS) and emergency department (ED) demand. Community-based disaster preparedness (CBDP) programs—such as household preparedness training, Community Emergency Response Team (CERT) models, community first-aid and psychosocial readiness curricula, and risk-communication initiatives—aim to strengthen self- and mutual-aid capacities and may mitigate avoidable prehospital and ED burden. **Objective:** To synthesize evidence on the effectiveness of CBDP programs in reducing the burden on EMS/EDs and in improving disaster-relevant health outcomes. **Methods:** We conducted a systematic review guided by PRISMA principles. Eligible studies (2000–2025) evaluated CBDP interventions in any hazard setting and reported outcomes relevant to emergency care burden (e.g., EMS call load, time-to-first-aid, appropriate care-seeking, ED utilization, surge management, or resilience proxies). Data were synthesized narratively given heterogeneity in programs and outcomes; risk of bias was appraised using ROBINS-I for nonrandomized studies and RoB 2 for randomized trials. **Results:** Evidence consistently links CBDP participation to improved household preparedness, faster initiation of lay first-aid, and more appropriate care-seeking, with downstream potential to moderate avoidable EMS/ED demand; however, direct causal estimates on ED utilization remain limited. CERT-style volunteer programs strengthen local surge capacity and coordination, while integrated mental-health + preparedness curricula improve preparedness and reduce psychological symptoms—factors associated with better adherence to shelter-in-place guidance and more judicious ED use. Primary health care (PHC)-linked preparedness frameworks demonstrate plausible pathways to decompress EDs by routing non-urgent needs to community and PHC assets. **Conclusions:** CBDP programs improve readiness and community response behaviors through multiple mechanisms that plausibly reduce emergency care burden, though rigorous, prospective measures of EMS/ED load effects are scarce. Standardized metrics (including ED crowding indices) and prospective, multi-site evaluations are needed to quantify system-level impact.

Keywords: Community, Disaster, Community-Based Disaster Preparedness Programs, Effectiveness, Reducing Emergency Care Burden.

الملخص:

الخلفية: تؤدي الكوارث والأحداث الجوية المتطرفة إلى زيادات مفاجئة في الطلب على خدمات الطوارئ الطبية (EMS) وأقسام الطوارئ (ED). تهدف برامج التأهب للكوارث المجتمعية – (CBDP) مثل تدريب الأسر على الاستعداد، ونماذج فرق الاستجابة الطارئة المجتمعية (CERT)، ومناهج الإسعافات الأولية المجتمعية والجاهزية النفسية-الاجتماعية، ومبادرات التواصل حول المخاطر – إلى تعزيز قدرات الاعتماد على الذات والمساعدة المتبادلة، وقد تسهم في التخفيف من الأعباء القابلة للتجنب على ما قبل المستشفى وأقسام الطوارئ.

الهدف: تلخيص الأدلة حول فعالية برامج التأهب المجتمعي للكوارث في تقليل العبء على خدمات الطوارئ الطبية وأقسام الطوارئ، وتحسين النتائج الصحية ذات الصلة بالكوارث.

المنهجية: أُجريت مراجعة منهجية استرشدت بمبادئ **PRISMA**. شملت الدراسات المؤهلة (2000–2025) التدخلات المجتمعية للتأهب للكوارث في أي بيئة خطرة، والتي أبلغت عن نتائج ذات صلة بعبء الرعاية الطارئة) مثل حجم مكالماتEMS ، وقت بدء الإسعافات الأولية، التوجه المناسب لطلب الرعاية، استخدامED ، إدارة الازدحام، أو مؤشرات الصمود .(جُمعت البيانات بشكل وصفي نظرًا لتباين البرامج والنتائج؛ وتم تقييم مخاطر التحيز باستخدام أداة **ROBINS-I**للدراسات غير العشوائية و **RoB 2**للتجارب العشوائية.

النتائج: ترتبط المشاركة في برامج التأهب المجتمعي للكوارث بشكل متسق بتحسن استعداد الأسر، وتسريع بدء الإسعافات الأولية على يد العامة، وتحسين سلوكيات طلب الرعاية بشكل ملائم، مما يؤدي لاحقًا إلى تخفيف محتمل في الطلب القابل للتجنب على خدماتEMS/ED ؛ ومع ذلك، تظل التقديرات السببية المباشرة على استخدام أقسام الطوارئ محدودة. تعزز برامج المتطوعين على نمط **CERT**القدرة المحلية على الاستجابة للزيادات المفاجئة والتنسيق، بينما تعمل المناهج المدمجة للصحة النفسية + التأهب على تحسين الجاهزية وتقليل الأعراض النفسية – وهي عوامل ترتبط بالالتزام الأفضل بتوجيهات البقاء في المنزل والاستخدام الأكثر حكمة لأقسام الطوارئ. وتُظهر أطر التأهب المرتبطة بالرعاية الصحية الأولية (PHC) مسارات معقولة لتخفيف الضغط عن أقسام الطوارئ من خلال توجيه الحالات غير العاجلة نحو المجتمع وأصول الرعاية الأولية.

الاستنتاجات: تحسن برامج التأهب المجتمعي للكوارث مستوى الجاهزية وسلوكيات الاستجابة المجتمعية عبر آليات متعددة تقلل بشكل معقول من عبء الرعاية الطارئة، رغم ندرة القياسات المستقبلية الصارمة لأثرها على حجم الطلب على .EMS/ED هناك حاجة إلى مقاييس موحدة (بما في ذلك مؤشرات ازدحام أقسام الطوارئ) وتقييمات مستقبلية متعددة المواقع لقياس الأثر على مستوى النظام.

الكلمات المفتاحية: المجتمع، الكوارث، برامج التأهب للكوارث المجتمعية، الفعالية، تقليل عبء الرعاية الطارئة.

Introduction:

Disasters disrupt access to care and rapidly overwhelm EMS and EDs through injury clusters, exacerbations of chronic disease, and behavioral health needs. ED crowding is associated with delays, adverse outcomes, and degraded quality—making pre-event risk reduction and community-level readiness essential levers for resilience (Sartini et al., 2022). CBDP programs, aligned with the Sendai Framework's whole-of-society approach, mobilize households, civil society, and local institutions to reduce risk, improve preparedness, and absorb initial shock waves before professional responders arrive (UNDRR, 2015). In theory, these programs can reduce unnecessary EMS activation and non-urgent ED attendance by improving self-care, mutual aid, and risk-appropriate care-seeking, while creating auxiliary surge capacity (e.g., CERT). In practice, the magnitude of their effect on emergency care burden has not been conclusively synthesized. This review addresses that gap.

1.Literature review

Conceptual foundations and policy context

Community-based disaster preparedness (CBDP) programs are grounded in the Sendai Framework's "whole-of-society" approach, which emphasizes risk understanding, governance, investment in resilience, and preparedness for effective response (UNDRR, 2015). Community participation is positioned as a critical lever for reducing disaster risk and moderating downstream burdens on emergency services and hospitals by improving readiness,

self- and mutual-aid, and risk-appropriate help-seeking. These priorities frame CBDP as both a public-health and systems strategy aimed at smoothing demand across the prehospital–ED continuum during shocks. Program typologies and mechanisms of action

CBDP encompasses heterogeneous models that share common mechanisms: (a) preparedness education for households and leaders; (b) volunteer responder schemes such as Community Emergency Response Teams (CERT); (c) integrated preparedness–mental-health curricula; and (d) primary-health-care (PHC)–linked preparedness frameworks. CERT programs, standardized under FEMA in the United States, train civilians in light search-and-rescue, basic disaster medicine, team organization, and risk communication—skills that can stabilize minor injuries, conduct welfare checks, and support incident organization when professional responders are delayed (Ossey et al., 2017). Evaluations consistently show improvements in local readiness and volunteer coordination, suggesting plausible pathways to avert unnecessary EMS activation and non-urgent ED visits (city program descriptions show common core content and drills).

A complementary line of work integrates mental-health skills (e.g., coping, social support) into preparedness training. In a randomized controlled trial in Haiti (N=480), participants receiving an integrated mental-health–preparedness program demonstrated significant gains in both preparedness behaviors and mental-health outcomes versus controls, supporting the hypothesis that psychosocial resilience enhances adherence to public-health guidance and reduces maladaptive care-seeking during crises (James et al., 2020).

PHC-linked frameworks aim to protect ED capacity by coordinating risk communication, continuity for chronic conditions, and low-acuity care through community and primary-care assets. A recent narrative review and subsequent updates propose structured PHC preparedness domains and assessment approaches, while highlighting gaps in standardized metrics and integration into national emergency risk-management plans (Lamberti-Castronuovo et al., 2022; 2024). These frameworks supply a systems pathway for CBDP to decompress EDs indirectly—by absorbing non-urgent demand upstream.

Effects on preparedness, first-aid, and care-seeking

Across designs and settings, CBDP consistently improves household and leader preparedness, time-to-first-aid, and coordination with responders. Experimental and quasi-experimental studies document meaningful behavioral gains—faster initiation of lay first aid, better supply readiness, and improved hazard-specific actions—that plausibly translate into moderated EMS demand and safer self-care until responders arrive (CERT curricula and community leader trainings show convergent effects).

However, direct causal estimates of CBDP on emergency-care utilization are less common because many studies track intermediate outcomes. Contemporary population-level evidence confirms that extreme events are associated

with spikes in ED utilization, particularly in rural/remote or otherwise underserved areas (Dewi et al., 2024), and U.S. analyses similarly report short-term increases in ED visits and mortality after disasters (Salas et al., 2024). These patterns underscore the potential system value of CBDP: even modest improvements in appropriate care-seeking or early lay stabilization could attenuate the peaks of post-disaster demand.

Equity, special populations, and community engagement

CBDP's community engagement lens can reduce information gaps and improve preparedness among groups that face language, cultural, or geographic barriers to accessing formal services. Case studies and program evaluations in minority or disadvantaged communities report improved readiness capacities when interventions are co-designed with local stakeholders—a principle that strengthens the face validity for CBDP's role in reducing avoidable ED use during disruptions.

Training innovations and implementation science

Implementation research increasingly explores digital and immersive training to sustain skills and decision-making under stress. While immersive/VR modalities can enhance user engagement and knowledge retention for disaster tasks, robust trials linking these modalities to measured reductions in EMS calls or ED presentations during real incidents remain scarce—reinforcing the need for standardized outcome sets (e.g., ED crowding indices, EMS call volumes) in future evaluations.

Regional lens: Saudi Arabia and the MENA context

In Saudi Arabia, policy analyses and hospital surveys highlight significant progress alongside persistent needs for standardized training and interoperable evaluation frameworks (Alyami, 2020; Shalhoub et al., 2017). National actors—including the Saudi Red Crescent Authority (SRCA)—operate public first-aid training and volunteer pathways that align with CBDP principles, potentially strengthening surge absorption and appropriate help-seeking at community level; recent updates describe expanded training platforms and outreach. Parallel efforts in undergraduate and professional education (e.g., disaster curricula, simulation-based training) point to growing system capacity that could be leveraged for community-facing preparedness partnerships.

Synthesis

Taken together, the literature supports a mechanistically coherent model: CBDP improves preparedness behaviors, accelerates lay first-aid, and strengthens local coordination—factors that plausibly temper surges on EMS and EDs during disasters. Yet quantified, prospective evidence that attributes reductions in emergency-care burden directly to CBDP remains limited, particularly in low- and middle-income settings and across the MENA region.

Future research should therefore pair CBDP implementation with rigorous designs that track standardized utilization metrics and patient-centered outcomes.

2. Methods

2.1 Design and protocol

Systematic review following PRISMA guidance for complex interventions. We specified outcomes relevant to EMS/ED burden and prehospital performance (Appendix available upon request).

2.2 Eligibility criteria

Population: Community members and local volunteers (adults/youth), including special or underserved populations.

Interventions: CBDP programs (e.g., CERT, household preparedness and first-aid training, community risk communication and drills, integrated mental-health + preparedness curricula, PHC-linked preparedness).

Comparators: Usual conditions or alternative preparedness programs.

Outcomes: Proxies of emergency care burden (EMS call volume; first-aid initiation time; appropriate care-seeking; ED utilization/overcrowding indices; surge throughput), plus health and psychosocial outcomes.

Designs: RCTs, quasi-experimental, cohort, cross-sectional with comparison, and mixed-methods with measurable outcomes.

2.3 Information sources and search strategy

We searched MEDLINE, Embase, Scopus, Web of Science, CINAHL, and Cochrane (2000–September 2025), plus grey literature (UNDRR/WHO/PAHO, FEMA/CERT, National Academies). References of included articles were hand-searched. Example terms: (“community-based” OR CERT OR “household preparedness”) AND (disaster* OR “extreme weather”) AND (emergency department OR “EMS” OR “first aid” OR “healthcare utilization”).

2.4 Study selection, extraction, and quality appraisal

Two reviewers independently screened, extracted, and appraised risk of bias (ROBINS-I; RoB 2). Heterogeneity precluded meta-analysis; we conducted a structured narrative synthesis with logic models linking intervention components to emergency-care outcomes.

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3. Results (Narrative Synthesis)

3.1 Program types and mechanisms

Volunteer responder models (e.g., CERT). CERT programs train civilians in light search-and-rescue, fire suppression, first aid, and incident organization. Evaluations report increased local readiness, coordination with emergency management, and potential to handle minor injuries and welfare checks—activities that can avert non-urgent EMS activation and ED presentations (Ossey et al., 2017; Franke, 2005; Flint, 2010).

Integrated mental-health + preparedness curricula. Randomized trials show that combining disaster-preparedness training with psychosocial skills reduces depression/PTSD symptoms and improves preparedness behaviors in disaster-affected communities—factors associated with better adherence to guidance and a lower likelihood of panic-driven ED use (James et al., 2020; Amberson et al., 2024).

PHC-linked preparedness and risk communication. Frameworks that strengthen primary care roles during disasters can divert non-urgent care from EDs, maintain continuity for chronic conditions, and improve appropriate care-seeking (Lamberti-Castronuovo et al., 2022; PAHO/WHO, n.d.).

Community leader and household training. Preparedness education for community leaders/households improves readiness and first-aid capability; disaster experience and tailored curricula further increase supply readiness and protective actions (Tang et al., 2024; Onuma et al., 2017).

3.2 Outcomes related to emergency care burden

Across studies, CBDP programs consistently improved time-to-first-aid, self-protective actions, and coordination with responders; several reported more appropriate care-seeking and enhanced local surge handling. Direct, high-quality estimates of ED visit reduction are scarce, but scoping reviews link extreme events to spikes in healthcare utilization in underserved settings—plausibly mitigable by CBDP through improved preparedness and risk communication (Dewi et al., 2024).

3.3 Special and underserved populations

Community engagement approaches in disadvantaged or ethnic-minority settings demonstrate gains in preparedness capacities and access to information, suggesting equity benefits and potential moderation of avoidable ED demand during disruptions (Hung et al., 2021; Wells et al., 2013).

3.4 Regional findings: MENA and Saudi Arabia

Saudi and regional evidence highlights growing policy alignment with Sendai and investments in disaster education. Studies in Saudi Arabia report gaps in disaster readiness—and parallel curriculum and training reforms for undergraduates and health workers—which together underscore the opportunity for CBDP integration with PHC and Red Crescent community training (Bajow et al., 2016; Alyami, 2020; Shalhoub et al., 2017; Alrowili et al., 2025; SRCA, 2025).

4. Discussion

4.1 Principal findings

CBDP programs consistently improve preparedness behaviors, expand lay response capacity, and strengthen community-responder linkages. These mechanisms plausibly decompress EMS/EDs by (a) avoiding non-urgent activations through better self-care and risk-appropriate decisions, (b) providing immediate first-aid that stabilizes conditions pending professional response, and (c) using PHC and community venues to absorb low-acuity demand. Nevertheless, direct, prospective measurements of EMS call loads or ED crowding outcomes attributable to CBDP remain limited and should be a priority for future research.

4.2 Interpreting “emergency care burden”

ED burden spans input (demand), throughput (flow), and output (bed availability). Even modest reductions in non-urgent arrivals or improvements in prehospital stabilization can meaningfully affect crowding dynamics (Sartini et al., 2022). Evaluations should incorporate standardized ED crowding indices and EMS performance metrics to quantify CBDP effects.

4.3 What appears to work consistently

CERT-style volunteers for neighborhood-level triage, welfare checks, and basic aid.

Integrated mental health + preparedness to improve adherence and reduce maladaptive help-seeking.

PHC-linked preparedness and risk communication that channel non-urgent needs away from EDs.

Tailored leader/household trainings that accelerate first-aid and protective actions.

4.4 Practice and policy implications (with MENA/Saudi lens)

Health authorities and EMS should co-design CBDP with municipalities and Red Crescent/Red Cross societies, adopting standardized curricula, CERT-like volunteer pathways, and PHC surge playbooks. In Saudi Arabia,

aligning community training with PHC networks and SRCA outreach can bolster readiness while generating measurable EMS/ED metrics for evaluation.

4.5 Strengths and limitations of the evidence

Strengths include diverse settings and multiple RCTs or quasi-experimental designs for preparedness and psychosocial outcomes. Limitations include heterogeneity, reliance on intermediate endpoints, and scarce prospective studies directly measuring EMS/ED burden. National-level guidance recognizes community roles, but evaluation frameworks and metrics remain fragmented (National Academies, 2020).

5. Conclusion

CBDP programs enhance readiness, accelerate lay first-aid, and improve coordination, offering realistic pathways to moderate emergency care burden in disasters. While the direction of effect on EMS/ED demand is strongly plausible and supported by improvements in mechanisms of action, quantitative, prospective evidence directly linking CBDP to reductions in ED crowding or EMS call volume remains limited. Health systems—particularly in MENA/Saudi Arabia—should integrate CBDP with PHC and EMS plans, adopt standardized outcome metrics (including ED crowding indices), and invest in rigorous evaluations to capture system-level benefits.

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