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Risk stratification in upper and upper and lower GI bleeding: Which scores should we use?

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ABSTRACT

Risk assessment is widely used in upper gastrointestinal bleeding (UGIB) however no score accurately predicts all important clinical outcomes. This review discusses the performance of the Rockall score, pre-endsocopy Rockall score, Glasgow-Blatchford score, AIMS-65 and newer scores such as Progetto Nazionale Emorragia Digestiva and CANUKA scores. The quality of external validation varies considerably for each score. There is a relative lack of risk scores available for use in lower GI bleeding (LGIB) but recent developments have focussed on the identification of low risk patients. The BLEED, NOBLADS, Strate and Sengupta scores have been developed to predict severe bleeding or death, each with varying performance. The Oakland score has been developed to identify patients at low risk of adverse outcomes who may be suitable for outpatient management. The comparative performance of the LGIB scores and Rockall, Glasgow-Blatchford and AIMS-65 in the prediction of outcomes in LGIB is also discussed.

Introduction

Risk scores are routinely used to predict adverse patients outcomes in upper gastrointestinal bleeding (UGIB). Outcomes of interest include death, need for intervention to treat bleeding such as endoscopic haemostasis, interventional radiology or surgery, re-bleeding, red blood cell (RBC) transfusion requirements and re-admission to hospital. Determining the most important clinical outcome in patients with UGIB is not straightforward. Initially death was prioritised and longitudinal population studies conducted since the adoption of risk stratification systems demonstrate a reduction in case fatality over the last two decades. [1,2]

There has been increasing focus on the use of risk scores to predict favourable outcomes, such as safe discharge, where low risk patients could avoid hospital admission in favour of outpatient management. For both UGIB and lower gastrointestinal bleeding (LGIB) there is a selection of risk scores that can be used, each developed in geographically diverse populations, some including all-comers with GIB and some restricted to subgroups such as non-variceal UGIB (NVUGIB). Each is powered to detect different outcomes and the robustness of external validation varies considerably.

This review article discusses individual risk scores and external validation studies. The tables include external validation studies if they reported area an under the receiver operating characteristic curve (AUROC) in populations of more than 500 participants.

Risk stratification in upper GI bleeding

The two most widely used scores are the Rockall (RS) and Glasgow Blatchford (GBS) scores (Table 1).

Rockall score

The RS was derived in 1996 from 4185 cases of AUGIB in the United Kingdom (UK) and designed to predict mortality [3]. The components of the score are age, shock, co-morbidity and the diagnosis and presence for stigmata of recent haemorrhage at endoscopy. As the full RS relies on endoscopic findings, its use at initial patient assessment is limited. A 'clinical' or 'pre-endoscopy' Rockall score (pRS) can be calculated by omitting the endoscopic criteria, but this may decrease the predictive power of the score.

Glasgow-Blatchford score

The GBS was derived seven years later based on 1748 patients with the aim of identifying patients who needed treatment [4]. The components of the score are urea, haemoglobin, systolic blood pressure, heart rate, presenting features and co-morbidity. Unlike

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Table 1
Validated scoring systems designed for use in UGIB.

Score	Derivation population	Population size	Main Predicted outcome	Outcome definition	Internal validation
Rockall	All UGIB, UK	4185	Mortality	In-hospital death	Performed but not statistically reported
GBS	All UGIB, UK	1748	Need for treatment	RBC transfusion, intervention to control bleeding, re-bleeding or death	AUROC 0.92
AIMS-65	All UGIB, USA	29,222	Mortality	In-hospital death	AUROC 0.80
CANUKA	All UGIB, Canada, UK, Australia	10,639	Lack of poor outcome	No transfusion, re-bleeding, therapeutic endoscopy, interventional radiology or surgery, or death	

the RS, the GBS does not require endoscopy findings to calculate, enabling it to be calculated before a gastroscopy is performed.

AIMS-65

The AIMS-65 score was developed using data from 29,222 patients admitted to 187 hospitals in the United States (US). It uses albumin, international normalised ratio, altered mental status, blood pressure and age to predict death (Table 2). The same authors externally validated the score in 32,504 patients from the same national database captured a year later, reporting an AUROC of 0.77 for the prediction of death. They also found that AIMS-65 reliably predicted length of hospital stay and cost [5].

Validation of the RS, GBS and AIMS-65

GBS and RS are the most widely externally validated scores for UGIB, although neither performs well across all clinically important outcomes (Table 3). The largest studies investigating the RS were performed in populations of 656–3012 patients [6–16]. Most studies focus on mortality as the outcome of interest, reporting AUROCs of 0.66–0.79. Re-bleeding was less well predicted, with AUROCs consistently of <0.65 in the five studies that reported this outcome. Only one study of 888 participants reported separate AUROCs for endoscopic therapy, surgery or IR, and RBC transfusion, reporting AUROCs of 0.76, 0.64 and 0.70, respectively [15].

The pRS has been extensively investigated, notably in larger populations than that of RS (590–10,639 patients) [9–11,15–19]. Like the RS its strength lies in the prediction of death, with AUROCs of 0.65–0.93 (Table 3). The two studies that reported an AUROC for mortality of >0.8 were amongst the smallest in size (1012 and 590 participants) [18,19] and one was restricted to patients with peptic ulcer bleeding [18]. The pRS performed little better than chance at predicting re-bleeding, endoscopic therapy or need for surgery or IR, but in the five studies assessing its use in predicting RBC transfusion it had AUROCs of 0.61–0.73.

Table 2
The AIMS-65 score.

Predictor	Score component value
Albumin	
≥30 g/l	0
<30 g/l	1
International normalised ratio	
≤1.5	0
>1.5	1
Alteration in mental status	
No	0
Yes	1
Systolic blood pressure	
<90	0
≥90	1
Age	
<65	0
≥65	1

The GBS has also been extensively assessed, again in larger populations than that of RS (530–10,639 participants) [10,11,13–20]. It has varying performance when predicting death with AUROCs between 0.63 and 0.80 (Table 3). The studies reporting AUROCs for mortality of >0.7 tended to be smaller. Although the GBS was designed to predict need for hospital intervention, again it had varying performance at predicting re-bleeding (AUROCs 0.63 to 0.75), endoscopic hemostasis (AUROCs 0.58 to 0.78) and need for surgery or IR (AUROCs 0.61 to 0.71). In the four studies that reported need for RBC transfusion it performed consistently well, with AUROCs of 0.77–0.93 [13,15–17].

In comparison to RS, pRS and GBS, AIMS-65 has a relative paucity of external validation studies, although notably its initial external validation study is significantly larger than equivalents for the other scores (Table 3). It performs consistently well at predicting death with AUROCs of >0.75 in three of the four studies that report this outcome [5,10,14,20]. Only two studies report its performance for other outcomes; Stanley et al. reported AUROCs of 0.60 and 0.75 for re-bleeding and endoscopic hemostasis [10]. Kim et al. reported an AUROC of 0.76 for the prediction of RBC transfusion [20].

Other risk scores

The Progetto Nazionale Emorragia Digestiva (PNED) score was developed using data from 21 hospitals in Italy and included 1360 all comers with UGIB. It uses the American Society of Anesthesiology (ASA) classification, haemoglobin, age, co-morbidity, re-bleeding and failure of endoscopic treatment to predict death. Like the RS its use is limited by the requirement for endoscopy for complete the score. An initial validation study reported that it was superior to the RS (AUROC, 0.81 versus 0.66 for RS) [7]. An external validation study of 3012 patients also found that it was superior to the RS, but that its performance was not significantly different to GBS [10]. It is yet to be further externally validated.

The CANUKA score was developed using data from 10,639 patients with UGIB [17]. It uses age, presenting features, co-morbidity, heart rate, systolic blood pressure, haemoglobin and urea to predict a composite adverse outcome composed of death, re-bleeding, surgery or interventional radiology (IR) to treat bleeding, endoscopic therapy or RBC transfusion. In a validation dataset of 2072 patients, CANUKA was marginally better than GBS in predicting death (AUROC, 0.77 vs 0.74; $P = 0.047$), but there was no significant difference in the identification of patients who required hemostatic intervention. CANUKA was not as good as GBS at identifying patients who required therapeutic endoscopy [17].

There is also evidence that generic tools such as the National Early Warning Score (NEWS) may also predict adverse outcomes in UGIB [20]. Scores developed to predict specific outcomes, such as the Baylor Bleeding score, which predicts re-bleeding following

Table 3
External validation studies for the RS, pRS, GBS and AIMS-65 in the prediction of outcomes in UGIB.

Score	Study	External validation population	Population size	External validation (AUROC)				
				Mortality	Re-bleeding	Endoscopic treatment	Surgery or IR	RBC transfusion
RS	Vreeberg 1999 [6]	All UGIB, Netherlands	951	0.73	0.61	NR	NR	NR
	Marmo 2010 [7]	All UGIB, Italy	1360	0.66	NR	NR	NR	NR
	Rotondano 2011 [8]	NVUGIB Italy	2380	0.67	NR	NR	NR	NR
	Custodio Lima 2013 [9]	NVUGIB Brazil	656	0.69	0.52	NR	NR	NR
	Stanley 2017 [10]	All UGIB, USA, Scotland, England, Denmark, Singapore, New Zealand	3012	0.72	0.64	NR	NR	NR
	Yang 2016 [11]	NVUGIB, Korea	1584	0.76	0.64	NR	NR	NR
	Taha 2016 [13]	NVUGIB, UK	1220	NR	NR	NR	NR	0.77
	Gu 2018 [14]	All UGIB, China	799	0.79	NR	NR	NR	NR
	Bryant 2013 [15]	All UGIB, Australia	888	NR	0.64	0.76	0.64	0.70
	Stanley 2011 [16]	All UGIB, UK	1555	0.74	NR	NR	NR	0.75
pRS	Custodio Lima 2013 [9]	NVUGIB Brazil	656	0.65	0.52	NR	NR	NR
	Stanley 2017 [10]	All UGIB, USA, Scotland, England, Denmark, Singapore, New Zealand	3012	0.72	0.62	0.61	NR	NR
	Oakland 2018 [17]	All UGIB, Canada, UK, Australia	10639**	0.70	0.56	0.51	0.49	0.61
			2072	0.79	0.64	0.66	0.62	0.75
	Ko 2017 [18]	All UGIB, Korea	590	0.93	NR	NR	NR	NR
	Budimir 2017 [19]	Peptic ulcer bleeding, Croatia	1012	0.82	0.61	NR	NR	0.68
	Yang 2016 [11]	NVUGIB, Korea	1584	0.75	0.59	NR	NR	NR
	Bryant 2013 [15]	All UGIB, Australia	888	NR	0.57	0.66	0.51	0.68
	Stanley 2011 [16]	All UGIB, UK	1555	0.80	NR	NR	NR	0.73
GBS	Stanley 2017 [10]	All UGIB, USA, Scotland, England, Denmark, Singapore, New Zealand	3012	0.64	0.66	0.75	NR	NR
	Oakland 2018 [17]	All UGIB, Canada, UK, Australia	10639**	0.67	0.59	0.58	0.61	0.83
			2072	0.74	0.68	0.78	0.70	0.93
	Ko 2017 [18]	All UGIB, Korea	590	0.66	NR	NR	NR	NR
	Kim 2018 [20]	All UGIB, Korea	530	0.66	NR	NR	NR	0.70*
	Gu 2018 [14]	All UGIB, China	799	0.71	NR	NR	NR	NR
	Budimir 2017 [19]	Peptic ulcer bleeding, Croatia	1012	0.63	0.75	NR	NR	NR
	Taha 2016 [13]	NVUGIB, UK	1220	NR	NR	NR	NR	0.77
	Yang 2016 [11]	NVUGIB, Korea	1584	0.64	0.56	NR	NR	NR
	Bryant 2013 [15]	All UGIB, Australia	888	NR	0.71	0.76	0.71	0.81
	Stanley 2011 [16]	All UGIB, UK	1555	0.80	NR	NR	NR	0.93
AIMS-65	Stanley 2017 [10]	All UGIB, USA, Scotland, England, Denmark, Singapore, New Zealand	3012	0.77	0.60	0.75	NR	NR
	Kim 2018 [20]	All UGIB, Korea	530	0.69	NR	NR	NR	0.76*
	Gu 2018 [14]	All UGIB, China	799	0.91	NR	NR	NR	NR
	Saltzman 2011 [5]	All UGIB, USA	32,504	0.77	NR	NR	NR	NR

NR, not reported; * Transfusion of >4 units RBC; ** The study by Oakland et al. included two separate cohorts of patients.

endoscopic haemostasis have also been developed but have not been adopted into widespread practice [21].

Comparing the performance of widely used risk scores in UGIB

Most national guidelines focus on the use of RS and GBS, but as neither accurately predicts all important outcomes (such as mortality and need for endoscopy) current guidelines recommend that both full RS and GBS are calculated. However as RS relies on endoscopic findings it utility in triaging patients and planning intervention is limited.

The largest study comparing the performance of pRS and GBS was conducted by Oakland et al. in 10,639 patients with UGIB, finding that the pRS performs little better than chance alone at predicting re-bleeding, endoscopic therapy, radiological or surgical hemostasis, and was no better than GBS at predicting mortality (AUROC 0.67 for GBS and 0.70 for pRS; $P = 0.21$) [17]. In a study of 1555 patients Stanley et al. also found equivalent performance between GBS and pRS at predicting death [16]. However, two other large studies found conflicting results. pRS performed better than GBS at predicting death in studies by Yang et al. and Budimir et al., reporting AUROCs of 0.75 versus 0.64, and 0.71 versus 0.57, respectively [11,19]. These studies differ from those by Oakland et al. and Stanley et al.; Ko et al. used a population of just 590 participants, and Budimir et al. limited their study population to patients with peptic ulcer bleeding. Despite the uncertainty regarding the value of GBS at predicting mortality, studies consistently demonstrate that it performs better than pRS in the prediction of re-bleeding [10,15], need for endoscopic therapy [10,15,19], hospital-based intervention [11] and a composite outcome of intervention or death [10].

There are conflicting reports on the efficacy of AIMS-65. The large study by Oakland et al. was unable to compare GBS to AIMS-65 due to missing data for the latter. A study by Stanley et al. found that AIMS-65 was superior at predicting mortality (AUROC 0.77 versus 0.64 for GBS) but that GBS was superior at predicting intervention and mortality (AUROC 0.86 versus 0.68) [10]. Gu et al. also found that AIMS-65 was superior to GBS at predicting death [14]. Another study of 433 UGIB patients found that AIMS-65 was inferior to GBS at predicting death, however [22]. AIMS-65 was also not as good as GBS at predicting re-bleeding, endoscopic haemostasis or RBC transfusion. Further studies comparing AIMS-65 and GBS are required. In preliminary studies the CANUKA score performed similarly to GBS [17]. Further studies are required to establish whether CANUKA provides any advantage over GBS and also to compare its performance to that of AIMS-65.

Table 4
Validated scoring systems designed for use in LGIB.

Score	Derivation population	Population size	Main Predicted outcome	Outcome definition	Internal validation
BLEED	Upper or lower GIB, USA	465	In-hospital complication	Re-bleeding, surgery to control the source of hemorrhage, hospital mortality	Performed but not statistically reported
NOBLADS	All LGIB, Japan	439	Severe LGIB	Continuous and/or recurrent bleeding	0.77
Strate	All LGIB, USA	252	Severe LGIB	Continued bleeding within the first 24 h of hospitalization (transfusion of ≥2 units RBC and/or hematocrit decrease of ≥20%) and/or recurrent bleeding> 24 h of stability (additional transfusions, further hematocrit decrease ≥20%, or readmission for LGIB within 1 week of discharge	Performed but not statistically reported
Oakland	All LGIB, UK	2336	Safe discharge	Absence of re-bleeding, blood transfusion, therapeutic intervention, 28-day re-admission or death	0.84
Sengupta	All LGIB, USA	4044	Mortality	30 days	0.81

Identifying low risk patients

An additional desirable outcome of a risk score is the ability to identify patients at low risk of harm, who may be suitable for outpatient management. Guidelines suggest that patients with a GBS of ≤1 could be suitable for early discharge [23]. However in clinical practice very few patients have such a low score [11]. Additionally, observational studies suggest that some patients with a low score may ultimately hospital-based intervention [24]. Stanley et al. assessed a GBS threshold of ≤1 in 3012 patients, reporting that 1.8% of patients required RBC transfusion, 1.4% required endoscopic haemostasis and 0.4% died, giving a negative predictive value of 56% [10]. Laursen et al. and Banister et al. assessed a threshold of ≤2 in 2035 and 569 patients, respectively [25,26]. In both studies patients experienced adverse outcomes; 3% in the Laursen study and 8% in the Banister study.

There have been attempts at modifications to the established risk scores to enhance the identification of low risk patients. Stephens et al. describe a modification to the GBS that up-scores patients based on age, which allows the threshold for safe discharge to be extended to a score of 2 in patients aged less than 70 years [27], which may identify twice as many low risk patients as GBS [28]. Whether this is safe to adopt into standard practice requires further study.

The CANUKA score was designed to predict absence of 'poor outcome' as well as identify patients at risk of adverse events (Table 1). Oakland et al. reported that a CANUKA score of ≤1 had a probability of safe discharge of 96.3% [17]. However a score of ≤1 was applicable to only 7% of the patient population. In comparison, in the same study a GBS of ≤1 was applicable to 24%. A previous study in LGIB has suggested that 95% is an acceptable probability for safe discharge [29]. Extending the CANUKA score to ≤2 maintained a probability of safe discharge of >95%, and identified a greater proportion of patients, however there was a trade off with specificity; nine patients re-bled, including one death [17]. CANUKA is yet to be further externally validated.

Risk stratification in lower GI bleeding

In comparison to UGIB, there is a lack of options for risk stratification in LGIB. Scores that do exist are either poorly externally validated, or have failed to be adopted into widespread clinical practice (Table 4). Recently the Oakland score has been developed which focuses on the identification of patients who are at low risk of adverse outcomes (Table 5).

Adverse outcome scores

The BLEED score (on-going bleeding, systolic blood pressure, elevated prothrombin time, erratic mental status, unstable co-morbid disease) was developed in 465 patients and aims to predict in-hospital complication [30]. Oakland et al. investigated its performance in 2336 patients with LGIB, finding that it did have some ability to predict death (AUROC 0.68), but was less good at predicting re-bleeding or RBC transfusion (Table 4). Small database studies from Europe also report that it has limited ability to predict adverse events [31,32].

The NOBLADS score was developed from 439 hospitalised patients with LGIB in Japan and uses non-steroidal anti-inflammatory (NSAID) use, no diarrhoea, no abdominal tenderness, systolic blood pressure, antiplatelet use, albumin, co-morbidity score and syncope to predict severe LGIB [12]. The same authors externally validated

Table 5
The Oakland score for predicting safe discharge.

Predictor	Score component value
Age	
<40	0
40–69	1
>70	2
Gender	
Female	0
Male	1
Previous LGIB admission	
No	0
Yes	1
DRE findings	
No blood	0
Blood	1
Heart rate	
<70	0
70–89	1
90–109	2
>110	3
Systolic blood pressure	
50–89	5
90–119	4
120–129	3
130–159	2
>160	0
Haemoglobin	
36–69	22
70–89	17
90–109	13
110–129	8
130–159	4
>160	0

the score in 511 patients, reporting good performance in the prediction of death, re-bleeding and RBC transfusion (AUROCs 0.83, 0.74 and 0.71, respectively) [33]. Oakland et al. attempted to further validate the score but reported that although it did moderately predict death, it was a weaker predictor of re-bleeding and RBC transfusion (Table 6).

The Strate score was developed in 252 patients with LGIB and uses heart rate, blood pressure, syncope, non-tender abdominal examination, bleeding per rectum within the first 4 h of evaluation, aspirin use and co-morbidity to predict severe bleeding [34]. In a separate study of 275 patients the authors externally validated the score, reporting an AUROC of 0.75 [35]. The largest study externally validating this score was performed by Oakland et al. who reported that it had a good discriminative ability at predicting RBC transfusion (AUROC 0.73), but was a weaker predictor of morality and re-bleeding [29]. Small database studies have also found that it does not reliably predict adverse outcomes [32,36].

The Sengupta score was derived from 4044 patients with LGIB and uses age, dementia, metastastic cancer, chronic kidney disease, respiratory disease, anticoagulant use, haemoatocrit and albumin to predict death [37]. The authors externally validated the score in a cohort of 2060 patients reporting an AUROC of 0.72. A small study of 170 patients found that it did not reliably predict death, or severe bleeding [36]. It is yet to be further externally validated.

Upper GI risk scores in LGIB

There is also evidence that risk scores designed for UGIB may be effective at stratifying risk in patients with LGIB. Oakland et al. assessed the performance of pRS, GBS and AIMS-65 in 2336 patients with LGIB, reporting that of these scores AIMS-65 was the best at predicting death, but that GBS was the best at predicting re-bleeding or RBC transfusion (Table 6). Ur-Rahman et al. compared the performance of GBS in 562 UGIB and 464 LGIB patients at predicting a composite outcome of death, haemostatic intervention and RBC transfusion, finding comparable performance in the two groups (LGIB AUROC 0.78 versus UGIB AUROC 0.77) [38].

Oakland score

The Oakland score was designed to predict safe discharge, a composite outcome compiled of absence of re-bleeding, blood transfusion, therapeutic intervention, 28-day re-admission or death. It was developed from 2336 patients with LGIB form a national prospective observational study in the UK and is composed of seven variables: age, gender, previous LGIB admission, digital rectal examination findings, heart rate, systolic blood pressure and haemoglobin (Table 5) [29]. Although the score was designed to predict safe discharge, it also predicts adverse outcomes such as re-bleeding and RBC transfusion (Table 6). A recent study of 170 patients hospitalised with LGIB who underwent colonoscopy found that it also predicted severe bleeding (AUROC 0.74) although GBS was superior at predicting RBC transfusion (AUROC 0.87) [36]. In the original study by Oakland et al., the score outperformed GBS, pRS, AIMS-65, Strate and NOBLADS at predicting patients who would be safe for immediate discharge from hospital [29]. An Oakland score of <9 is associated with a 95% chance of safe discharge [29].

Other risk scores for LGIB

Several studies have developed prognostic algorithms using artificial neural networks, however these scores are restricted by the high number of variables needed to compute the score [39,40]. Hreinsson et al. sought to derive a new score to predict adverse outcomes; the SHA2PE score, but this is yet to be externally validated [41].

Comparing the performance of risk scores in LGIB

There are few large studies that directly compare the performance of risk scores within a LGIB population (Table 6). The largest is the study of 2336 patients by Oakland et al., who reported that AIMS-65 and RS were the strongest predictors of death, Oakland and GBS were the strongest predictors of re-bleeding, no score predicted need for haemostatic intervention well, and Oakland was the strongest predictor of RBC transfusion [29].

Discussion and summary

Decisions about the optimal risk score to use should consider the importance of the outcome predicted, as well as the performance of the score. Traditionally the RS has been used to predict mortality in UGIB, although in the larger validation studies all AUROCs are <0.8. Additionally the requirement of endoscopic findings is a major limitation. The pRS avoids this limitation, but studies suggest that it does not improve much on the performance of GBS and is significantly poorer at predicting other important clinical outcomes. The AIMS-65 score may yet be shown to be the best predictor of death given promising results in previous studies. The accurate prediction of death has allowed the deployment of resources that may reduce risk of death, such as early endoscopy and multimodal endoscopic therapy. Robust risk scoring has likely contributed to the reduction in case fatality rates seen in the last two decades [42]. The prediction of death in patients with LGIB may have less utility than for UGIB because fewer patients die, [43] and there is considerable uncertainty about which interventions improve clinical outcomes [44].

For both UGIB and LGIB most admitted patients do not come to harm, but do use considerable healthcare resources [2,45]. This has led to increased interest in the use of risk scores to identify patients at low risk of harm, who can be immediately discharged for

Table 6
External validation studies in the prediction of outcomes in LGIB.

Score	Study	External validation population	Population size	External validation (AUROC)				
				Mortality	Re-bleeding	Endoscopic treatment	Surgery or IR	RBC transfusion
BLEED	Oakland 2017 [29]	All LGIB, UK	2336	0.68	0.63	NR	NR	0.63
NOBLADS	Oakland 2017 [29]	All LGIB, UK	2336	0.72	0.62	NR	NR	0.66
	Aoki 2018 [33]	All LGIB, Japan	511	0.83	0.74	NR	NR	0.71
Strate	Oakland 2017 [29]	All LGIB, UK	2336	0.67	0.66	NR	NR	0.73
Oakland	Oakland 2017 [29]	All LGIB, UK	2336	0.67	0.74	NR	NR	0.92
pRS	Oakland 2017 [29]	All LGIB, UK	2336	0.75	0.61	NR	NR	0.64
GBS	Oakland 2017 [29]	All LGIB, UK	2336	0.73	0.74	NR	NR	0.86
AIMS-65	Oakland 2017 [29]	All LGIB, UK	2336	0.78	0.63	NR	NR	0.63

outpatient management. In UGIB, GBS is the most extensively studied score to do this, though clinicians face uncertainty about which score threshold to use as studies show that some patients with GBS 0–1 may come to harm. The CANUKA score aims to improve on the GBS at identifying low risk patients but captures a smaller proportion of patients. Future research should prospectively investigate whether it is safe to extend the CANUKA safe discharge threshold to ≤2 and directly compare patient capture to that of a range of GBS thresholds. In LGIB the Oakland score has specifically been designed for this purpose and a preliminary study demonstrates that it is a better predictor than the other scores. Its major limitation is that it identifies a relatively small number of patients. Further studies should investigate whether its thresholds can be extended to >9 for safe discharge.

The continued evolution of treatments may mean that scores that were once valid become archaic. An example of this is the use of RBC transfusion in UGIB, which is predicted most effectively by GBS. Recent studies suggest that liberal RBC transfusion may be associated with harm in patients with UGIB [46] and national guidelines recommend restrictive transfusion in patients who are not shocked. The randomised studies that described the adverse effects of liberal transfusion were reported in 1999, 2013 and 2015 [46], therefore after the development of GBS. Whether GBS is able to predict this outcome once restrictive blood transfusion becomes established will require further research.

In summary there are several well validated risk scores for UGIB but fewer for LGIB. For LGIB the risk scores are not well established and those that have been developed are at early stages of external validation.

Practice points

- The GBS may be the preferred risk score for use in UGIB as it is reliably superior at predicting re-bleeding and hospital-based interventions, and may be as good as the pRS at predicting death
- Newer scores such as AIMS-65 and CANUKA may prove to be the best predictors of death and safe discharge respectively
- The Oakland score is a new risk score for use in LGIB and performs well at identifying low risk patients

Research agenda

- Further studies examining the safety of identifying low risk patients using GBS 0–2 and comparing to that of the CANUKA score are required
- Studies to determine the best scores to predict adverse outcomes in LGIB should be undertaken
- Further external validation of AIMS-65, CANUKA and the Oakland score is required

Conflicts of interest

None.

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