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Systematic review

# Patient Education and Follow-Up After Severe Hypoglycemia Treated by Emergency Medical Services in Adults: A Systematic Review

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## Abstract

Background: Severe hypoglycemia often leads to emergency medical services (EMS) attendance, and many patients remain at home after on-scene treatment. Post-encounter education and follow-up differ between services. This review synthesized evidence on education, referral, follow-up, and recurrence after EMS-treated severe hypoglycemia in adults. Methods: The review followed PRISMA 2020. PubMed, Scopus, and Web of Science were searched from inception to 31 October 2026. Two authors independently screened records, extracted data, and assessed risk of bias with the Newcastle-Ottawa Scale, ROBINS-I, RoB 2, and the JBI qualitative checklist. Results: Eighteen reports of 17 cohorts from five countries were included. Non-transport ranged from 31% to 86%, and recurrence or repeat emergency contact within 72 hours stayed below 10% wherever reported. Thirty-day recurrence was 22.8%

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16/11/2026

among non-transported and 10.6% among transported patients. Hypoglycemia was discussed at only 11.5% of encounters without transport or outpatient care. Nurse- or educator-initiated referral achieved contact rates of 72% to 100%, and a booklet with crew advice halved the odds of repeat attendance, while self-referral prompts and electronic referral showed low uptake. Risk of bias was moderate or high in 11 of 18 reports. Conclusion: Follow-up after EMS-treated severe hypoglycemia is inconsistent. Recurrence is low within 72 hours and rises over the following month among patients left at home. Active referral and written advice at the scene improve engagement and reduce repeat attendance.

Keywords: Hypoglycemia; Emergency Medical Services; Patient Education; Referral and Consultation; Aftercare; Recurrence

## Introduction

Severe hypoglycemia is an episode in which a person with diabetes needs another person to give carbohydrate, glucagon, or other corrective treatment, and it remains the main acute hazard of insulin and sulfonylurea therapy (1). In the ADVANCE trial of 11,140 adults with type 2 diabetes, severe hypoglycemia was associated with a 2.88-fold higher adjusted risk of major macrovascular events and a 2.69-fold higher risk of death from any cause (2). In a specialty diabetes clinic cohort of more than 1,000 adults, those who reported severe hypoglycemia had 3.4-fold higher mortality over 5 years than those who reported mild or no episodes (3). In ADVANCE, the median interval from a severe episode to death was about one year, which places the months after an event at the center of preventive care (2).

Emergency medical services (EMS) attend a large share of these events, and diabetes-related activations accounted for 2.3% of all EMS activations across 23 US states in 2015 (4). In Victoria, Australia, paramedics attended 12,411 hypoglycemia events in people with diabetes over 3 years, and most of these events ended without transport to hospital (5). Protocols guiding this decision differ widely, and a structured review of US EMS protocols found that only 49% permitted non-transport once hypoglycemia had been corrected (6). In the Victorian data, transport was more likely at the extremes of age, in type 2 diabetes, and in the presence of comorbidity, and the authors described the burden of the remaining home-managed events as unrecognized in hospital statistics (5).

Clinical guidance calls for review of glucose-lowering therapy and patient education after a severe episode, so the days after an EMS call form a natural point for intervention (1). An earlier systematic review of post-hypoglycemic safety in the prehospital setting located no high-quality research on repeat events among patients taking oral agents who were left at home, relying instead on case reports of repeat or prolonged hypoglycemia (7). Variation in protocols means that the advice and onward care a patient receives after release depend largely on local policy, including whether any follow-up is arranged at all (6). The present systematic review therefore synthesized evidence on patient education, referral, and follow-up after EMS-treated severe hypoglycemia in adults, together with recurrence and repeat emergency contact after the encounter, to inform the design of post-encounter care pathways.

## Methods

### Protocol and eligibility

This review was conducted and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement. Eligible studies enrolled adults (lower age limit 16 years) treated by EMS for hypoglycemia, and EMS attendance was taken to meet the definition of severe hypoglycemia. Studies had to report at least one post-encounter outcome: EMS-delivered education or advice, referral or contact with diabetes care, content of follow-up care, recurrence, repeat EMS or emergency department (ED) contact, or patient experience. Randomized, non-randomized, cohort, cross-

16/11/2026

sectional, and qualitative studies in English were eligible; reviews, case reports, conference abstracts, and studies of patients without diabetes or limited to on-scene treatment, transport decisions, or mortality were excluded.

**Search strategy**

PubMed, Scopus, and Web of Science were searched from inception to 31 October 2026. The strategy joined, with AND, MeSH terms and free-text words for hypoglycemia, for EMS (ambulance, paramedic, prehospital), and for education or follow-up (education, advice, leaflet, referral, follow-up, recurrence, repeat, non-transport, non-conveyance, refusal). Field tags were adapted to TITLE-ABS-KEY in Scopus and TS in Web of Science.

**Study selection**

After duplicate removal, two authors independently screened titles, abstracts, and full texts, resolving disagreements by discussion. The search identified 243 records in PubMed, 211 in Scopus, and 215 in Web of Science (total n = 669), and 155 duplicates were removed. Of 515 records screened, 477 were excluded on title and abstract, 38 reports were sought, 3 were not retrieved, and 35 were assessed in full text. Seventeen reports were excluded for no eligible post-encounter outcome (n = 8), conference abstract (n = 4), review design (n = 3), mortality as the only outcome (n = 1), and a population without diabetes (n = 1), leaving 18 reports of 17 cohorts (Figure 1).

**Data extraction and risk of bias**

Two authors independently extracted design, sample, EMS model, education or follow-up component, follow-up window, and outcomes into a piloted form. The same authors assessed risk of bias with the Newcastle-Ottawa Scale (NOS) for cohort and cross-sectional studies (7-9 stars low, 5-6 moderate, 0-4 high risk), ROBINS-I for non-randomized intervention studies, RoB 2 for the randomized trial, and the JBI checklist for qualitative research. Disagreements were settled by consensus (Table 1).

**Synthesis**

Meta-analysis was not undertaken because designs, follow-up windows, and outcome definitions differed widely. Findings were grouped into EMS-delivered education and referral, follow-up care, and recurrence or repeat contact. Results were summarized narratively and in tables, and risk of bias informed interpretation.

**Results**

**Study characteristics**

The 18 reports (Tables 2 and 3), published between 1998 and 2024, described 17 cohorts, as two reports drew on one Upper Midwest cohort (24,25). Six studies came from the United Kingdom (14,16,17,20,21,23), four from Canada (11,13,18,22), four cohorts from the United States (8,9,12,24), two from Denmark (10,15), and one from Australia (19). Designs comprised 13 cohort reports, one cross-sectional study, two non-randomized intervention studies, one qualitative study, and one randomized controlled trial (RCT) (16,20-23). Non-transport after on-scene treatment ranged from 31% to 86% (17,18).

**Education and referral by EMS**

In Yorkshire, all 38 patients referred to a diabetes specialist nurse (DSN) team received telephone review, and 79% needed a clinic appointment (14). In the East of England, crews gave every patient written information, and 72.1% of 2,000 calls led to education within a median of 5 days (17). A booklet given with crew advice to 4,825 East Midlands patients halved the odds of repeat attendance (odds ratio [OR] 0.50, 95% confidence interval [CI] 0.33-0.76) and raised care bundle completion from

16/11/2026

63% to 71% (20). In the RCT, 90% of patients referred to a DSN had a documented consultation within 4 weeks against 65% of those referred to their general practitioner (GP), though missing data prevented formal testing (23). Approaches that depended on patient action performed less well, as a prompt card with an NHS 24 call reached full delivery in 36% of cases without raising follow-up (16), and an Ontario electronic referral program yielded 133 referrals and 50 attended sessions (22). In Northern Ireland, paramedics referred 40.4% of 418 calls to community diabetes teams, and under 5% of referred patients re-contacted the service within 3 days (21).

**Follow-up care**

In the Upper Midwest cohort, hypoglycemia was discussed at 11.5% of encounters without transport or outpatient care and at 98% among hospitalized patients with outpatient follow-up (25). In Halifax, most non-transported patients did not follow up with their physician (13). In Copenhagen, poor adherence to diabetes treatment instructions was often involved in recurrent episodes after release (10).

**Recurrence and repeat contact**

Short-term recurrence after release was 6.1% within 48 hours in Milwaukee (9), 9% within 3 days in Philadelphia (8), under 5% within 72 hours in Copenhagen (10), and 5.8% within 24 hours in a second Danish cohort (15). In Ottawa, 5.4% of 791 patients had repeat prehospital or ED access within 72 hours, unrelated to refusal of transport (adjusted OR 1.1) (18). Thirty-day recurrence reached 22.8% among non-transported against 10.6% among transported patients (OR 0.58) (24), and 10.7% of 505 Victorian adults had a further EMS-attended episode within 3 months (19). Repeat calls made up 36.4% of East of England calls (17), and 32% of trial participants had a repeat call-out within 12 months (23).

**Risk of bias**

Of 14 NOS-rated reports, seven carried low, four moderate, and three high risk of bias, mainly from absent adjustment for confounding (8-15,17-19,21,24,25). The stepped-wedge study carried moderate and the historical-control study serious risk, while the RCT carried high risk from missing outcome data (16,20,23). The qualitative study met seven of ten JBI criteria (22).

16/11/2026

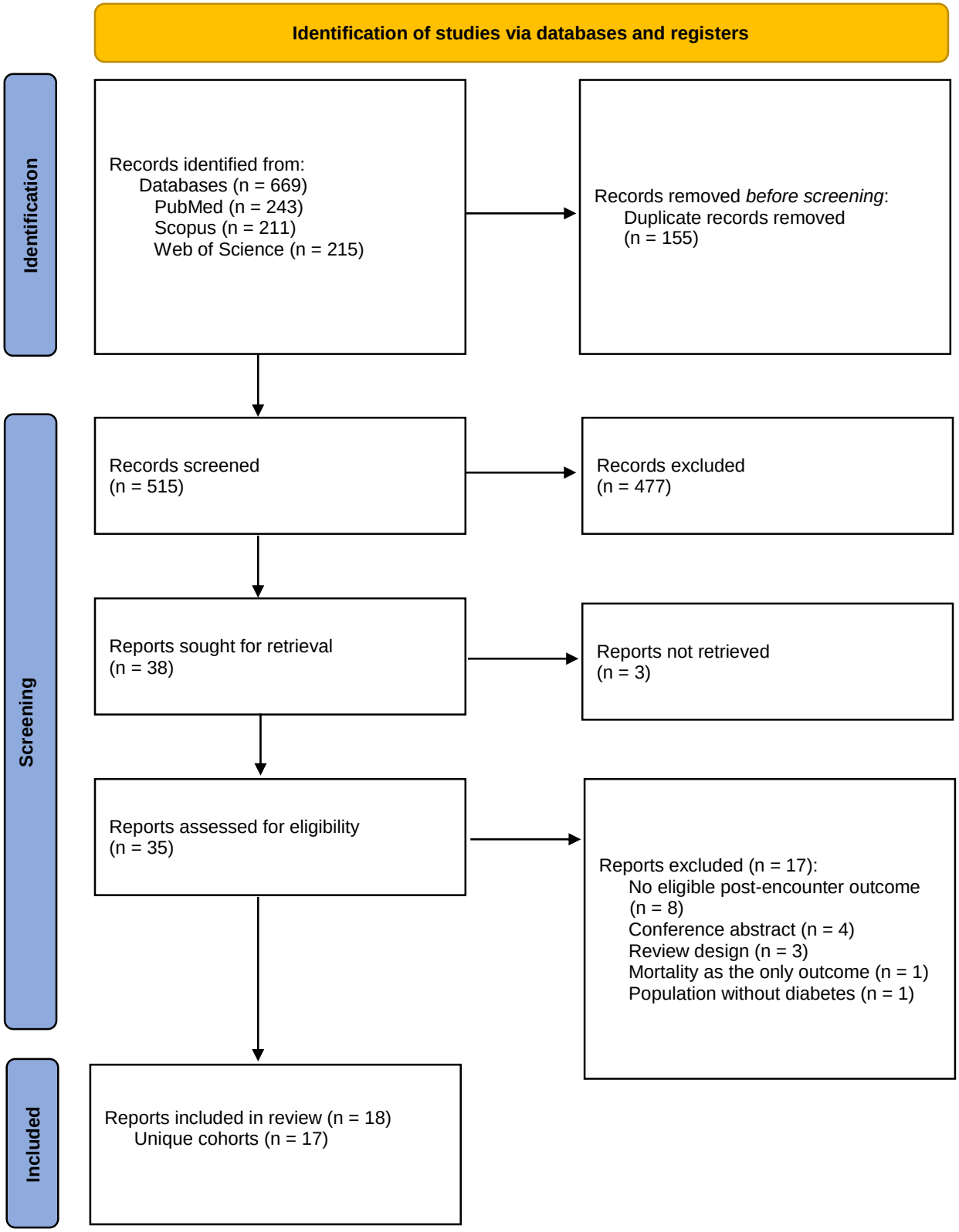



*Figure 1: PRISMA flow chart*

16/11/2026

**Table 1. Risk of bias of included studies**

| Study | Tool | Domain judgements | Overall risk |
|---|---|---|---|
| Mechem 1998 (8) | NOS | S3, C0, O1 (4/9) | High |
| Socransky 1998 (9) | NOS | S4, C0, O3 (7/9) | Low |
| Anderson 2002 (10) | NOS | S4, C0, O3 (7/9) | Low |
| Carter 2002 (11) | NOS | S4, C0, O1 (5/9) | Moderate |
| Lerner 2003 (12) | NOS | S2, C0, O1 (3/9) | High |
| Cain 2003 (13) | NOS | S4, C0, O2 (6/9) | Moderate |
| Walker 2006 (14) | NOS | S2, C0, O2 (4/9) | High |
| Hatting 2015 (15) | NOS | S4, C0, O3 (7/9) | Low |
| Duncan 2016 (16) | ROBINS-I | D1 S, D2 M, D3 M, D4 S, D5 S, D6 M, D7 M | Serious |
| Sampson 2017 (17) | NOS | S3, C0, O3 (6/9) | Moderate |
| Sinclair 2019 (18) | NOS | S4, C1, O3 (8/9) | Low |
| Villani 2019 (19) | NOS | S3, C2, O2 (7/9) | Low |
| Botan 2021 (20) | ROBINS-I | D1 M, D2 L, D3 M, D4 M, D5 L, D6 M, D7 L | Moderate |
| Bloomer 2021 (21) | NOS | S3, C0, O3 (6/9) | Moderate |
| Liu 2021 (22) | JBI | 7/10 items met | Moderate |
| Willis 2022 (23) | RoB 2 | D1 SC, D2 SC, D3 H, D4 SC, D5 SC | High |
| Myers 2022 (24) | NOS | S4, C2, O2 (8/9) | Low |
| Rode 2024 (25) | NOS | S4, C1, O2 (7/9) | Low |
| NOS: S, selection (0-4); C, comparability (0-2); O, outcome (0-3). ROBINS-I (D1-D7) and RoB 2 (D1-D5) domains follow the published tools. L, low; M, moderate; S, serious; SC, some concerns; H, high. | | | |

**Table 2. Characteristics of included studies**

| Study | Country | Design | Sample | Education or follow-up component |
|---|---|---|---|---|
| Mechem 1998 (8) | USA | Prospective cohort | 132 refusers | Nurse call at 3 days |
| Socransky 1998 (9) | USA | Retrospective cohort | 571 calls | Record review at 48 h |
| Anderson 2002 (10) | Denmark | Retrospective cohort | 1,148 patients | MICU release; registry review at 72 h |
| Carter 2002 (11) | Canada | Telephone survey cohort | 100 patients | Telephone survey at 3 days |
| Lerner 2003 (12) | USA | Prospective cohort | 36 patients | Discharge instructions; call at 24 h |

16/11/2026

| Study | Country | Design | Sample | Education or follow-up component |
|---|---|---|---|---|
| Cain 2003 (13) | Canada | Prospective cohort | 220 calls | Repeat calls and physician visits |
| Walker 2006 (14) | UK | Service evaluation | 38 patients | Crew referral to DSN team |
| Hatting 2015 (15) | Denmark | Retrospective cohort | 138 cases | MECU release; 30-day record review |
| Duncan 2016 (16) | UK | Historical-control cohort | 205 patients | Prompt card plus NHS 24 call |
| Sampson 2017 (17) | UK | Service evaluation | 2,000 calls | Written information; referral to educators |
| Sinclair 2019 (18) | Canada | Retrospective cohort | 791 patients | Record linkage at 72 h |
| Villani 2019 (19) | Australia | Prospective cohort | 505 adults | Telephone calls at 1 and 3 months |
| Botan 2021 (20) | UK | Stepped wedge | 4,825 patients | Booklet with crew advice |
| Bloomer 2021 (21) | UK | Cross-sectional | 418 calls | Referral to community diabetes teams |
| Liu 2021 (22) | Canada | Qualitative | 14 patients | Electronic referral for education |
| Willis 2022 (23) | UK | RCT | 162 patients | DSN telephone pathway vs GP referral |
| Myers 2022 (24) | USA | Retrospective cohort | 1,028 adults | Record linkage to 30 days |
| Rode 2024 (25) | USA | Retrospective cohort | 1,028 adults | Content of care within 7 days |

**Table 3. Follow-up outcomes of included studies**

| Study | Window | Main findings |
|---|---|---|
| Mechem 1998 (8) | 3 days | 9% recurrence; 1 death |
| Socransky 1998 (9) | 48 h | Relapse 6.1% (refusers) vs 4.4% (transported) |
| Anderson 2002 (10) | 72 h | 84% released; <5% secondary hypoglycemia |
| Carter 2002 (11) | 3 days | 68% refused transport; similar repeat care |
| Lerner 2003 (12) | 24 h | 91% without complications; 85% very satisfied |
| Cain 2003 (13) | 48 h and later | Repeat episodes 27.6% vs 22.7%; most skipped physician follow-up |
| Walker 2006 (14) | Not stated | 100% telephone review; 79% clinic review |
| Hatting 2015 (15) | 30 days | 50% released; 5.8% needed care within 24 h |

16/11/2026

| Study | Window | Main findings |
|---|---|---|
| Duncan 2016 (16) | Linked records | Full delivery 36%; follow-up unchanged |
| Sampson 2017 (17) | Median 5 days | 72.1% educated; 36.4% repeat calls |
| Sinclair 2019 (18) | 72 h | Repeat access 5.4%; refusal not predictive |
| Villani 2019 (19) | 3 months | Recurrence 10.7% |
| Botan 2021 (20) | 26 months | Repeat attendance OR 0.50 |
| Bloomer 2021 (21) | 3 to 30 days | 40.4% referred; <5% re-contact at 3 days |
| Liu 2021 (22) | 18 months | 133 referrals; 50 attended |
| Willis 2022 (23) | 4 weeks; 12 months | Consultation 90% vs 65%; repeat call-out 37% vs 28% |
| Myers 2022 (24) | 30 days | Recurrence 22.8% vs 10.6% (OR 0.58) |
| Rode 2024 (25) | 7 days | Hypoglycemia discussed 11.5% to 98% |

**Discussion**

This review found that structured follow-up after EMS-treated severe hypoglycemia is limited, and that the content of later care depends on whether patients reach hospital or outpatient services (13,25). Short-term recurrence after release was uncommon, which supports the safety of treat-and-release practice within the first 72 hours (9,10,18). Recurrence over the following month was about twice as frequent among non-transported patients, which points to the weeks after the event as the period in which follow-up matters most (24).

Nationally, about 43% of 270,945 US hypoglycemia EMS incidents ended without transport, so many events never enter hospital-based follow-up (26). In Ontario, 24.4% of 9,185 paramedic calls ended in refusal of transport, leaving a follow-up gap because diabetes physicians are often unaware of these events (27). A similar gap appears in specialist clinics, where 71% of self-reported severe episodes in adults with type 1 diabetes involved an ambulance while therapy change and specialist review were uncommon (28). Even after an ED visit or hospitalization, sulfonylurea or insulin therapy was deintensified within 100 days in fewer than half of episodes among older adults (29). Glucagon was prescribed to only 22.4% of 9,200 high-risk adults in one health system, mirroring the rare prescribing after EMS calls (25,30).

Active referral models produced the strongest engagement, with contact rates of 72% to 100% when a nurse or educator initiated contact (14,17,23). By contrast, strategies that relied on patients to self-refer or to attend a booked session achieved low uptake (16,22). The East Midlands booklet combined low cost with crew advice and reduced repeat attendance across a whole ambulance service (20). These findings agree with evidence that structured education in flexible insulin therapy is the first step in restoring hypoglycemia awareness, a condition linked to a sixfold higher risk of severe hypoglycemia (31). The Endocrine Society guideline recommends easier-to-use glucagon formulations and, conditionally, real-time continuous glucose monitoring for people at high risk, and an EMS-triggered review offers an early point to start both (32).

Twelve-month mortality after community-treated severe hypoglycemia reached 22.1% in people with type 2 diabetes in a UK cohort, which marks the EMS

16/11/2026

call as a sign of high-risk status (33). Ambulance services and diabetes teams therefore need a direct handover, written self-management advice at the scene, and a review within days of the event (17,20). An earlier rapid review reached a similar view, reporting that repeat episodes rarely occur in the acute phase and that evidence on how referral pathways are built remains limited (34).

This review applied design-specific risk of bias tools and examined education, referral, and recurrence together across five countries (8-25). Most cohorts were observational and unadjusted, and outcome windows ranged from 24 hours to 12 months, which prevented pooling (12,23). Several outcomes relied on records from a single ambulance service or health system, so events managed elsewhere went undetected (21,24). The randomized trial retained only half of its participants at full consent, which limits causal inference about nurse-led pathways (23).

## Conclusion

Follow-up after EMS-treated severe hypoglycemia in adults is inconsistent, and many patients released at the scene never reach their usual diabetes team. Recurrence in the first 72 hours is low, while recurrence over the following month is about twice as high among non-transported patients. Referral models in which a nurse or educator contacts the patient achieve high engagement, and a structured booklet with crew advice reduces repeat attendance. Ambulance services and diabetes teams need shared pathways that combine written advice at the scene with active outreach within days. Adequately powered trials are needed to confirm effects on recurrence.

## List of Abbreviations

ADVANCE, Action in Diabetes and Vascular Disease: Preterax and Diamicron Modified Release Controlled Evaluation; CI, confidence interval; DSN, diabetes specialist nurse; ED, emergency department; EMS, emergency medical services; GP, general practitioner; JBI, Joanna Briggs Institute; MECU, mobile emergency care unit; MeSH, Medical Subject Headings; MICU, mobile intensive care unit; NHS, National Health Service; NOS, Newcastle-Ottawa Scale; OR, odds ratio; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; RCT, randomized controlled trial; RoB 2, Cochrane Risk of Bias tool for randomized trials, version 2; ROBINS-I, Risk Of Bias In Non-randomized Studies of Interventions; UK, United Kingdom; US/USA, United States.

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16/11/2026

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16/11/2026

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16/11/2026

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16/11/2026