Brief in Person Interventions for Adolescents and Young Adults Following Alcohol-Related Events in Emergency Care: A Systematic Review and European Evidence Synthesis

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Key Words

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Abstract

Background: Increasing numbers of youth in need of emergency medical treatment following alcohol intoxication have been a major public health concern in Europe in recent years. Brief interventions (BIs) in the emergency department (ED) could prevent future risky drinking. However, effectiveness and feasibility of this approach are currently unclear. **Method:** A systematic literature search on controlled trials including participants aged 12–25 years treated in an ED following an alcohol-related event was conducted. Additionally, a grey literature search was conducted to support findings from the systematic review with evidence from practice projects and uncontrolled trials. Data on effectiveness, acceptance, implementation and reach were extracted. **Results:** Seven randomised controlled trials (RCT), 6 practice projects, 1 non-randomised pilot study and 1 observational study were identified. Six RCTs found reductions of alcohol use for all participants. Four RCTs found effects on alcohol consumption, alcohol-related risk-behaviour or referral to treatment. Participation and referral rates varied strongly, whereas data

on acceptance and implementation were rarely assessed. **Conclusion:** Heterogeneity of study designs and effects limit conclusions on effectiveness of BIs for young ED patients following an alcohol-related event. However, the number of practice projects in Europe indicates a need perceived by practitioners to address this population.

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Introduction

Adolescents in Europe start alcohol use and heavy use at an early age with 47% of European students report having been drunk at least once in their lifetime before the age of 15 to 16 [1]. Episodes of heavy drinking, that is, consumption of 5 (4 for girls) or more standard drinks on one occasion (binge drinking) [2], in the past 30 days are reported by 39% of 15- to 16-year-old European school children [1], a considerably higher prevalence than in the United States with 16% in the equivalent age group [3]. Recently, rising numbers of adolescents in need of emergency medical treatment due to acute alcohol intoxication (AAI) have attracted public attention in a number of European countries including Germany [4], the United Kingdom [5], Austria [6], Switzerland [7], the Netherlands [8], Croatia [9], Bulgaria [10] and the Slovak Republic

[11]. While adolescent drinking patterns such as the prevalence of alcohol use and binge drinking in the past 30 days and quantity of alcohol consumption on the latest drinking day vary considerably across European countries, alcohol-related hospitalisations do not vary as strongly across the different countries. An average of 3% (SD = 1.4) of 15- to 16-year-old students in Europe report having been hospitalised or admitted to an emergency room as a result of their alcohol use in the past 12 months [1].

Heavy episodic drinking at a young age is related to a number of negative short-term consequences such as violence (as a victim or perpetrator), unwanted or regretted sexual activities, drinking and driving as well as engagement in other risk behaviours increasing the likelihood of serious injuries [12–14]. Conflicts with parents, peers, teachers and police are often observed if heavy episodic alcohol consumption persists [15, 16]. Apart from short-term consequences repeated binge drinking episodes at an early age are associated with an increased risk of experiencing alcohol-related problems [12], impairments of neurocognitive functions [17, 18] and the development of an alcohol-related disorder later in life [19, 20].

In order to address the rising numbers of adolescent AAI patients in ED, some EDs in Europe have introduced brief interventions (BI) delivered before discharge from hospital [6, 7]. In Germany, the alcohol prevention project HaLT-Hart am Limit ('Stop – close to the limit') was developed to address the target population of underage AAI patients and 1 element of this project is the delivery of BIs in ED. The project is currently implemented at more than 170 locations nationwide [21]. However, effectiveness and feasibility of this approach are currently unclear.

Although a number of systematic reviews have addressed the effectiveness of BIs in the ED with mixed to positive results [22–24], only little is known about the effectiveness of BIs in ED for adolescents and young adults. Wachtel and Staniford [25] conducted a critical literature review on the effectiveness of BIs for adolescents in the clinical setting with inconclusive results. However, of the 14 studies included in the review only 4 were conducted in an ED. A systematic review by Yuma-Guerrero and colleagues [26] reviewed trials on BIs in ED targeting adolescent at-risk drinkers identified through screening. Four of the 7 included studies found significant intervention effects on at least 1 outcome related to alcohol consumption or consequences of alcohol use. However, the authors conclude that evidence is not clearly supporting effectiveness of screening, brief intervention and referral to treatment for this target population.

A first attempt to review evidence for effectiveness of BIs specifically targeting adolescents in the ED following an alcohol-related event was realized by Ahmed [27]. The rationale behind addressing patients following an alcohol-related event is that enhanced effectiveness of alcohol interventions was found for patients who attributed the need for ED treatment to their preceding alcohol consumption [28, 29]. The alcohol-related hospitalisation is assumed to create a teachable moment for alcohol interventions [29, 30]. Ahmed and Mackway-Jones [27] reported findings of 2 US-American [31, 32] and 1 Australian trial [33]. The author interpreted findings as generally supporting effectiveness of BIs in this context. A recent systematic review by Newton et al. [34] analysed a subset of 4 trials evaluating 'targeted' interventions (i.e. addressing adolescents whose ED visit was preceded by alcohol use) for adolescents in the ED. The authors conclude that targeted BIs did not yield clear benefits with regard to a reduction of alcohol use or alcohol-related problems. However, the small number of randomized-controlled trials (RCT) examined in these reviews limit conclusions that can be drawn. From a European perspective, it is also problematic that existing evidence is exclusively derived from US-American trials and one Australian trial [27, 34]. Different drinking patterns in adolescence as well as differences in health care systems and cultural contexts impose considerable concern as to whether results can be generalized to the European situation [1, 35].

Therefore, the aim of this literature review is to broaden the evidence base for BIs targeting adolescents and young adults following an alcohol-related event by including non-Anglo-Saxon evidence and evidence going beyond effectiveness such as parameters indicative of acceptance, participation and implementation. In doing so, we aim at providing an overview over the effectiveness, feasibility and current practice of BI delivery to adolescent and young adult ED patients following alcohol-related events in Europe. We used 2 strategies to achieve this. First, in contrast to existing reviews [26, 34], we conducted a systematic literature search on controlled trials addressing this population without applying language restrictions, thereby allowing identification of studies published in European languages other than English. In order to broaden the evidence base for BIs for this target group, we also included non-randomised controlled trials with other allocation methods (e.g. investigator assigns participants to groups) in the search. At the same time, we addressed the problem of methodological heterogeneity as reported in previous reviews [26, 34] by focusing our

search on BIs delivered in person. The problem of heterogeneity in study populations was addressed by focusing the search on BIs targeting adolescents in the presumed teachable moment of hospitalisation as a result of an alcohol-related event. Second, additional European evidence was sought stemming from other sources such as best practice reports, government documents or reports of uncontrolled trials. This approach follows the concept of a rapid evidence synthesis [36]. Originally developed as a tool for supporting policy makers' decision making, rapid evidence synthesis is an emerging method synthesizing a broad spectrum of evidence on a specific topic allowing for nonintervention studies to be included [36]. As a result, information on feasibility, implementation, process of intervention delivery, acceptance and receipt by patients and involved stakeholders are considered in order to support evidence from systematic reviews and meta-analyses [5, 37]. In order to provide an overview over effectiveness, feasibility and current implementation of this approach from a European perspective, it is useful to combine these 2 strategies. While the systematic review mainly provides evidence regarding effectiveness, the additional European evidence synthesis informs on feasibility and current implementation and therefore adds important dimensions for programme evaluation [38].

Method

First, we conducted a systematic review following the standards for reporting systematic reviews as put forward in the PRISMA statement [39]. In a second step, a grey literature search was conducted.

Systematic Review

Search Strategy

The literature search was conducted between May 5 and May 29, 2012 and was updated by e-mail alerts (Medline, CINAHL, Web of Science) up until October 20, 2014. The databases Medline, EMBASE, PubMed, Science Citation Index Expanded and Social Sciences Citation Index (Web of Science), PsycInfo, Database of Abstracts of Reviews and Effects (DARE), CINAHL, Cochrane Clinical Trials and Cochrane Database of Systematic Reviews, Psynex and Current Controlled Trials were searched for relevant records. The searches were not limited to a specific range of publication years and no language restrictions were applied.

Search terms for the study population were 'adolescen*', 'child*', 'youth' and 'young' each combined by the Boolean operator 'OR'. Search terms for the intervention were 'intervention', 'brief intervention', 'early intervention', 'psychotherapy, brief' each combined by 'OR'. The study outcomes were addressed by the search terms 'alcohol*', 'substance', 'ethanol', 'binge drinking', 'at-risk drinking', 'problem drinking', 'high-risk drinking', 'risky drinking', 'alcohol drinking', 'alcohol-related disorders' and 'alcoholic intoxication', again combined by 'OR'. The setting was ad-

ressed by the search terms 'hospital*', 'emergency department', 'emergency care', 'emergency service', 'hospital', 'emergency medical services', 'emergency medicine', 'emergency treatment', 'hospital department' and 'emergency services, psychiatric' combined by 'OR'. In a final step, all search results for the searches 'population', 'intervention', 'outcome' and 'setting' were combined by 'AND' to retrieve the relevant list of records.

In addition, we reviewed reference lists of relevant studies and systematic reviews to identify relevant publications that could have been missed in the systematic search process. Moreover, we reviewed conference proceedings to identify unpublished studies and the Current Controlled Trials database for trials with unpublished results.

Inclusion Criteria and Study Selection

We considered studies as relevant, if a BI was delivered to patients aged 25 years and younger treated for an alcohol-related event in the ED. The age range was chosen to cover the periods of adolescence and emerging adulthood as described by Arnett [40]. Records identified in the database searches and hand searches were screened for the following inclusion criteria:

- Study participants are aged between 12 and 25 years and are treated in an emergency care setting (inpatient or outpatient) following an alcohol-related event;
- The intervention is a brief intervention (maximum 60 min) consisting of a maximum of 3 sessions with a minimum of 1 session delivered in the ED;
- The intervention is focused on alcohol use and is delivered in person;
- The control condition consists either of no treatment, standard care, an intervention other than a BI or a BI of different intensity;
- Outcome measures address 1 or more of the following: alcohol consumption, alcohol-related risk behaviours, alcohol-related negative consequences and/or seeking of further alcohol treatment or counselling;
- The study design is a controlled trial with 1 or more follow-up assessments.

Two reviewers (SD, MD) independently screened titles and abstracts with regard to inclusion criteria and rated records whether they were clearly relevant (i.e. met all inclusion criteria) or clearly not relevant. If raters were indecisive or had reached different conclusions, consensus was obtained by discussion involving all authors. Where necessary, authors were contacted to provide additional information to aid the selection process.

Data Extraction and Quality Assessment

Two reviewers (SD, MD) independently conducted the extraction of data from the selected studies using a checklist that was developed on the basis of the Cochrane EPOC Data Collection Checklist [41]. Data were extracted with regard to the following aspects:

- Sample characteristics: sample size, age range, mean age, gender;
- Inclusion criteria for study participation;
- Study design and follow-up assessment points;
- Elements and duration of intervention and control condition;
- Interventionists' professional background, training and supervision;
- Outcomes;
- Participation rates, loss to follow-up, acceptance, implementation.

Any disagreement between raters was discussed and resolved by consensus. The methodological quality of the selected studies was assessed using the Cochrane Collaboration's tools for assessing risk of bias [42]. Two independent reviewers (SD, MD) conducted data extraction and again any disagreements were discussed and resolved by consensus involving all authors.

Additional Evidence Synthesis

Search Strategy

In order to collect additional evidence for effectiveness and feasibility of BIs in this context stemming from uncontrolled trials, best practice reports, government documents or press releases, web-based searches with the search engine 'google' were conducted using the keywords 'alcohol', 'alcohol intoxication', 'adolescents', 'underage', 'minor', 'emergency department', 'brief intervention' in combination with names of European countries. This search was repeated with keywords translated into the four most-spoken languages in the EU next to English, that is, German, French, Spanish and Italian. The first 10 pages of results of each search were screened for records meeting the inclusion criteria. Additionally, in order to collect information on projects not represented on the Internet or taking place in a country with a language not covered in our web search, researchers from 9 European countries (Sweden, the Netherlands, Czech Republic, Ireland, Catalonia, Great Britain, Switzerland, Croatia, France) who had published on relevant topics were contacted in person or by e-mail and asked if they could provide information on research or practice projects regarding ED-based BIs targeting adolescents following alcohol-related events in their respective countries. Additionally, search results of the systematic literature search were screened for relevant publications such as BI studies not conducted in a controlled design or reports on practice projects.

Inclusion Criteria

Records were included if they met the following criteria:

- Patients are aged between 12 and 25 years and are treated in an emergency care setting (inpatient or outpatient) following an alcohol-related event;
- The intervention is a brief intervention (maximum 60 min) consisting of a maximum of 3 sessions with a minimum of 1 session delivered in the ED;
- The intervention is focussed on alcohol use and is delivered in person;
- Reported information addresses 1 or more of the following: participation rates, acceptance, implementation and intervention effects on alcohol use, alcohol-related harm and referral to treatment.

Data screening and consensus procedures were equivalent to the procedure described earlier. Where necessary, authors were contacted to provide additional information to aid the selection process.

Data Extraction

Data were extracted on participation rates, acceptance, implementation, intervention content, facilitator's vocational background and intervention effects on alcohol use, alcohol-related harm and referral to treatment. Two independent reviewers (SD, MD) conducted data extraction and again any disagreements were resolved by consensus.

Results

Search Results Systematic Review

A total of 1,846 records were retrieved through database searches and an additional 9 records were identified through hand searches. The inclusion process is displayed in a flow chart according to the PRISMA statement [39] (fig. 1). Two reviewers (SD, MD) independently screened abstracts with an inter-rater agreement of 94.5%. A total of 1,445 records were excluded after screening of the abstracts, because they were clearly irrelevant. After removal of duplicates, a total of 236 full texts were retrieved. Records were excluded if they did not report on a controlled trial ($n = 83$), study participants did not meet the age range of 12–25 years ($n = 70$), the study did not take place in an ED ($n = 50$), the intervention was not focussed on alcohol use ($n = 17$) or study participants were not hospitalised as a result of an alcohol-related event (but for instance, identified through a positive alcohol screening) ($n = 46$). Another 16 records were excluded because they were secondary analyses of data reported in another publication. One of the 9 records identified through hand search was a conference abstract [43] describing a relevant study that could be retrieved online through a 'google' search [44]. A total of 7 studies met all inclusion criteria [31–33, 44, 46–48]¹.

Description of Included Studies

The 7 included studies were all randomized controlled trials of which 4 were conducted in the United States, 1 in Australia, 1 in Brazil and 1 in Germany.

Participants. Included studies represented a total sample size of 1,125, ranging from a minimum of 94 [32] to a maximum of 254 [44] participants. All except one study showed similar patterns of gender distribution with a weighted mean of 60.2% of participants being male. The study sample in Segatto et al. [46] represented an exception with 90.3% male participants (table 1).

Inclusion Criteria. All studies required self-reported alcohol use within 6 h prior to hospitalisation or alcohol use having led to hospitalisation as the central inclusion criteria. One study [47] additionally included individuals who screened 8 or higher on the Alcohol Use Disorders Identification Test (AUDIT) (23.7% of the total sample). Another study also included adolescents who presented to the ED following a drug-related event [33]. However,

¹ Data for [33] were also extracted from Tait et al. [45] where 4 months outcomes for the same trial were reported.

Fig. 1. Inclusion flowchart of studies for the systematic review according to the PRISMA statement (* multiple entries possible).

the majority (77%) of the sample reported having used alcohol prior to the ED visit.

Intervention Conditions. All interventions took place in the ED before discharge and lasted between 30 and 60 minutes. One study delivered 2 additional sessions, 1 addressing adolescents and parents together and 1 addressing parents only [48]. Of the remaining 6 studies, 1 reported offering counselling to parents in addition to the BI for the patients [44]. Six studies [31, 32, 44, 46–48] tested the effectiveness of a brief motivational intervention (BMI), thereby applying an approach based on the principles of motivational interviewing (MI) [49]. In 6 of the 7 studies, the primary intervention goal was harm reduction with regard to alcohol use, whereas 1 study [33] primarily targeted motivating patients to seek further alcohol-related treatment. Interventionists were either trained counsellors and psychologists [44, 46–48] or research staff [31–33] most of whom had received special training in MI [31, 32, 44, 46–48] with durations ranging from 15 h [48] to 30 h [47]. In 4 studies, interventionists additionally attended regular clinical supervisions [31, 32, 47, 48]. Some studies provided additional booster sessions by telephone [33, 47], online [44] or in person [48]. Frequency and durations varied from one booster with a duration not recorded [33] to two 20–30 min telephone

boosters including assessment and counselling [47] to 3 weekly web-based boosters lasting 10 min each [44].

Control Conditions. Five studies had minimal active control groups such as standard care [31–33], educational brochures [46] or feedback only [47]. Two studies compared a BI with an enhanced BI, that is, with an individual-level intervention plus family intervention [48] and an individual-level intervention plus computer-delivered exercises based on drinking motives, respectively [44].

Methodological Quality of Included Studies

The methodological quality of included studies assessed according to the Cochrane Collaboration's tools for assessing risk of bias [42] indicated reasonable to good quality (table 2).

Search Results Additional Evidence Synthesis

A total of 8 publications were identified containing additional information on BIs delivered to adolescent ED patients following an alcohol-related event of which 5 reported on projects or studies conducted in Germany, 2 in Austria and 1 in Switzerland (table 3). Four publications were retrieved from screening publications excluded from the systematic review. Three of those reported on practice projects [6, 7, 50] and 1 on the evaluation of a

Table 1. Characteristics of studies included in systematic review

Author, year, country	Sample size (% male); age range (mean age)	Study inclusion criteria	Study design; follow-ups	Intervention	Control condition
<i>Trials with minimal active control condition</i>					
Monti et al. (1999), USA	n = 94 (64); 18–19 (18.4)	Positive BAC or self-reported alcohol consumption that caused hospitalisation	RCT; 3, 6 months	MI (35–40 min) plus standard care (handout on drinking and driving, list of treatment agencies)	Standard care (5 min), handout on drinking and driving, list of treatment agencies
Segatto et al. (2011), Brazil	n = 175 (90.3); 16–25 (21.8)	Self-reported alcohol consumption related to the ED visit in the 6 h prior to hospitalisation	RCT; 3 months	MI plus educational brochure (45 min)	Educational brochure (5 min)
Monti et al. (2007), USA	n = 198 (67.7); 18–24 (20.5)	BAC >0.01%, or self-reported alcohol consumption in the 6 h prior to the event that caused hospitalisation or AUDIT score 8+	RCT; 6, 12 months	BMI (30–45 min), handouts on alcohol risks and treatment facilities, copies of feedback and worksheets, 2 telephone boosters consisting of assessment and counselling (20 min) at 1 month and assessment, counselling and feedback (25–30 min) at 3-month	Feedback only (1–3 min) handouts on alcohol risks and treatment facilities, copies of feedback, 2 telephone contacts consisting of assessment only (5–10 min) at 1 month and assessment plus feedback (10–5 min) at 3-month
Tait et al. (2005), Australia	n = 127 (55); 12–19 (16.7)	ED presentation involving AOD use. Identification 'through the ED information system and liaison with medical staff' (quote)	RCT; 4, 8, 12 months	BI (duration not recorded ^a) focussed on enhancing motivation for taking up further substance use treatment, 1 telephone booster	Standard care (duration not recorded ^b)
Spirito et al. (2004), USA	n = 152 (63.8); 13–17 (15.6)	Positive BAC or self-reported alcohol use in the 6 h prior to ED visit	RCT; 3, 6, 12 months	BMI (35–45 min)	Standard care (5 min)
<i>Trials with enhanced intervention control condition</i>					
Spirito et al. (2011), USA	n = 125 (46); 13–17 (15.4)	Positive BAC or self-reported drinking of alcohol in the 6 h before ED visit	RCT; 3, 6, 12 months	Individual BMI (45–60 min) plus family BMI (60 min family assessment, 60 min parent feedback), handout on substance use treatment agencies, 5 monthly brochures for parents	Individual BMI (45–60 min), handout on substance use treatment agencies, 5 monthly brochures for parents
Wurdak and Wolstein (2012), Germany	n = 254 (57.5); 14–17 (15.56)	Hospitalisation following alcohol intoxication	RCT; 1 month	Individual BMI plus drinking-motive based exercises on a tablet computer (10 min), parent counselling, 3 weekly drinking-motive based web-boosters (10 min each)	Individual BMI plus alcohol knowledge exercises on a tablet computer (10 min), parent counselling, 3 weekly alcohol knowledge web-boosters (10 min each)

eBI = Enhanced BI (i.e. individual plus family brief intervention); BAC = blood alcohol concentration.

^a Information obtained from written communication with author.

Table 2. Risk of bias assessed using the Cochrane Collaboration's tools for assessing risk of bias (Higgins and Green, 2011)

Bias	Author, year						
	Monti et al., 1999	Segatto et al., 2011	Monti et al., 2007	Tait et al., 2005	Spirito et al., 2004	Spirito et al., 2011	Wurdak and Wolstein, 2012
Random sequence generation (selection bias)	Low-risk Patients randomly assigned to groups	Low-risk Lottery system	Low-risk Quote: 'using a random numbers table'	Low-risk Quote: 'computer generated randomisation'	Low-risk Quote: 'using a random numbers table'	Low-risk Patients randomly assigned to groups	Low-risk Computer-generated randomisation
Allocation concealment (selection bias)	Unclear No information provided	Unclear No information provided	Unclear No information provided	Low-risk Quote: 'after the interview, an envelope containing a randomisation code (...) was opened'	Low-risk Quote: 'allocation was concealed in sealed envelopes' ^a	Low-risk Quote: 'condition assignments contained in sealed envelopes'	Low-risk Allocation was computer-generated during initial contact with participant
Blinding of participants and personnel (performance bias)	Unclear No information provided	High-risk Quote: 'patients were blinded to the intervention applied', personnel not blinded	Unclear No information provided	Unclear No information provided	High-risk Quote: 'participants were not blinded' ^a	Low-risk BI was conducted before randomisation to BI or eBI	High-risk Participants were blinded, facilitators were not blinded
Blinding of outcome assessment (detection bias)	Low-risk Quote: 'by research assistants who were unaware of treatment condition'	Low-risk Quote: 'applied by an independent researcher'	Low-risk Quote: 'by research assistants blind to intervention condition'	High-risk Outcome assessment not blinded; data on subsequent ED presentations were collected blind	Low-risk Quote: 'by research assistants who were blind to treatment group assignment'	Low-risk Quote: 'by research assistants who were masked to treatment group assignment'	Low-risk Computer-based assessment
Incomplete outcome data (attrition bias)	Unclear Completion rates: 93% (3-month), 89% (6-month); quote: 'no differential follow-up rates between groups or by gender'; ITT analysis; no information on balance of reasons for missing data across groups	Low-risk Completion rates: 85% (3-month); reasons for missing data reported in detail and balanced across groups	Unclear Completion rates: 83% (6-month), 81% (12-month); quote: 'completion rates (...) did not differ by gender or condition'; ITT analysis; no information on balance of reasons for missing data across groups	Low-risk Completion rates: BI: 53%, CG: 76% (4-month); significant differences in 4-month follow-up rates across groups (p < 0.01); no significant difference in 12-month follow-up completion rates across groups; BI 63%, CG 73%; balanced reasons for missing data across groups ^a ; ITT analysis	Unclear Completion rates: 93% (3-month), 89% (6-month), 89% (12-month); significantly different follow-up rates at 6-month follow-up (not significant at 3 and 12-month); no information on balance of reasons for missing data across groups	Unclear Completion rates: BI: 58% (12-month), eBI: 74% (12-month) Quote: 'there were no significant differences in follow-up rates between conditions'; no information on balance of reasons for missing data across groups	High-risk Completion rates: 40.7% (1 month), completion rates differed by frequency of high volume drinking and educational status; no information on balance of reasons for missing data across groups

Table 2. (continued)

Bias	Author, year						
	Monti et al., 1999	Segatto et al., 2011	Monti et al., 2007	Tait et al., 2005	Spirito et al., 2004	Spirito et al., 2011	Wurdak and Wolstein, 2012
Selective reporting (reporting bias)	Low-risk Published report includes all expected outcomes	Low-risk Published report includes all expected outcomes	Low-risk Published report includes all expected outcomes	Low-risk Published report includes all expected outcomes	Low-risk Published report includes all expected outcomes	Low-risk Published report includes all expected outcomes	Low-risk Published report includes all expected outcomes
Other biases (other bias)	Intervention effect and therapist effect cannot be differentiated as only 1 therapist conducted interventions						
eBI = Enhanced BI (i.e. individual plus family brief intervention); ITT = intent-to-treat. a Information obtained from written communication with author.							

project combining ED-based BIs with community-based prevention strategies [51]. The ‘google’ web search identified additional 3 publications. Two final reports to government bodies, 1 evaluating the dissemination of an alcohol prevention programme combining BIs in ED with community-based prevention [52] and 1 reporting on BIs in paediatric EDs in Berlin, Germany [53]. A press release on a practice project in an Austrian ED was also identified. After contacting project staff we were provided with an unpublished manuscript describing the project and its evaluation [54]. One additional publication was identified through personal communication with researchers, that is, a publication reporting on a pilot study not indexed in the 10 databases searched for the systematic review [55].

Description of Included Publications

With the exception of Stolle et al. [55], all publications report on BIs in the ED targeting those under 18 years and delivering a BI before discharge from hospital. Six publications reported on programmes already implemented into routine practice delivering BIs to adolescents following acute alcohol intoxication (AAI) [6, 7, 50, 52–54]. One publication reported on a pilot BI study with follow-up assessment at 6 months post intervention [55] and the remaining publication reported evaluation data on a project combining BIs in ED with community-based prevention strategies [51]. In this study, AAI prevalence was compared between a project region and a control region. Other publications did not include control conditions. Five of the publications [50–54] reported on the programme HaLT-Hart am Limit (‘Stop – close to the limit’) or adaptations thereof. Six publications reported that parents or caregivers were offered counselling as well when they arrived in hospital to pick up their child [6, 7, 50, 52–54]. A detailed description of publications is depicted in table 3.

Key Findings of Systematic Review and Additional Evidence Synthesis

Alcohol Consumption

All except one study [33] with follow-up assessments [31, 32, 44, 46–48, 55] observed reductions of alcohol consumption following the ED visit regardless of the form of care (table 4). Two studies found significant differences across conditions for alcohol consumption-based outcomes. Monti and colleagues [47] observed significantly greater reductions in the intervention group in the number of past-month drinking days at 6 ($F = 6.34$; $p = 0.01$) and 12-month follow-up ($F = 11.02$; $p \leq 0.001$) as well as the number of past-month heavy drinking days

Table 3. Characteristics and key findings of additional evidence synthesis

Author, year, country	Sample size (% male); age range (mean age)	Publication type; study design/content of publication	Study/project inclusion criteria	Follow-ups; loss to follow-up	Intervention; interventionists	Intervention effects on alcohol-related outcomes; referral rate	Participation rate; acceptance; implementation
Fandler et al. (2008), Austria	–; <18 (15.5)	Journal article; cross-sectional access-to-care sample characterisation and project description	Treatment in a paediatric ED following acute alcohol intoxication	No follow-up	BI addresses youth and caregivers, informs about consequences of underage alcohol use, AAI and youth protection law. Psychosocial risk factors are addressed in order to determine need for further treatment; psychologist (weekdays), medical doctor (weekends)	–; –	–; –; –
Cafilisch et al. (2013), Switzerland	356 (42%); 9.2–17.4* (14.9)*	Journal article; cross-sectional access-to-care sample characterisation and project description	Treatment in a paediatric ED following acute alcohol intoxication	No follow-up	BI with adolescents in ED and BI (30–45 min) with adolescent and caregivers within 10 days after ED visit addressing context and risks of AAIs, drinking patterns, consequences of underage drinking, parenting, goal setting, strategies for achieving drinking goals. Referral to youth-specific substance use counselling or psychiatric services if indicated; –	–; 88%	82.8%*; –; –
Müller et al. (2009), Germany	128 (55.5); <18 (15.5)	Journal article; cross-sectional access-to-care sample characterisation and project description	Treatment in an ED following acute alcohol intoxication	No follow-up	Youth and caregivers receive standardized BI (45 min), at-risk alcohol consuming youth are referred to a youth specific group programme; trained youth- and substance use counsellors	–; –	88.3%; –; –
Reis et al. (2009), Germany	182 (59); <18 (15.3)	Journal article; evaluation of a project combining BIs in ED with community-based alcohol prevention strategies by comparing AAI prevalence in 2 regions (experimental vs. control)	Treatment in an ED following acute alcohol intoxication	No follow-up	BI including MI elements addressing context and risks of AAIs, drinking patterns, consequences of underage drinking, goal setting, strategies for achieving drinking goals. Standardized psychiatric and substance use assessment resulting in referral to either detoxification, inpatient treatment, psychotherapy or experience-oriented group programme; child and adolescent psychiatrist	12-month AAI prevalence dropped by 20% in the experimental region and increased by 33% in the control region; –	83.1%; –; –
Fenzl et al. (submitted), Austria	175 (58); <18 (15.9)	Journal article; cross-sectional access-to-care sample characterisation and project description	Treatment in a paediatric ED following acute alcohol intoxication	3–4 months follow-up; –	BI for adolescents and caregivers addressing consequences of underage alcohol use, aiming at motivating to take up further treatment; ED staff members	–; 25.1%	21.7%; –; –

Table 3. (continued)

Author, year, country	Sample size (% male); age range (mean age)	Publication type; study design/content of publication	Study/project inclusion criteria	Follow-ups; loss to follow-up	Intervention; interventionists	Intervention effects on alcohol-related outcomes; referral rate	Participation rate; acceptance; implementation
Stolle et al. (2013), Germany	88 (48.9); <21 (16.4)	Journal article; pilot study with one intervention group, no control group	Treatment in an ED following acute alcohol intoxication	6-month follow-up; 11.4%	Semi-structured 40 min brief motivational intervention; external advanced medical students	Quantity of alcohol use (g/l in past 30 days) significantly reduced at 6-month follow-up (M = 544 (SE = 102) vs. M = 358 (SE = 108), $p < 0.05$); 17%	–; –; –
Prognos AG (2008), Germany	764 (59); <18 (15.5)	Final report to government body; cross-sectional access-to-care sample characterisation and project description	Treatment in an ED following acute alcohol intoxication	No follow-up	BI addresses youth and caregivers, is based on MI and aims at supporting youth to reflect upon at-risk alcohol use and consequences and referring them to an experience-oriented group programme especially developed for this target group; trained external facilitators with different vocational backgrounds	–; –	–; –; project implementation (BI in ED and community-based alcohol prevention) was strongly dependent on support from relevant opinion leaders in the community
Delphi (2010), Germany	339 (44.9); <18 (15.6)	Final report to government body; cross-sectional assessment of post intervention data and comparison with representative reference sample	Treatment in an ED following acute alcohol intoxication	One overall assessment point resulting in varying individual assessment points (1–18 months post intervention); 60.9%	BI addresses youth and caregivers, is based on MI and provides information on consequences of alcohol use, promotes sensible drinking and refers to an experience-oriented group programme and further treatment if indicated; –	In BI group lower alcohol abstinence rates (53.8 vs. 71.4% for <16 year-olds, 14.7 vs. 23.8% for >16 year-olds) and higher 30-day binge-drinking prevalence (60 vs. 20%); 20% took part in experience-oriented group programme/18.3% took up further medical or psychiatric treatment	–; 77.5% for participants who would recommend the BI to a friend, staff in 6 of 10 clinics rated BI implementation a valuable addition to TAU; –

‘–’ = Indicates ‘no information provided’; TAU = treatment as usual.
 * Information obtained from written communication with author.

Table 4. Measures, key findings and potential limitations of studies included in systematic review

Drinking quantity		Drinking frequency	Frequency of high volume drinking	Alcohol-related problems	Drinking and driving	Alcohol-related injuries	Referral to treatment	Summary of intervention effects on alcohol-related outcomes; referral rate	Participation rate; acceptance; implementation; limitations
<i>Trials with minimal active control condition</i>									
Monti et al., 1999	Measure	ADQ	ADQ	ADQ	5 items from HBQ	YADDQ	AIC	Yes/no	Drinking and driving declined significantly in BI group; participants in BI group were less likely to experience alcohol-related injury, significantly fewer alcohol-related problems were reported in BI group, alcohol consumption (ADQ total score) declined in both groups with no inter-group differences; no differences in seeking additional treatment
	Between-group difference; effect size (Cohen's d)	n.s.; n/a ^a	n.s.; n/a ^a	n.s.; n/a ^a	6 months ^b : p < 0.05, d = 0.42	6 months ^b : p < 0.05, d = 0.75	6 months ^b : p < 0.01, d = 0.76	n.s.; 6 months: d = 0.12	
Segatto et al., 2011	Measure	ACQ	ACQ	ACQ	RAPI	ACRQ	-	-	Significant reduction in alcohol consumption in both groups, no inter-group differences, significant reductions of negative alcohol-related harm in both groups with no inter-group differences; –
	Between-group difference; effect size (Cohen's d)	n.s.; n/a ^a	n.s.; 3 months: d = 0.27	n.s.; 3 months: d = 0.13	n.s.; 3 months: d = 0.04	n.s.; 3 months: d = 0.31	-	-	
Monti et al., 2007	Measure	TLFB	TLFB	TLFB	RAPI	Frequency of driving within 1 hour after drinking	AIC	Yes/no	BI group reduced number of drinking days, heavy drinking days and drinks per week significantly stronger at 6 and 12 months follow-up; significant increase of referral to treatment at 12-month follow-up in both groups with no between-group effect
	Between-group difference; effect size (Cohen's d)	6 months: p = 0.01, d = 0.24 12 months: p < 0.01, d = 0.30	6 months: p = 0.01, d = 0.24 12 months: p < 0.001, d = 0.34	6 months: p = 0.01, d = 0.17 12 months: p = 0.01, d = 0.18	n.s.; 12 months: d = 0.02	n.s.; 12 months: d = 0.03	n.s.; 12 months: d = 0.08	n.s.; 12 months: d = 0.23	

Table 4. (continued)

	Drinking quantity	Drinking frequency	Frequency of high volume drinking	Alcohol-related problems	Drinking and driving	Alcohol-related injuries	Referral to treatment	Summary of intervention effects on alcohol-related outcomes; referral rate	Participation rate; acceptance; implementation; limitations
Tait et al., 2005	Measure AUDIT-3 n.s.; n/a ^a Between-group difference; effect size (Cohen's d)	AUDIT-3 n.s.; n/a ^a	AUDIT-3 n.s.; n/a ^a	AUDIT-3 n.s.; n/a ^a	-	-	Yes/no 4 months: p < 0.001, d = 0.70	BI group showed significant reductions in AOD-related ED presentations from pre- to post enrolment; at 4-month follow-up significantly more participants from BI group attended further treatment	69%; -; -; significant differences in hazardous alcohol use between groups at baseline
Spirito et al., 2004	Measure ADQ n.s.; 3 months: d = 0.19 6 months: d = 0.05 12 months: d = 0.04 Between-group difference; effect size (Cohen's d)	ADQ n.s.; 3 months: d = 0.21 6 months: d = 0.02 12 months: d = 0.41	ADQ n.s.; 3 months: d = 0.35 6 months: d = 0.10 12 months: d = 0.37	5 items from HBQ n.s.; n/a ^a	YADDQ n.s.; n/a ^a	AIC n.s.; n/a ^a	Yes/no n.s.; n/a ^a	Both groups significantly reduced quantity of drinking at 3, 6 and 12-month follow-ups, a subgroup of participants who scored above the cut-off for referral for alcohol treatment at baseline reported lower drinking frequency and lower frequency of heavy drinking in the BI group than in CG at 3, 6 and 12 months follow-ups; -	53.1%; participants rated facilitators' competency (rapport, empathy, self-efficacy enhancement) as high; -; school drop outs were less likely to complete 6-month follow-up; rates of follow-up alcohol-related problems were relatively low making it difficult to detect effects
<i>Trials with enhanced intervention control condition</i>									
Spirito et al., 2011	Measure ADQ n.s.; 3 months: d = 0.28 6 months: d = 0.28 12 months: d = 0.12 Between-group difference; effect size (Cohen's d)	ADQ n.s.; 3 months: d = 0.25 6 months: d = 0.18 12 months: d = 0.05	ADQ 3 months: p = 0.48 3 months: d = 0.19 6 months: d = 0.18 12 months: d = 0.23	-	-	-	-	Drinking quantity, drinking frequency and frequency of high volume drinking declined significantly in both groups. High volume drinking at 3-month follow-up was significantly lower in the eBI group than in BI group; -	47.3%; -; return visits to complete eBI proved problematic for 20% of families, 'the addition of the family component is more challenging logistically' (p 273); no 'no intervention' control group, low completion rates at 12-month follow-up (BI: 58%, eBI: 74%)

Table 4. (continued)

Drinking quantity	Drinking frequency	Frequency of high volume drinking	Alcohol-related problems	Drinking and driving	Alcohol-related injuries	Referral to treatment	Summary of intervention effects on alcohol-related outcomes; referral rate	Participation rate; acceptance; implementation; limitations
Wurdak and Wolstein, 2012b	'Items derived from Kraus et al., 2008'	'Items derived from Kraus et al., 2008'	'Items derived from Kraus et al., 2008'				Both groups significantly reduced drinking frequency and binge drinking frequency at 1-month follow-up. Females in the eBI group reduced drinking frequency and binge drinking frequency significantly stronger than in BI group at 1-month follow-up; –	Approximately 80% (facilitators' estimation); 75.9% of participants rated the intervention as 'very good', 'good' or 'satisfactory', no significant between group differences; facilitators rated feasibility of eBI as 'good' to 'satisfactory'; significantly lower educational status in intervention group, low follow-up completion rate (40.7%), follow-up completers reported significantly fewer days of excessive alcohol use and higher educational status than non-completers
Between-group difference; effect size (Cohen's d)	n.s.; n/a ^a	n.s.; n/a ^a	n.s.; n/a ^a					

ADQ = Adolescent drinking questionnaire; HBQ = health behaviour questionnaire; YADDQ = young adult drinking and driving questionnaire; AIC = adolescent injury checklist; CG = control group; ACQ = alcohol consumption questionnaire; RAPI = Rutgers alcohol problem index; ACRO = alcohol consumption risk questionnaire; TLFB = time-line follow-back; AUDIT-3 = first 3 questions from the alcohol use disorder identification test; eBI = enhanced brief intervention, i.e. individual plus family brief intervention; GHQ = general health questionnaire; n.s. = not significant.

^a Effect size calculation not possible from published data; ^b data from 3- and 6-month follow-up were added to analyse group differences.

at 6 ($F = 9.49$; $p = 0.01$) and 12-month follow-up ($F = 8.20$; $p = 0.01$). Significant between-group differences were also observed on past-month average number of drinks per week at 6- ($F = 7.98$; $p = 0.01$) and 12-month follow-up ($F = 10.35$; $p < 0.01$). Spirito et al. [48] observed a significant effect of the enhanced BI (eBI) on high-volume drinking days, defined as consuming more than 5 drinks per occasion, at 3-month follow-up (14.6 vs. 32.1%; $p = 0.048$). Two studies found significant between-group differences in reductions of alcohol use for subgroups. Spirito and colleagues [31] found a significant effect of the intervention on drinking days per month ($F(1, 120) = 7.05$; $p < 0.01$) and frequency of high-volume drinking at 3-, 6- and 12-month follow-up ($F(1, 120) = 10.04$; $p < 0.01$) for patients who screened positive for referral to alcohol treatment at baseline. Wurdak and Wolstein [44] found significantly stronger reductions in drinking frequency ($F = 7.85$; $p = 0.009$) and high-volume drinking frequency ($F = 7.08$; $p = 0.012$) for females in the eBI group. Both studies [31, 44] did not find significant between-group difference in alcohol use in the overall sample. In addition to the effect sizes reported in table 4, we calculated combined effects for the 3 alcohol consumption outcomes drinking quantity, drinking frequency and frequency of high-volume drinking. Relevant data for effect size calculation were published in 4 of the 7 RCTs and combined effects on alcohol consumption ranged from 0.19 [31, 48] to 0.20 [46] and 0.25 [47].

Alcohol-Related Harm

Of the 4 studies that assessed differences in reductions of alcohol-related problems in BI and control groups [31, 32, 46, 47], only 1 [32] reported significantly stronger reductions in the BI group at 6-month follow-up compared to the standard care group ($F(1, 78) = 4.10$; $p < 0.05$). Four studies assessed intervention effects on drinking and driving. One study [32] found a significant effect favouring the intervention group ($\chi^2(1, n = 73) = 5.82$; $p < 0.05$). The effect of the BI on alcohol-related injury was assessed in 3 studies [31, 32, 47]. Again, only 1 study [32] reported a significant effect of the intervention on the quantity of alcohol-related injuries ($\chi^2(1, n = 82) = 7.72$; $p < 0.01$). In this study, a significant decline in moving violations in the intervention group at 6-month ($\chi^2(1, n = 62) = 5.17$; $p < 0.05$) was also observed.

Referral to Treatment

Seven of the 15 publications identified in the systematic literature and additional evidence search assessed whether study participants accessed alcohol treatment or

counselling following the BI [7, 32, 33, 47, 53–55]. Referral rates in BI groups ranged from 17% [54] to 88% [7] with a mean referral rate of 35.4%. Only 1 of 4 studies comparing referral rates in a BI group with a control group reported significant intervention effects with patients in the intervention group reporting higher numbers in referral to treatment ($\chi^2(1) = 22.3$; $p < 0.001$) at 4-month follow-up [33].

Participation Rates

Of the 15 publications a total of 11 reported data on the ratio of those eligible and youth receiving a BI. On average, 68.8% of eligible youth agreed to take part in the BI. Participation rates ranged from 21.7% [54] to 97.8% [46].

Acceptance

Acceptance of the BI by patients or clinic staff was systematically assessed in 3 studies [31, 44, 53]. In Wurdak and Wolstein [44], 75.9% of participants rated their overall impression of the intervention as 'very good', 'good' or 'satisfactory' when asked immediately following the BI. Furthermore, participants rated the BI on a 5-point scale (1 = agree, 5 = not agree) as 'helpful' ($M = 4.21$, $SD = 1.01$) and felt being taken seriously ($M = 4.04$, $SD = 1.20$). At 1-month follow-up, ratings were slightly lower with $M = 3.67$ ($SD = 1.29$) for perceiving the BI as 'helpful'. In another study [53], 77.5% of participants reported they would recommend the BI to a friend in a similar situation and 60% of clinic staff rated the BI programme as being a valuable addition to ED standard care. Spirito et al. [31] asked study participants to rate counselor's perceived empathy, rapport and self-efficacy enhancement with generally positive ratings of 3.7–3.8 on a 4-point scale ranging from 1 (strongly disagree) to 4 (strongly agree). Originally introduced as a measure for protocol adherence, these ratings also reflect patients' acceptance of the intervention. Authors of 5 publications [6, 7, 50, 52, 54] reported that the BI programmes were initiated by clinic staff as a result of a perceived increase in numbers and symptom severity of those under 18 years treated for AAI, which indicates high motivation of clinic staff to implement and support BI programmes.

Implementation

Data on implementation were reported in 3 of the 15 publications [44, 48, 52]. Facilitators rated the feasibility of BI delivery as 'good' to 'satisfactory' ($M = 2.76$, $SD = 1.33$) on a 6-point scale ranging from 1 = very good to 6 = very bad in 1 study [44]. Qualitative interviews in another publication [52] revealed that the implementation of a project combining BIs in ED with community-based al-

cohol prevention was strongly dependent on the support of relevant stakeholders in the community. Another study [48] reported that return visits including patients' family members were problematic for 20% of participants.

Booster Sessions

Four studies included BIs with booster sessions [33, 44, 47, 48]. Spirito et al. [48] found a significant effect at 3-month follow-up in reducing high-volume drinking when a booster session with parents and a parent feedback session were added to the BI. Monti et al. [47] compared a BI including two booster sessions by telephone with standard care and found significant reductions in the BI group on all assessed alcohol consumption measures at 6- and 12-month follow-up. Tait et al. [33] compared a BI including a telephone booster with standard care and found a significant effect of the intervention on the target outcome, which was taking up further treatment. Wurdak and Wolstein [44] applied 3 weekly web-based boosters focussing on drinking motives (enhanced BI) or alcohol knowledge (control condition) and found reductions on frequency of alcohol use and heavy use in both groups with females in the enhanced BI condition reporting significantly stronger reductions on these outcomes. The three studies that did not add booster sessions to the interventions yielded either no between-group effects [46], significant effects on alcohol-related harm only [32] or significant intervention effects only for a subgroup of patients with problematic alcohol consumption at baseline [31].

Discussion

This review identified seven RCTs evaluating effectiveness of alcohol BIs in ED for adolescents and young adults following an alcohol-related event and eight additional publications on practice programmes or uncontrolled trials. In contrast to existing reviews [26, 34], this is the first review to identify European evidence for this approach. It is also the first review to support evidence on effectiveness with data on implementation, acceptance and reach of BIs for this target population, essential dimensions for programme evaluation according to the RE-AIM framework [38]. Although a considerably higher number of RCTs than in previous reviews was included [27, 34], evidence of effectiveness of BIs for this target population remains inconclusive. Four of the 7 RCTs found beneficial effects of BIs on alcohol consumption or alcohol-related harm for the overall sample or for subgroups reporting small to medium effect sizes. However, effects relate to

heterogeneous outcomes and are limited to a small share in assessed outcomes. None of the studies found effects on both alcohol consumption and alcohol-related harm. Only one of four trials provided evidence supporting effectiveness of BIs in increasing rates of referral to further treatment. The heterogeneity of study methodologies, particularly with regard to control conditions (minimal active vs. enhanced BI) and booster delivery modes (in person including parents [48] vs. telephone [47] vs. web-based [44]) and frequencies (1 [45, 48], 2 [47] or 3 [44]) precluded combining effects with a meta-analysis.

Participation rates as assessed in 11 publications varied strongly, a finding that underlines the importance of systematic process evaluation in order to identify factors contributing to variations in participation rates. Measures on acceptance revealed generally favourable appraisals, but were rarely assessed ($n = 3$), mainly focussing on acceptance by patients and only in one case by clinic staff. Few publications contained information on BI implementation ($n = 3$). Reported measures focussed on heterogeneous aspects of implementation such as feasibility of BI delivery rated by facilitators [44], structural prerequisites of BI implementation from a community perspective [52] and feasibility of return visits with family members [48], limiting generalisability of findings and highlighting the need for a more standardized and comprehensive approach to implementation evaluation.

Overall, it has to be noted that there are substantial activities under way in Europe to provide BIs in EDs to children and adolescents following an alcohol-related event. The majority of publications on such programmes originate from Germany, followed by Austria and Switzerland. This finding is likely due to varying degrees of programme implementation in European countries, among which Germany takes on a special role with project 'HaLT-Hart am Limit' ('Stop – close to the limit') implemented at more than 170 locations across the country. Many of the identified practice projects were initiated by hospital staff [6, 7, 50, 52, 54] as a reaction to rising numbers of alcohol-intoxicated minors treated in EDs, a fact that reflects the articulate need perceived by practitioners to address this target group with appropriate support. In addition to these programmes which provide BIs in ED, a number of programmes exist in Europe, which cater to adolescents with alcohol intoxication with different support, for example, the Dutch programme 'Jeugd en Alcohol', which offers adolescents with AAI a counselling and educational session at a scheduled re-visit a couple of weeks after hospitalisation [56, 57] or the Swedish Maria Ungdom, which offers treatment for adolescents with AAI in a specialised

clinic for adolescents with problematic alcohol and other drug use [58], again underlining the need perceived by practitioners to address this target group.

Several reasons may account for the inconclusive findings of this review regarding the effectiveness of BIs in this context. The fact that none of the studies found effects on both alcohol consumption and alcohol-related harm could be due to different contents of the BIs. Monti et al. [32] for example, stated that the BI applied in their study did not emphasize a reduction in alcohol consumption, but focussed on promoting behaviours to reduce alcohol-related harm. The same applies for Tait et al. [33] who tested an intervention that primarily focussed on enhancing motivation for further treatment instead of a reduction in alcohol consumption. Heterogeneity of study methodologies due to different control conditions as well as different numbers and modes of booster sessions also limits comparability of findings. Albeit focussing on studies and programmes targeting adolescents following an alcohol-related event, it needs to be noted that some heterogeneity in the study populations remained, for example, Wurdak and Wolstein [44] only included adolescents treated for an AAI, while other studies generally included adolescents who consumed alcohol prior to the ED visit. It remains unclear if adolescent patients treated for an alcohol-related injury respond differently to the BI. Small sample sizes in some RCTs made it difficult to detect intervention effects for variables with low rates of baseline manifestation as reported, for example, by Spirito et al. [31] for alcohol-related problems and by Monti et al. [32] for alcohol consumption. BMIs have proven to be effective in adolescent populations also for other health behaviours such as smoking and peer violence; however, it has to be taken into account that effects are typically small [59–61]. Small effects may partly be explained by a finding by Mallett et al. [62], who found college students who have experienced negative consequences from alcohol use to be at an increased risk of experiencing similar consequences in the future, indicating that they did not learn from their mistakes.

All except one RCT [33] found reductions in alcohol consumption in both intervention and control groups following the ED visit. Changes in drinking in control groups are often observed in BI studies and factors such as assessment reactivity, research participation effects, regression to the mean and maturation have been identified to contribute to this finding [63, 64]. Furthermore, due to ethical considerations control group participants received some kind of an active intervention in all studies included in this review, potentially contributing to a sys-

tematic underestimation of effects under real-world conditions. On the other hand, it is also possible that the ED visit itself represents an event that triggers behaviour change [65] in a way that BIs do not add a significant additional effect, potentially even more so for young individuals treated following an alcohol-related event. Segato et al. [46] reported the only RCT that did not find positive effects of the BI on any outcome. In this study, the sample differed strongly from those in the other RCTs with a high percentage (37.9% in BI, 35.2% in control group), screening positive for alcohol dependence. BIs for alcohol-dependent patients have been found to be not as effective as for non-dependents [66–68].

Against the background of typical alcohol consumption patterns in adolescence, that is, infrequent heavy drinking [69, 70] it can be questioned whether average quantity of alcoholic drinks consumed over a given period of time and consumption frequency of any quantity of alcohol are appropriate main outcomes to capture intervention effectiveness in this context. Taking into account the harm-reduction approach applied by most BIs in this context, the frequency of high-volume drinking and quantity of alcohol consumption on a typical drinking occasion as well as experience of negative alcohol-related harm could be more appropriate outcome measures to depict risky adolescent drinking.

All RCTs in this review included patients who received ED treatment following the consumption of alcohol. However, none of the studies assessed whether or to what extent patients actually attributed their ED visit to the preceding alcohol use, a fact that could provide additional information contributing to the understanding of differential intervention effects [28].

Conclusions that can be drawn from the current review are limited in several ways. Because of the small number of relevant RCTs it was not feasible to determine publication bias with a funnel plot. However, unpublished studies were sought through a trials registration database, by screening conference proceedings and reference lists, and additional evidence was sought in a grey literature search. The grey literature search cannot meet the claim of completeness and it can only describe programmes published in some kind of a report. Expert contacts for this review were restricted to authors who had published on relevant topics. Furthermore, the age group addressed in this review was 12–25 years, resulting in the inclusion of young people in different developmental stages. Although alcohol BMIs with college-aged participants have a strong evidence base [67], doubts have been expressed whether the MI approach is effective for young

teenagers [34, 71]. In order to determine differential effectiveness of BIs for different age groups in this setting, further studies investigating larger samples including children, adolescents and young adults are needed.

Future European research into effectiveness and feasibility of BIs targeting adolescent ED patients following an alcohol-related event is needed, because rising numbers of adolescent AAI patients pose a major public health concern in Europe and numerous practice projects initiated by clinicians reflect the perceived need for effective interventions addressing this population. Replications of successful RCTs would be desirable in order to establish a pool of studies with comparable designs that allow synthesizing of results. Furthermore, research with minimal assessment would be desirable in order to minimize assessment reactivity and evaluate effects under 'real-world' conditions. Additionally, the investigation of potential moderators and mediators of effectiveness would be desirable in order to shed light on factors contributing to differential effectiveness of alcohol BIs targeting adolescents after alcohol-related events and thereby contributing to understanding the heterogeneity of existing findings.

Conclusion

Through the unique combination of a systematic review and additional evidence synthesis, this review provided an overview over evidence for BIs in ED for adoles-

cents and young adults following an alcohol-related event that goes beyond effectiveness by including evidence on current implementation, acceptance and reach. In Europe to date, a number of BI programmes targeting adolescents in EDs following alcohol-related events are implemented in clinical practice, whereas evidence regarding their effectiveness and feasibility is limited. The identified gap between current implementation and clinicians' perceived need for programmes addressing this population on the one hand and the inconsistent evidence for effectiveness and feasibility on the other hand needs to be addressed by future research.

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The authors have no conflict of interest to disclose.

References

- Hibell B, Guttormsson U, Ahlström S, Balakireva O, Bjarnason T, Kokkevi A, Kraus L: The 2011 ESPAD Report. Substance Use Among Students in 36 European Countries, 2012. http://www.espad.org/Uploads/ESPAD_reports/2011/The_2011_ESPAD_Report_FULL_2012_10_29.pdf (accessed November 3, 2012).
- Herring R, Berridge V, Thom B: Binge drinking: an exploration of a confused concept. *J Epidemiol Community Health* 2008;62:476–479.
- Johnston LD, O'Malley PM, Miech RA, Bachman JG, Schulenberg JE: Monitoring the Future National Results on Drug Use: 2013 Overview, Key Findings on Adolescent Drug Use. Ann Arbor, Institute for Social Research, 2014.
- Gesundheitsberichterstattung des Bundes: Diagnosedaten der Krankenhäuser ab 2000. Federal Health Statistics: Data on Diagnoses in Hospitals from 2000. http://www.gbe-bund.de/oowa921-install/servlet/oowa/aw92/WS0100/_XWD_FORMPROC?TARGET=&PAGE=_XWD_106&OPINDEX=4&HANDLER=_XWD_CUBE.SETPGS&DATACUBE=_XWD_134&D.001=1000001&D.002=25&D.003=1000004&D.972=1000619&D.100=10101 (accessed February 2, 2014).
- Healey C, Rahman A, Faizal M, Kinderman P: Underage drinking in the UK: changing trends, impact and interventions. A rapid evidence synthesis. *Int J Drug Policy* 2014;25:124–132.
- Fandler E, Scheer P, Rödl S, Müller W: Alkoholmissbrauch und –abhängigkeit bei Kindern und Jugendlichen [Alcohol misuse and dependence in children and adolescents]. *Monatsschr Kinderheilk* 2008;156:591–604.
- Cafilisch M, Uldry V: [At the crossover of adolescent and alcohol]. *Rev Med Suisse* 2013;9:406–409.
- Van Hoof JJ, Lely NV, Pereira RR, van Dalen WE: Adolescent alcohol intoxication in the Dutch hospital departments of pediatrics. *J Stud Alcohol Drugs* 2010;71:366–372.
- Bitunjac K, Saraga M: Alcohol intoxication in pediatric age: ten-year retrospective study. *Croat Med J* 2009;50:151–156.
- Loukova A: Study of acute alcohol poisoning in children admitted to a emergency hospital Pirogov in Sofia, Bulgaria. *Macedonian J Med Sci* 2011;4:275–280.
- Kuzelová M, Harárová A, Ondriasová E, Wawruch M, Riedel R, Benedeková M, Kovács L, Plaková S: Alcohol intoxication requiring hospital admission in children and adolescents: retrospective analysis at the university children's hospital in the Slovak Republic. *Clin Toxicol (Phila)* 2009;47:556–561.
- Hingson RW, Heeren T, Winter MR: Age at drinking onset and alcohol dependence: age at onset, duration, and severity. *Arch Pediatr Adolesc Med* 2006;160:739–746.
- Hingson R, Heeren T, Zakocs R, Winter M, et al: Age of first intoxication, heavy drinking, driving after drinking and risk of unintentional injury among U.S. college students. *J Stud Alcohol* 2003;64:23–31.

- 14 Sindelar HA, Barnett NP, Spirito A: Adolescent alcohol use and injury. A summary and critical review of the literature. *Minerva Pediatr* 2004;56:291–309.
- 15 Miller JW, Naimi TS, Brewer RD, Jones SE: Binge drinking and associated health risk behaviors among high school students. *Pediatrics* 2007;119:76–85.
- 16 Wechsler H, Davenport A, Dowdall G, Moeykens B, Castillo S: Health and behavioral consequences of binge drinking in college. A national survey of students at 140 campuses. *JAMA* 1994;272:1672–1677.
- 17 Heffernan T, Clark R, Bartholomew J, Ling J, Stephens R: Does binge drinking in teenagers affect their everyday prospective memory? *Drug Alcohol Depend* 2010;109:73–78.
- 18 McQueeney T, Schweinsburg BC, Schweinsburg AD, Jacobus J, Bava S, Frank LR, Tapert SF: Altered white matter integrity in adolescent binge drinkers. *Alcohol Clin Exp Res* 2009;33:1278–1285.
- 19 Viner RM, Taylor B: Adult outcomes of binge drinking in adolescence: findings from a UK national birth cohort. *J Epidemiol Community Health* 2007;61:902–907.
- 20 Grant BF, Stinson FS, Harford TC: Age at onset of alcohol use and DSM-IV alcohol abuse and dependence: a 12-year follow-up. *J Subst Abuse* 2001;13:493–504.
- 21 Project-halt, 2014. http://www.halt-projekt.de/images/stories/pdf/2014_01_24_standorte_deutschland_januar_2014 (accessed February 4, 2014).
- 22 Nilsen P, Baird J, Mello MJ, Nirenberg T, Woolard R, Bendtsen P, Longabaugh R: A systematic review of emergency care brief alcohol interventions for injury patients. *J Subst Abuse Treat* 2008;35:184–201.
- 23 D'Onofrio G, Degutis LC: Preventive care in the emergency department: screening and brief intervention for alcohol problems in the emergency department: a systematic review. *Acad Emerg Med* 2002;9:627–638.
- 24 Havard A, Shakeshaft A, Sanson-Fisher R: Systematic review and meta-analyses of strategies targeting alcohol problems in emergency departments: interventions reduce alcohol-related injuries. *Addiction* 2008;103:368–376; discussion 377–378.
- 25 Wachtel T, Staniford M: The effectiveness of brief interventions in the clinical setting in reducing alcohol misuse and binge drinking in adolescents: a critical review of the literature. *J Clin Nurs* 2010;19:605–620.
- 26 Yuma-Guerrero PJ, Lawson KA, Velasquez MM, von Sternberg K, Maxson T, Garcia N: Screening, brief intervention, and referral for alcohol use in adolescents: a systematic review. *Pediatrics* 2012;130:115–122.
- 27 Ahmed M, Mackway-Jones K: Towards evidence based emergency medicine: best BETs from the Manchester Royal Infirmary. Is ED-based brief intervention worthwhile in children and adolescents presenting with alcohol-related events? *Emerg Med J* 2007;24:125–128.
- 28 Walton MA, Goldstein AL, Chermack ST, McCammon RJ, Cunningham RM, Barry KL, Blow FC: Brief alcohol intervention in the emergency department: moderators of effectiveness. *J Stud Alcohol Drugs* 2008;69:550–560.
- 29 Longabaugh R, Minugh PA, Nirenberg TD, Clifford PR, Becker B, Woolard R: Injury as a motivator to reduce drinking. *Acad Emerg Med* 1995;2:817–825.
- 30 Lawson PJ, Flocke SA: Teachable moments for health behavior change: a concept analysis. *Patient Educ Couns* 2009;76:25–30.
- 31 Spirito A, Monti PM, Barnett NP, Colby SM, Sindelar H, Rohsenow DJ, Lewander W, Myers M: A randomized clinical trial of a brief motivational intervention for alcohol-positive adolescents treated in an emergency department. *J Pediatr* 2004;145:396–402.
- 32 Monti PM, Colby SM, Barnett NP, Spirito A, Rohsenow DJ, Myers M, Woolard R, Lewander W: Brief intervention for harm reduction with alcohol-positive older adolescents in a hospital emergency department. *J Consult Clin Psychol* 1999;67:989–994.
- 33 Tait RJ, Hulse GK, Robertson SI, Sprivilis PC: Emergency department-based intervention with adolescent substance users: 12-month outcomes. *Drug Alcohol Depend* 2005;79:359–363.
- 34 Newton AS, Dong K, Mabood N, Ata N, Ali S, Gokiort R, Vandermeer B, Tjosvold L, Hartling L, Wild TC: Brief emergency department interventions for youth who use alcohol and other drugs: a systematic review. *Pediatr Emerg Care* 2013;29:673–684.
- 35 Woolard R, Cherpitel C, Kathleen T: Brief Intervention for emergency department patients with alcohol misuse: implications for current practice. *Alcohol Treat Q* 2011;29:146–157.
- 36 Athanasious T, Darzi A: Evidence synthesis in healthcare: a practical handbook for clinicians. London, Springer, 2011.
- 37 Khangura S, Konnyu K, Cushman R, Grimshaw J, Moher D: Evidence summaries: the evolution of a rapid review approach. *Systematic Reviews*, 2012. <http://systematicreviewsjournal.com/content/1/1/10> (accessed June 15, 2014).
- 38 Glasgow RE, Vogt TM, Boles SM: Evaluating the public health impact of health promotion interventions: the RE-AIM framework. *Am J Public Health* 1999;89:1322–1327.
- 39 Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group: Preferred reporting items for systematic reviews and meta-analysis: the PRISMA statement. *Open Med* 2009;3:123–130.
- 40 Arnett JJ: Emerging adulthood: what is it, and what is it good for? *Child Dev Perspect* 2007;1:68–73.
- 41 Cochrane Effective Practice and Organisation of Care Group (EPOC): The Data Collection Checklist. Ottawa, 2002. <https://epoc.cochrane.org/sites/epoc.cochrane.org/files/uploads/datacollectionchecklist.pdf> (accessed March 3, 2012).
- 42 Higgins JPT, Green S: Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 (updated March 2011). The Cochrane Collaboration, 2011. <http://www.cochrane-handbook.org> (accessed March 5, 2012).
- 43 Wurdak M, Wolstein J: Trinkmotive von Jugendlichen und deren Bedeutung für eine zielgruppenspezifische Kurzintervention. *Sucht* 2012;58:44.
- 44 Wurdak M, Wolstein J: Motivbasierte Intervention am Krankenbett im Rahmen des Projektes 'HaLT – Hart am Limit'. Abschlussbericht an das Bundesministerium für Gesundheit, 2012. http://www.drogenbeauftragte.de/fileadmin/dateien-dba/DrogenundSucht/Alkohol/Downloads/Abschlussbericht_MotivbasierteInterventionFin.pdf (accessed January 18, 2013).
- 45 Tait RJ, Hulse GK, Robertson SI: Effectiveness of a brief-intervention and continuity of care in enhancing attendance for treatment by adolescent substance users. *Drug Alcohol Depend* 2004;74:289–296.
- 46 Segatto ML, Andreoni S, de Souza e Silva R, Diehl A, Pinsky I: Brief motivational interview and educational brochure in emergency room settings for adolescents and young adults with alcohol-related problems: a randomized single-blind clinical trial. *Rev Bras Psiquiatr* 2011;33:225–233.
- 47 Monti PM, Barnett NP, Colby SM, Gwaltney CJ, Spirito A, Rohsenow DJ, Woolard R: Motivational interviewing versus feedback only in emergency care for young adult problem drinking. *Addiction* 2007;102:1234–1243.
- 48 Spirito A, Sindelar-Manning H, Colby SM, Barnett NP, Lewander W, Rohsenow DJ, Monti PM: Individual and family motivational interventions for alcohol-positive adolescents treated in an emergency department: results of a randomized clinical trial. *Arch Pediatr Adolesc Med* 2011;165:269–274.
- 49 Miller S, Rollnick WR: Preparing People for Change. New York, The Guilford Press, 2002.
- 50 Müller S, Pabst A, Kronthaler F, Grubl A, Kraus L, Burdach S, Tretter F: [Acute alcohol intoxication in adolescents: preliminary results of a pilot project in Munich]. *Dtsch med Wochenschr* 2009;134:1101–1105.
- 51 Reis O, Papke M, Haessler F: Ergebnisse eines projektes zur kombinierten prävention jugendlichen rauschtrinkens [Evaluation of a project for the prevention of adolescent binge-drinking]. *Sucht* 2009;55:347–356.
- 52 Prognos: Wissenschaftliche Begleitung des Bundesmodellprogramms 'HaLT – Hart am Limit', 2008. http://www.halt-coburg.de/files/halt-projekt_endbericht.pdf (accessed December 5, 2013).
- 53 Delphi: Evaluation des 'NachHaLT'-Projektes in Berlin – Ergebnisbericht. Evaluation of the project 'NachHaLT' in Berlin – final report, 2010. http://www.halt-berlin.de/tl_files/nachhalt/bilder/PDF/NachHaLT_Evaluation_Ergebnisbericht_delphi_Nov2010.pdf (accessed February 3, 2014).

- 54 Fenzl T, Mayring P, Drobesh-Binter B, Moshitz C, Gschwendner A: Grenzwert: Praktische Erfahrungen zur Prävention von riskantem Alkoholkonsum bei Jugendlichen in Kärnten [Bordeline: Practical experiences in the prevention of risky alcohol consumption in adolescents in Carinthia]. Unpublished manuscript 1–21.
- 55 Stolle M, Sack PM, Broening S, Baldus C, Thomasius R: Brief Intervention in alcohol intoxicated adolescent – a follow-up study in an access-to-care sample. *J Alcoholism Drug Depend* 2013;1:106.
- 56 Reinier de Graaf. Jeugd en Alcohol, 2015. <https://www.reinierdegraaf.nl/kids/ouderinformatie/kinderpoliklinieken/jeugd-en-alcohol/> (accessed May 6, 2015).
- 57 De Visser M, van der Lely N, van Zanten E: Alcohol intoxication and risk factors in adolescents. *Addict Sci Clin Pract* 2013;8(suppl 1):A80.
- 58 Maria Ungdom, 2015. <http://mariaungdom.se/> (accessed May 11, 2015).
- 59 Colby SM, Monti PM, O’Leary Tevyaw T, Barnett NP, Spirito A, Rohsenow DJ, Riggs S, Lewander W: Brief motivational intervention for adolescent smokers in medical settings. *Addict Behav* 2005;30:865–874.
- 60 Brown RA, Strong DR, Abrantes AM, Myers MG, Ramsey SE, Kahler CW: Effects on substance use outcomes in adolescents receiving motivational interviewing for smoking cessation during psychiatric hospitalisation. *Addict Behav* 2009;34:887–891.
- 61 Cunningham RM, Chermack ST, Zimmerman MA, Shope JT, Bingham CR, Blow FC, Walton MA: Brief motivational interviewing intervention for peer violence and alcohol use in teens: one-year follow-up. *Pediatrics* 2012; 129:1083–1090.
- 62 Mallett KA, Lee CM, Neighbors C, Larimer ME, Turrissi R: Do we learn from our mistakes? An examination of the impact of negative alcohol-related consequences on college students’ drinking patterns and perceptions. *J Stud Alcohol* 2006;67:269–276.
- 63 Heather N: Interpreting null findings from trials of alcohol brief interventions. *Front Psychiatry* 2014;5:85.
- 64 Jenkins RJ, McAlaney J, McCambridge J: Change over time in alcohol consumption in control groups in brief intervention studies: systematic review and meta-regression study. *Drug Alcohol Depend* 2009;100:107–114.
- 65 Boudreaux E, Bock B, O’Hea E: When an event sparks behavior change: an introduction to the sentinel event method of dynamic model building and its application to emergency medicine. *Acad Emerg Med* 2012;9:329–335.
- 66 Saitz R, Palfai TP, Cheng DM, Horton NJ, Dukes K, Kraemer KL, Roberts MS, Guerriero RT, Samet JH: Some medical inpatients with unhealthy alcohol use may benefit from brief intervention. *J Stud Alcohol Drugs* 2009;70: 426–435.
- 67 Carey KB, Scott-Sheldon LA, Carey MP, DeMartini KS: Individual-level interventions to reduce college student drinking: a meta-analytic review. *Addict Behav* 2007;32:2469–2494.
- 68 Moreira MT, Smith LA, Foxcroft D: Social norms interventions to reduce alcohol misuse in University or College students. *Cochrane DB Syst Rev* 2009;3:1–97.
- 69 Reboussin BA, Anthony JC: Latent class marginal regression models for modelling youthful drug involvement and its suspected influences. *Stat Med* 2001;20:623–639.
- 70 Kraus L, Hannemann TV, Pabst A, Kronthaler F, Grübl A, Stürmer M, Wolstein J: Stationäre Behandlung von jugendlichen mit akuter alkoholintoxikation: die spitze des eisbergs? Inpatient treatment of adolescents with acute alcohol intoxication: the tip of the iceberg? *Gesundheitswesen*, 2012. <https://www.thieme-connect.com/ejournals/pdf/10.1055/s-0032-1321755.pdf> (accessed June 3, 2014).
- 71 Thush C, Wiers RW, Moerbeek M, Ames SL, Grenard JL, Sussman S, Stacy AW: Influence of motivational interviewing on explicit and implicit alcohol-related cognition and alcohol use in at-risk adolescents. *Psychol Addict Behav* 2009;23:146–151.
- 72 Härter M, Kentgens M, Brandes A, Bock T, Dirmajer J, Erzberger M, Furstenberg W, Hillebrandt B, Karow A, von Dem Knesebeck O, König HH, Lowe B, Meyer HJ, Romer G, Rouhiainen T, Scherer M, Thomasius R, Watzke B, Wegscheider K, Lambert M: Rationale and content of psychenet: the Hamburg network for mental health. *Eur Arch Psychiatry Clin Neurosci* 2012;262(suppl 2):S57–S63.