

**Supplementary material 1**

Search Strategy, developed for Medline (Ovid), October 9, 2018.

For the full search strategy please contact the study authors.

**Medline (October 9, 2018)**

Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily <1946 to Present>

1	exp *"Wounds and Injuries"/	685268
2	exp *Emergency Service, Hospital/	40504
3	exp *Emergency Medicine/	9475
4	exp *Emergency Treatment/	67739
5	exp *Emergency Medical Services/	82657
6	exp *Accidents/sn [Statistics & Numerical Data]	12878
7	*Traumatology/	2723
8	Traumatology/og, st, sn	889
9	*Disasters/	13701
10	*Disaster Medicine/	599
11	exp *Terrorism/	8845
12	*Relief Work/	2679
13	*Emergency Shelter/	83
14	*Rescue Work/	1344
15	or/1-14	845684
16	*"surveys and questionnaires"/	40830
17	Interviews as Topic/	55343
18	*Needs Assessment/	8221
19	exp *Quality Assurance, Health Care/og, st	29186
20	Vital Statistics/	5050
21	Medical Errors/	15457
22	*Registries/	22443
23	Injury Severity Score/	14406
24	*Hospitalization/sn	11858
25	*Quality Improvement/	9657
26	Benchmarking/	12274
27	*Quality Indicators, Health Care/	7910
28	or/16-27	223545
29	exp *"Delivery of Health Care"/ or Delivery of Health Care/mt, st	591826
30	exp *Health Services Accessibility/	54186
31	*"Health Services Needs and Demand"/	21052
32	*"outcome assessment (health care)"/	26940
33	*"outcome and process assessment (health care)"/	9293
34	*patient outcome assessment/	1611
35	*"Process Assessment (Health Care)"/	2337

36	*Risk Assessment/mt	13979
37	*Triage/ or Triage/og or (Triage/ and Health Services Research/)	6076
38	Program Evaluation/	57581
39	exp *Disaster Planning/mt, og	4659
40	or/29-39	692765
41	15 and 28 and 40	3417
42	*Trauma Centers/st	470
43	((trauma* or postrauma*) adj3 (access* or capacit* or evaluat* or assess* or tool or tools or interview* or survey* or qualit* improv*)).ti,kf.	2044
44	((emergency* or emergencies*) adj3 (access* or capacit* or evaluat* or assess* or qualit* improv* or indicator*)).ti,kf.	1927
45	((trauma* or postrauma* or emergency* or emergencies*) adj3 (access* or capacit* or benchmark* or evaluat* or assess* or triage* or rapid* or checklist* or check-list* or survey* or questionnair* or tool or tools or interview* or indicator* or (qualit* adj1 (assurance* or improv* or measure* or control*))).ab. /freq=3	558
46	(three-delay* or ((trauma* or postrauma* or emergency* or emergencies*) adj3 ((time* or length or duration*) adj1 (delay* or factor*))).tw,kf.	273
47	((trauma* or postrauma* or emergency* or emergencies*) and ((verbal* or social*) adj2 autops*)).tw,kf.	48
48	15 and ((verbal* or social*) adj2 autops*)).tw,kw.	36
49	or/41-48	8359
50	Animals/ not (Animals/ and Humans/)	4469363
51	((animal or animals or cat or cats or dog or dogs or feline or hamster* or mice or monkey or monkeys or mouse or murine or pig or pigs or piglet* or porcine or primate* or rabbit* or rats or rat or rodent* or sheep*) not (human* or patient*)).ti,kf.	1993676
52	49 not (50 or 51)	8266
53	from 52 keep 1-5000	5000
54	remove duplicates from 53	4992
55	from 50 keep 5001-8266	3266
56	remove duplicates from 55	3266
57	54 or 56	8258

**Supplementary Material 2****List of relevant national and international health organisations' websites to search.**

- World Health Organisation. (<https://www.who.int>)
- World Bank. (<https://www.worldbank.org>)
- USAID. (<https://www.usaid.gov>)
- United Nations Educational Scientific and Cultural Organisation. (<https://en.unesco.org>)
- Medecins Sans Frontiers. (<https://www.msf.org>)
- International Committee of the Red Cross. (<https://www.icrc.org>)
- The International Federation of Red Cross and Red Crescent Societies.  
(<https://www.ifrc.org/en/--/>)
- International Federation of Emergency Medicine. (<https://www.ifem.cc>)
- African federation of emergency medicine. (<https://afem.africa>)
- Asian society of emergency medicine. (<http://www.asiansem.org>)
- International Association for Trauma Surgery and Intensive Care. (<https://www.iatsic.org>)
- College of Surgeons of East, Central and Southern Africa. (<http://www.cosecsa.org>)
- G4Alliance. (<http://www.theg4alliance.org>)

**Supplementary Material Table 1 Studies according to World Bank Region by delay.**

<b>Geographic region</b>	<b>Total</b>	<b>Delay 1 (alone or combined)</b>	<b>Delay 2 (alone or combined)</b>	<b>Delay 3 (alone or combined)</b>
Sub-Saharan Africa	49	11	21	36
Latin America & Caribbean	24	0	5	18
South Asia	21	0	10	19
East Asia & Pacific	19	1	5	13
Middle East & North Africa	16	0	12	14
North America	8	0	5	7
Europe & Central Asia	5	0	4	5
Notes:				
More than one geographic region may apply per study				
Studies not assigned a delay included within total				

**Supplementary Material Table 2 Table of methodological approaches mapped to delays**

Included within methodology	Total	Delay 1 (alone or combined)	Delay 2 (alone or combined)	Delay 3 (alone or combined)	Not assigned
Facility assessment data	40	0	7 <sup>83 86 139 141-144</sup>	39 <sup>80 83 86-111 139 141 143-146 148 152 157 158 224</sup>	0
Medical record review	20	1 <sup>85</sup>	13 <sup>85 112-114 118 126-129 154 156 161 225</sup>	19 <sup>79 85 112-114 116-118 126-131 154 156 159 161 225 227</sup>	0
Registry review	14	0	10 <sup>119-122 124-129</sup>	13 <sup>120-131 150</sup>	0
Qualitative analysis	13	4 <sup>37 73 74 85</sup>	9 <sup>73-75 77 78 81 85 194 228</sup>	10 <sup>73 74 76 82 77 78 81 85 194 228</sup>	1 <sup>69</sup>
HCW interviews	13	1 <sup>73</sup>	9 <sup>73 75 77 78 83 84 86 194 228</sup>	11 <sup>73 76-78 80 83 84 86 90 194 228</sup>	1 <sup>69</sup>
Household Survey	8	7 <sup>132-138</sup>	5 <sup>135-139</sup>	1 <sup>139</sup>	0
Patient interviews	7	4 <sup>37 73 74 85</sup>	4 <sup>73 74 78 85</sup>	6 <sup>73 74 76 79 78 85</sup>	0
Preventable death panel	7	0	5 <sup>112 114 140 155 162</sup>	7 <sup>130 131 112 114 140 155 162</sup>	0
HCW survey	6	0	1 <sup>229</sup>	1 <sup>229</sup>	5 <sup>68-72</sup>
Secondary analysis of study data	6	0	2 <sup>142 160</sup>	4 <sup>145 146 157 158</sup>	0
Delphi study	5	0	2 <sup>114 149</sup>	1 <sup>114</sup>	3 <sup>64 66 67</sup>
GIS analysis	4	0	4 <sup>142 143 151 160</sup>	1 <sup>143</sup>	0
Other stakeholder FGD	4	1 <sup>73</sup>	4 <sup>73 84 194 228</sup>	4 <sup>73 84 194 228</sup>	0
Other stakeholder interviews	4	0	4 <sup>78 84 194 228</sup>	4 <sup>78 84 194 228</sup>	0
Literature review	4	0	2 <sup>163 230</sup>	3 <sup>158 163 230</sup>	1 <sup>64</sup>
Community FGDs	3	2 <sup>73 133</sup>	2 <sup>73</sup>	2 <sup>73 84</sup>	0
HCW discussion meetings	3	0	2 <sup>17 81</sup>	2 <sup>17 81</sup>	1 <sup>68</sup>
HCW FGD	3	0	2 <sup>194 228</sup>	3 <sup>82 194 228</sup>	0
Patient survey	3	1 <sup>193</sup>	2 <sup>164 229</sup>	3 <sup>164 193 229</sup>	0
Secondary analysis of procedural data	3	0	1 <sup>143</sup>	3 <sup>143 145 147</sup>	0
Autopsy report review	2	0	2 <sup>118 154</sup>	2 <sup>118 154</sup>	0
Care observation	2	0	1 <sup>17</sup>	2 <sup>17 159</sup>	0
Prehospital checklist assessment	2	0	2 <sup>83 84</sup>	2 <sup>83 84</sup>	0
Road traffic injury database review	1	0	1 <sup>151</sup>	0	0
Review of facility referral proformas	1	0	1 <sup>115</sup>	1 <sup>115</sup>	0
Travel time analysis	1	0	1 <sup>144</sup>	1 <sup>144</sup>	0
Document review	1	0	1 <sup>194</sup>	1 <sup>194</sup>	0
Individual visit to institutions	1	0	1 <sup>231</sup>	1 <sup>231</sup>	0
Teleconference case analysis	1	0	1 <sup>141</sup>	1 <sup>141</sup>	0
Patient group discussions	1	0	1 <sup>17</sup>	1 <sup>17</sup>	0
Family member interviews	1	1 <sup>74</sup>	1 <sup>74</sup>	1 <sup>74</sup>	0
Patient FGDs	1	1 <sup>73</sup>	1 <sup>73</sup>	1 <sup>73</sup>	0
Guidelines development	1	0	0	0	1 <sup>65</sup>

More than one methodological component possible per study. Discussions outside of FGDs represent a methodology that did not include formal recording, transcription and in-depth analysis. FGD – Focus Group Discussion, HCW – Health Care Worker, GIS – Geographic Information System.

**Supplementary Material Table 3 Study methods we judged to be potentially suitable or potentially unsuitable for rapid health system assessment**

Study method suitability for rapid health system assessment	
Potentially suitable	Patient, staff or stakeholder interviews, meetings, group discussion or surveys <sup>37 68-84</sup> . Sometimes combined with care observation <sup>17</sup> or case note supplementation <sup>85</sup> .
	Facility assessments through survey or interview <sup>86-111</sup> .
	Literature reviews <sup>64 158 163 230</sup> .
	Secondary data analysis <sup>108 145 146 157</sup> . Including adaptation of routine procedural data <sup>147</sup> .
	Delphi studies for expert consensus <sup>64 66 67 149</sup> .
	Application of established guidelines as assessment through document review or stakeholder discussion <sup>65 194 224 228</sup> .
	EMS process measure review <sup>150</sup> .
	GIS analysis <sup>142 143 151 160</sup> .
	Actual travel time analysis <sup>144</sup> .
	Teleconference based case analysis and electronic survey <sup>141</sup> .
Potentially unsuitable	Retrospective studies reliant on case note data <sup>112-118</sup> , established registry data <sup>119-124</sup> , or a combination of both <sup>125-131</sup> .
	Household surveys in the local language <sup>132-139</sup> .
	Prospective patient surveys <sup>164 193</sup> .
	Prospective case note review of injured cohorts <sup>154 156 161 225</sup> .
	Combining record data with care <sup>159</sup> or transfer process observation <sup>227</sup> .
	Preventable death panel reviews <sup>140 155 162</sup> .
	A yearlong patient and staff survey <sup>229</sup> .
	Serial WHO ETC assessments either side of a trauma training programme <sup>148</sup> .
	Institutional visits not reported clearly enough to replicate <sup>231</sup> .

**Supplementary Material Table 4 – How different study data sources were combined .**

<b>Method type</b>	<b>Other methods triangulated with</b>
Household Surveys	Focus group discussions <sup>133</sup> Facility assessment data and EMS data review <sup>139</sup>
Discussion groups	Household survey data <sup>133</sup> Stakeholder interviews and document review <sup>194</sup> EMS data review and stakeholder interviews <sup>84</sup> Care observation <sup>17</sup> Staff interviews <sup>73</sup> Health care worker survey <sup>68</sup>
GIS or travel time	Police data <sup>151</sup> Facility assessment data <sup>142 144</sup> Facility assessment data, ministry health data and administrative data <sup>143</sup>
Government ministry or police data	GIS <sup>151</sup> Secondary study analysis <sup>160</sup> Facility assessment data <sup>145</sup> Facility assessment and logbook data <sup>108</sup> Facility assessment data, GIS and administrative data <sup>143</sup>
Facility assessment data	Household survey and EMS data review <sup>139</sup> GIS <sup>142</sup> Travel time analysis <sup>144</sup> EMS data review <sup>83</sup> Peer case analysis <sup>141</sup> Ministry of health data, GIS and administrative data <sup>143</sup> Staff interviews <sup>86 80</sup> Clinician knowledge assessment <sup>94</sup> Logbook data <sup>106 105</sup> Desk review <sup>107</sup> Ministry of health data <sup>145</sup> Ministry of health data and logbook data <sup>108</sup>
Trauma Registry	EMS data review <sup>121 126</sup> EMS data review and medical record review <sup>125</sup> Peer review and TRISS analysis <sup>112</sup> Peer review, TRISS analysis and clinician compliance <sup>130</sup> Peer review, TRISS analysis and key performance indicator assessment <sup>131</sup>
EMS data review	Trauma registry <sup>121 126</sup> Trauma registry and medical record review <sup>125</sup> Facility assessment <sup>83</sup> Facility assessment and household survey <sup>139</sup> Focus group discussion and stakeholder interviews <sup>84</sup>
TRISS analysis	Peer review and trauma registry <sup>112</sup> Peer review, trauma registry and clinician compliance <sup>130</sup> Peer review, trauma registry and key performance indicator assessment <sup>131</sup>
Administrative records	Trauma registry and medical records <sup>127</sup> Facility assessment data, GIS and ministry of health data <sup>143</sup>
Medical record review	Trauma registry and EMS data review <sup>125</sup> Trauma registry and administrative records <sup>127</sup> Peer review and Delphi <sup>114</sup> Staff interviews <sup>85</sup> Stakeholder interviews and vehicle inspection <sup>227</sup>
Peer review analysis or panel	Trauma registry and TRISS analysis <sup>112</sup> Medical record review and Delphi <sup>114</sup> Facility assessment <sup>141</sup> Trauma registry, TRISS analysis and clinician compliance <sup>130</sup> Trauma registry, TRISS analysis and key performance indicator assessment <sup>131</sup>
Delphi study	Medical record review and peer review panel <sup>114</sup> Literature review <sup>64</sup>
Staff or stakeholder interviews	Focus group discussions and document review <sup>194</sup> Focus group discussion and EMS data review <sup>84</sup> Focus group discussion <sup>73</sup>

	Facility assessment data <sup>86 80</sup> Medical record review <sup>85</sup> Medical record review and vehicle inspection <sup>227</sup> Literature review and healthcare worker survey <sup>70</sup>
Document, desk or literature review	Focus group discussions and stakeholder interview <sup>194</sup> Facility assessment <sup>107</sup> Stakeholder interview and healthcare worker survey <sup>70</sup> Delphi <sup>64</sup>
Clinician compliance or knowledge assessment	Facility assessment data <sup>94</sup> Trauma registry, TRISS analysis and peer review panel <sup>130</sup>
Logbook data	Facility assessment data <sup>106 105</sup> Facility assessment and ministry of health data <sup>108</sup>
Healthcare worker survey	Group discussion <sup>68</sup> Literature review and stakeholder interview <sup>70</sup>



**Supplementary Material Table 5 Original study author reported pragmatic and non-pragmatic features of studies**

<b>Positively pragmatic aspect</b>		
<b>Category</b>	<b>Reported positively pragmatic aspect</b>	<b>Study method associated with author reported features</b>
Leveraging available data or infrastructure.	Police injury data readily available to facilitate GIS analysis <sup>151</sup> .	Road traffic injury database review with GIS analysis. <sup>151</sup> .
	High quality spatial data increasingly available to perform GIS analysis <sup>142</sup> previously more restricted in earlier studies <sup>151</sup> .	GIS Modelling study evaluating physical access to emergency care facilities. <sup>142</sup> Road traffic injury database review with GIS analysis. <sup>151</sup> .
	Technological advances facilitated international trauma teleconferencing for care quality assessment and improvement <sup>141</sup> .	Mixed methods use of teleconferencing for academic discussion model case analysis and electronic surveys to evaluate care processes and structures <sup>141</sup> .
	Adapting an existing database, including those primarily for administrative use and billing, can be a pragmatic way to evaluate outcomes and processes of care following injury <sup>147</sup> .	A retrospective study using administrative procedural codes before and after a Standardised Trauma Protocol intervention <sup>147</sup> .
	The wide availability of routinely reported data such as C-section rates was proposed as potentially useful as a surrogate for facility trauma care capacity. <sup>145</sup>	Secondary analysis of reported WHO TSAEEESC facility data and MoH procedural data (C-section and hernia repair) for associations between procedure frequency and resource availability. <sup>145</sup>
Effective engagement of stakeholders.	Leveraging pre-existing research networks or panels helped enable community based FGDs shed insight to prehospital trauma care. <sup>84</sup>	A mixed method cross sectional study using FGDs, interviews and checklist surveys. <sup>84</sup>
	Engaging MoH stakeholders and leadership was reportedly important to be able to conduct assessments effectively. <sup>17 109 150</sup>	Cross sectional mixed methods using small group discussion and observation of care. Developed tool from American College of Surgeons guidelines. <sup>17</sup> Cross sectional survey (PIPES and INTACT) of facility staff. <sup>109</sup> Pre and post QI intervention study using ambulance service maintained database for effect on measure of prehospital care processes. <sup>150</sup>
	Access to HCWs for study participation was aided by established contact networks <sup>78</sup> attending professional meetings <sup>70</sup> and exploiting electronic, telephonic and mail communication <sup>67 110</sup> .	Qualitative cross-sectional study using in-depth interviews. Develops own framework. <sup>78</sup> Cross sectional survey of health care workers. Draws on WHO TQIP. Administered to health care providers at a conference. <sup>70</sup> Delphi study, via questionnaire, identifying indicators for trauma care process evaluation. <sup>67</sup> Cross sectional telephone or electronic survey based on WHO TSAEEESC of key facility personnel. <sup>110</sup>
Methodological convenience and	Some patient surveys or interviews took practical approaches including	Prospective patient survey <sup>164</sup> Qualitative cross-sectional study using interviews. <sup>74</sup>

feasibility was maximised.	convenience sampling and using family members as proxies. <sup>74 164</sup>	
	Some authors applied HIC criteria directly to an LMIC setting reporting effective direct translation for health system assessment <sup>194</sup> .	Cross sectional study using semi-structured, unstructured interviews, FGDs and document review involving multiple stakeholders. Draws on American College of Surgeons guidelines <sup>194</sup> .
	The widespread use of certain tools such as the WHO ETC, allowed potential for pan country or international comparisons to be drawn <sup>88 89 95 96</sup> .	Cross sectional WHO ETC based instrument using staff interviews and inspection. <sup>88 89 95 96</sup> .
	Some tools were found to be simple to use and administered quickly in each facility often only over a few hours per facility <sup>88 89 95 96 157</sup> .	Cross sectional WHO ETC based instrument using staff interviews and inspection. <sup>88 89 95 96</sup> . INTACT assessment score developed from Secondary analysis of WHO TSAAEESC and PIPES survey data <sup>157</sup> .
<b>Negatively pragmatic aspects</b>		
<b>Category</b>	<b>Reported negatively pragmatic aspect</b>	<b>Study method associated with author reported features</b>
Difficult practical challenges of facility based research.	Retrospective case note data extraction was acknowledged as cumbersome <sup>114</sup> .	A mixed method study using cross sectional and retrospective data sources including Delphi, case note review and peer review analysis of deaths <sup>114</sup> .
	Medical record completeness was often insufficient <sup>116 117 159</sup> .	Retrospective case note review and application of TRISS methodology. <sup>116</sup> Retrospective medical records review. <sup>117</sup> Step wedged prospective study implementing the WHO Trauma Care Checklist using care observations and medical record review. <sup>159</sup>
	Trauma registries require the effort and skill of trained researchers to set up and maintain <sup>122</sup> .	Retrospective review of trauma registry <sup>122</sup> .
	Engaging and convening expert HCWs for preventable death panel review was difficult, taking longer than anticipated <sup>140 155 162</sup> .	Preventable death panel review <sup>140 155 162</sup> .
Practical challenges for study conduct across facilities or communities.	Security concerns limiting the scope of data collection in conflict affected settings <sup>17 111</sup> .	Cross sectional mixed methods using small group discussion and observation of care. Developed tool from American College of Surgeons. Limited to Military Hospital Juba set in South Sudan. <sup>17</sup> Cross sectional facility surveys during visits with direct inspection in non-government controlled Syrian during civil war. <sup>111</sup>
	Resource intensive household surveys require large numbers of field workers to undertake <sup>135</sup> .	Cross-sectional household survey based on WHO guidelines for community surveys on injuries and violence <sup>135</sup> .

**Supplementary Material Table 6 Author reported strengths and weaknesses of included studies.**

	<b>Author reported weaknesses of studies</b>
Aspects of care covered	Patient outcomes not assessed <sup>17 66 72 80 83 99 102 144 148 150</sup>
	Non-mortality related outcomes or indicators lacking e.g. complication rate <sup>67 123 159</sup>
	Care process not assessed <sup>102 106</sup>
	Care quality not assessed <sup>119</sup>
	Infrastructure not assessed <sup>103</sup>
	Resources not assessed <sup>123</sup>
	Timely availability of services not assessed <sup>92</sup>
Design choice	Sampling method non-randomised risking response bias and non-representation <sup>70-72 86 91 100 109 110 146 229</sup>
	Relies on recall risking recall bias <sup>70 134-137 139 164</sup>
	Retrospective <sup>124 126 128 129</sup>
	TRISS method relies on HIC orientated MTOS data set limiting applicability to LMICs <sup>124 161 225</sup>
	Resource availability or improvement does not necessarily equate to good or improved care process or outcome for injured persons. <sup>88 89 152</sup>
	Not able to adjust for population baseline demographics <sup>139</sup>
	Non blinded design <sup>159</sup>
	Cross sectional design limits ability to infer causality <sup>164</sup>
	Not experimental design for evaluating effectiveness <sup>154</sup>
	Observation can induce Hawthorne effect <sup>159</sup>
	If using C-section ratio as a marker of trauma capacity, improvements may mean the ratio of C-sections may correspond less to overall surgical capacity <sup>145</sup>
	Limited in scope e.g. no paediatric items assessed <sup>102</sup>
	C-section rate, when used as a marker of trauma capacity, is highly dependent on birth rate, national and local policies limiting generalisability <sup>145</sup>
	Asymmetrical data collection periods <sup>147</sup>
	Secular trends or seasonal variation could confound <sup>159</sup>
	Mixed method studies may not be understood by those reading the literature <sup>68</sup>
	Choice of consensus level in Delphi is a judgement and a different cut off could be used. <sup>67</sup>
Data availability	Small sample sizes risks bias and limits analysis and generalisability <sup>37 68 74 78 79 82 110 128 129 131 134 137 164</sup>
	Injury severity either not captured, adjusted or heterogenous <sup>125 133-135 146 147 151</sup>
	Some contributing risk factors could not be determined <sup>114</sup>
	Exact cause of death analysis not possible <sup>114</sup>
Study completeness	Expert consensus not achieved <sup>64</sup>
	Subjects not raised by experts will not be included <sup>149</sup>
	Transcripts not validated / verified <sup>75</sup>
	Highly variable resource, access and settings may limit comparability of multiple centres <sup>123</sup>
	Key surgical services not included <sup>111</sup>
	Patients not looked after by trauma team excluded about 1/4 <sup>116</sup>
	Clinical details not available to confirm the right process occurred with right patient <sup>147</sup>
	Some aspects of injury e.g. domestic violence / suicide might not be disclosed <sup>137</sup>
	Few penetrating injuries limits generalisability <sup>154</sup>

Definitions	Definitions of trauma systems and performance varies <sup>163</sup>
	Definition of quality prehospital care in LMICs not established <sup>150</sup>
Data Triangulation or validation or linking	Facility resources not confirmed with inspection / observation <sup>99 106 109 110 144 146</sup>
	Provider insights or perceptions not measured or validated in another way <sup>64 70-72</sup>
	Data not linked to hospital / facility records <sup>151</sup>
	Patient case level data not included <sup>91</sup>
	Skill competence reported not verifiable <sup>88</sup>
	No weighting applied to KPIs <sup>131</sup>
	Information about social capital and financial leveraging were self-reported and may underestimate true effect <sup>79</sup>
	Data inputted not possible to externally validate <sup>150</sup>
	Disease burden not established, unable to match resources to burden <sup>103</sup>
	No other data for comparison available <sup>17</sup>
	Self-report in HH survey inhibits independent validation of injury <sup>137</sup>
	Respondent estimates and observed patient volumes not well correlated <sup>111</sup>
Geographical	Geographically limited area limiting generalisability <sup>66 81 84 90 92-94 102 105 111 157 163</sup>
	Studies may have been focussed on only urban or rural environments <sup>37 68 70 71 81 106</sup>
	Low population density areas not included <sup>99</sup>
	Weighted to one geographic region <sup>71</sup>
	Urban and rural rates vary greatly for C-section <sup>145</sup>
	Dynamic conflict situation means likely out of date quickly <sup>111</sup>
System parts included	Community or prehospital care excluded <sup>80 85 94 101 103 104 108 114 120 124 128 148 153-158</sup>
	Follow up absent or hospital based only <sup>80 129 147 159</sup>
	Emergency phone number knowledge of or use was not assessed <sup>83</sup>
Interviewers	Social desirability possible with interview questions <sup>37 90 135 136</sup>
	Interpreters limit qual research insight / data lost in translation <sup>37 74</sup>
	Participants may not wish to offend interviewers e.g. if HCWs <sup>85</sup>
	Interviewer was foreign and not speaking native language <sup>70</sup>
	Interviewers may not have sufficient professional understanding e.g. med students interviewing HCWs. <sup>75</sup>
	Multiple interviewers may lead to inconsistency <sup>77</sup>
Data sources	Concern about missing, incomplete or inaccurate data. <sup>114 116 119 122 126 129 140 154 155 159-164</sup>
	No reliable trauma records or registry or data systems available <sup>86 94 106 147 164</sup>
	Data volume and quality available comparing HIC and LMIC contexts may limit comparability. <sup>127</sup>
	Non-electronic records limit case identification and data extraction <sup>162</sup>
	Literature is heterogenous <sup>163</sup>
	Use of secondary data meant some items were not included e.g. cervical collar <sup>157</sup>
	Relies on published data. <sup>158</sup>
	Relies on validity of reported findings <sup>158</sup>
	Limited literature to inform indicator development list <sup>67</sup>
	Secondary data sources such as SPAs and other surveys may be out of date. <sup>142</sup>
Respondents / population	Definitions and opinions of expert HCW subjective. <sup>83 88 98 109 112 114 140 148 149 155 162</sup>
	Limiting number, type or seniority of HCWs may limit insights or introduce bias <sup>68 75 90 94 157</sup>

	Respondents not representative of general population / HCWs <sup>70 71 84</sup>
	Patient perspective lacking <sup>75 81 91</sup>
	Patient data or perspective limited to specific injury pathologies or age <sup>125 127 128</sup>
	No population / community data <sup>113</sup>
	HH surveys limited by lack of household head at home. <sup>133</sup>
	Facility provider voice lacking <sup>77 135</sup>
	Key stakeholder voices missing e.g. dispatch workers, fire / police <sup>75</sup>
	Enthusiastic respondents may overestimate the success of or engagement with interventions <sup>84</sup>
	Private providers not included <sup>75 83</sup>
	Survey respondents may not have sufficient expertise / understanding <sup>71</sup>
	Prehospital and hospital views may differ <sup>75</sup>
	Facility inpatients only <sup>159</sup>
	Including referred patients introduces bias <sup>154</sup>
	Tendency to exaggerate positives when self-reporting practices <sup>70</sup>
Mapping related	GIS not validated with actual measured travel times <sup>151</sup>
	Unmapped roads could be in use <sup>142</sup>
	Facility use not captured in GIS <sup>142</sup>
	GIS using household location misses injuries occurring away from the home <sup>142</sup>
	Population matched rather than disease burden when mapping <sup>143</sup>
	Travel times only measured at specific times of day / days of week <sup>144</sup>
	Spatial access does not consider non spatial barriers such as affordability and acceptability <sup>143</sup>
Facility related	Limiting number of facilities may limit insights or generalisability <sup>74 75 79 80 88 91 98 101 120 125 126 128 129 147</sup>
	Limiting types of facilities e.g. district only or government only may limit insights or generalisability <sup>72 85 92 95 96 100 128 155 224</sup>
	Facilities selected for comparison might not be representative <sup>123</sup>
	Facility not open at times during study <sup>164</sup>
	Facility list may not have been complete (i.e. missed some facilities) <sup>110</sup>
Pragmatism	Study took a long time <sup>128 140</sup>
	Limited time frame for study <sup>128 163</sup>
	Long time between study and publishing report <sup>229</sup>
	Time delay between assessments may attenuate benefit of intervention without support <sup>148</sup>
Tool or instrument related	Assessment tool ratings are subjective <sup>87-89 93 95 96 100-102 105 106 143 152</sup>
	Assessment tool or method not validated <sup>17</sup>
	Assessment tool was modified <sup>99</sup>
	Distinction between supplies and equipment not clear <sup>146</sup>
	Inhalation injuries and ventilatory requirement not addressed <sup>146</sup>
	Specialist burn nursing not included <sup>146</sup>
	Resources in tool not exhaustive for burn care <sup>146</sup>
	Binary scores will not assess gradual improvements <sup>157</sup>
	Translation difficulties with instrument <sup>109</sup>
	Survey instrument evolved meaning some metrics not reported by some respondents <sup>70</sup>
	Some capacity assessments not included such as INTACT, GTSET and ACS/COT <sup>64</sup>
Intervention or improvement related	Feasibility of proposed improvements not established <sup>82</sup> .
	<b>Author reported strengths of studies</b>
Multiple data sources	Adding in other data sources e.g. FGDs or in-depth interviews added depth to understanding <sup>79 86 133</sup>
	Combining flowchart with WHO ETC useful approach for elsewhere <sup>80</sup>

	Data triangulation using multiple peer reviewers <sup>114</sup>
Validation / Triangulation	A pilot study validated staff reporting by direct observation <sup>99</sup>
	Established and standardised TRISS methodology <sup>116</sup>
	Validation of a clinical indicator for trauma system quality <sup>127</sup>
	Strengths and weaknesses of various assessment tools are discussed <sup>64</sup>
Pragmatism	Applicable to any country / broadly applicable <sup>89 98 100 140 146 147</sup>
	Straight forwards / simple <sup>89 140</sup>
	A Participatory process engaged HCWs with process <sup>130</sup>
	High quality GIS data increasingly available <sup>142</sup>
	Efficient and easy to implement <sup>109</sup>
	Convenient, available and practical <sup>146</sup>
	Easily interpreted and standardised <sup>157</sup>
	Local interpreters functioned as cultural ambassadors <sup>90</sup>
	C-section data widely available for changes over time <sup>145</sup>
	Few variables needed to compare O/E ratios. <sup>123</sup>
	Routine data adapted <sup>147</sup>
	Data reviewed monthly to discuss attainment and barriers <sup>150</sup>
Speed	Allows quick assessment / short time to complete <sup>37 146 157</sup>
Cost effectiveness	Low cost <sup>80 140</sup>
	Low cost teleconferencing software available <sup>141</sup>
Prehospital / community perspective or data	Captures injuries not presenting to a facility <sup>133</sup>
Pro-generalisable facets	Range of staff /sectors / professions and patients included <sup>67 76 78 84 88 148 149</sup>
	High response rates can allow generalisability <sup>72 135</sup>
	Can compare changes (in performance) over time <sup>98 161</sup>
	Nationally representative / diverse sampling <sup>99 159</sup>
	Broad / representative section of population captured <sup>129 139</sup>
	Generates theoretical model of understanding that could be applied to other contexts <sup>77</sup>
	Allows comparisons across countries and settings <sup>87 128</sup>
	Allows comparison with WHO guidelines <sup>86</sup>
	Including large facilities captured 50% of those receiving injury care (i.e. majority) <sup>88</sup>
	Comprehensive <sup>88</sup>
Novel	Facilitated remotely without face to face contact <sup>67 141</sup>
	First or Early application / evaluation <sup>86 151</sup>
	Road types and response times captured for comparison <sup>119</sup>
	Potentially valuable basis of future data set <sup>154</sup>
Permits deeper or more detailed understanding or analysis	Comparing crash data with GIS and facilities allows high risk locations to be identified. <sup>160</sup>
	Native interviewers will have contextual insights <sup>75</sup>
	Able to assess dynamic intricacies of care provision and process <sup>141</sup>
	Discrete functions, services or specific equipment were reported <sup>111</sup>
Study rigour factors	Measures of good qualitative research practice included <sup>70 75</sup>
	Qualitative methods well matched to characterising range of patient experiences from injury arrival including pre facility and peripheral facility experiences <sup>74</sup>
	Long study period of data analysed <sup>129</sup>
	Able to adjust data for confounders <sup>154</sup>
	Most important variable reliably recorded in all study centres <sup>123</sup>
	Well powered <sup>159</sup>
	Large scale detailed assessment <sup>70</sup>

	Interrupted time series analysis allows effect of quality improvement intervention to be separate from secular trends <sup>150</sup>
	Iterative process <sup>67</sup>
Stimulates improvement	Stimulates corrective action or improvement <sup>140 152</sup>
	Identified local leaders and advocates <sup>141</sup>
	Local Peruvian collaborators at all stages <sup>69</sup>
A single author (JW) classified the author reported strengths and weaknesses into thematic categories.	

**Supplementary Material Table 7 Non-Study literature identified**

<b>Publication name and date (if given)</b>	<b>Brief summary of resource</b>	<b>Mapped to delay</b>
Guidelines for conducting community surveys on injury and violence. 2004	This tool provides instruction on how to conduct a community based survey on injury	Delay 1 and 2
WHO Prehospital Trauma Care Systems. 2005	Reports to identify core strategies, equipment, supplies and organizational structures needed to create effective and adaptable prehospital care systems for injured persons.	Delay 2
WHO Model Trauma System Policy. 2004	A brief set of policy recommendations that countries can consider adopting to support minimum standards for injury care for their population	Delays 2 and 3
WHO Trauma System Maturity Index.	A 1-4 grading system covering 4 domains of Prehospital trauma care, Education and Training, Facility Based Trauma Care, Quality Assurance.	Delays 2 and 3
Guidelines for essential trauma care. 2004	Foundational WHO document describing minimum standards of injury care according to facility level.	Delay 3
Essential Trauma Care Project Checklist for Surveys of Trauma Care Capabilities. 2004	Derived from the Guidelines for essential trauma care as a tool to allow stakeholders to assess human and physical facility resources.	Delay 3
Guidelines for trauma quality improvement programmes. 2009	Document guidance for conducting quality improvement activity, proposing Morbidity and Mortality conferences, preventable death panel review and tracking of audit filters.	Delay 3
WHO Emergency and Trauma Care Activities	5 current activities are listed with an encouragement for interested individuals to get in touch if they wish to pilot the instruments proposed	Delay 3



**Supplementary Material Table 8 Included study settings and methodological approach ordered by conceptual delay**

Delay	Author + Year of publication	Number of countries by income status (LIC, Lower MIC, Upper Middle Income (UMIC), HIC)	Names of countries	Urban, rural or both?	Summary of methods used	Brief description of study methodology	Trauma population studied	Subject of study	Study Outcomes
<b>Delay 1</b>									
<b>1</b>	Aries et al 2007	Lower MIC 1	Ghana	Urban	Qualitative cross-sectional study using in-depth interviews.	Treatment choices of patients from a single hospital with radiologically confirmed fractures were explored. Patients were classified as either 'stayers' (staying for hospital care), 'leavers' (leaving from traditional healers - bone setters) and 'returners' (those who had come back to biomedical care from traditional healer).	Fractures or orthopaedics only	Patients and non-healthcare workers (traditional healers).	Description of barriers and challenges.
<b>1</b>	Spangenberg et al 2006	Lower MIC 1	Ghana	Urban	Cross-sectional household survey using developed tool.	Describing the urban Kumasi subgroup of a previously reported study focusing on healthcare utilisation.	All trauma	Patients and community members.	Mortality. Care seeking behaviour.
<b>1</b>	Nordberg et al 2000	Lower MIC 1	Kenya	Both	Mixed method cross-sectional study using Household survey (developed from other Kenyan surveys) and FGDs.	Set in Kiambu district Kenya, women, school children, teachers and factory workers were FGD participants to explore local community perception of injuries, their causes and appropriate preventive interventions.	All trauma	Patients and community members.	Care seeking behaviour.
<b>1</b>	Wu et al 2016	UMIC 1	China	Both	Cross-sectional household survey (injury data from provincial household survey).	This study reports the injury related questions from a stratified random cluster provincial health household interview survey, Hunan, China. Injuries and health system utilisation were reported from the preceding 14 days.	All trauma	Patients and community members.	Care seeking behaviour.
<b>Delay 1 and 2</b>									
<b>1 and 2</b>	El Tayeb et al 2015	Lower MIC 1	Sudan	Both	Cross-sectional household survey based on WHO guidelines for community surveys on injuries and violence.	Community based household survey in Khartoum state.	All trauma	Patients and community members.	Care seeking behaviour.
<b>1 and 2</b>	Mock et al 2001	Lower MIC 1	Ghana	Rural	Cross-sectional household survey using developed tool.	Conducted in four contiguous districts in Brong-Ahafo Region in Ghana. Information sought on all individuals living in the selected households included treatment obtained.	All trauma	Patients and community members.	Mortality. Care seeking behaviour.
<b>1 and 2</b>	Mock et al 1997	Lower MIC 1	Ghana	Both	Cross-sectional household survey	Household survey in Kumasi Ghana covering urban and rural settings.	All trauma	Patients and community members.	Mortality. Care seeking behaviour.

					using developed tool.				
<b>1 and 2</b>	Petroze et al 2015	LIC 1	Rwanda	Both	Cross-sectional household survey using SOSAS tool.	An injury focused analysis of SOSAS (Surgeons overseas assessment of surgical need) tool cross sectional cluster based population based survey in 52 villages nationwide representing all 30 administrative districts. Barriers to injury care were reported.	All trauma	Patients and community members.	Care seeking behaviour. Description of barriers and challenges.
<b>Delay 1 and 3</b>									
<b>1 and 3</b>	Orimolade et al 2013	Lower MIC 1	Nigeria	Urban	Prospective patient survey.	Prospective survey of patients discharging against medical advice from the orthopaedic trauma service at a single centre in Nigeria.	Fractures or orthopaedics only	Patients.	Patient disposal. Other (reasons for self-discharge). Description of barriers or challenges.
<b>Delay 2</b>									
<b>2</b>	Bigdeli et al 2010	UMIC 1	Iran	Urban	EMS Registry retrospective analysis.	Retrospective analysis of EMS registry data for time intervals of EMS response following RTC in the city of Urmia, Iran.	Road traffic only	Patients and prehospital workers.	Defined measure of care process (prehospital time intervals (response, on scene and transport)).
<b>2</b>	Nagata et al 2011	Lower MIC 1	Vietnam	Urban	Road traffic injury database review with GIS analysis.	This study used a police and traffic agency database for road traffic injuries to map locations of severe and fatal road traffic injuries to 3 major trauma centres within Hanoi, Vietnam.	Road traffic only	Patients.	Mortality. Other (distance to facility).
<b>2</b>	Tansley et al 2015	LIC 1, UMIC 2	Haiti and Namibia	Both	GIS Modelling study evaluating physical access to emergency care facilities. Uses WHO TSAAEESC standards.	A GIS modelling study (using Google Map Maker and United Nations 2015 population projections) applying WHO TSAAEESC standards to existing SPA data for Namibia and Haiti to classify adequacy of emergency care for each facility. 5, 10, and 50-kilometer catchment areas for all facilities capable of providing 24-hour care, higher-level resuscitative services or tertiary care was described to estimate the proportion of population with access to each level of service.	All trauma	Secondary and tertiary facilities.	Other (distance to facility).
<b>2</b>	Vanderschuren et al 2015	UMIC 1	South Africa	Both	GIS modelling study evaluating whether RTC victims could physically access a suitable facility within 1 hour.	GIS analysis using a variety of data sources from provincial government and prior research, including; crash locations, EMS stations, medical facilities, road network and speed limits, average ambulance dispatch and on scene times. Fatality rates per kilometre of road was calculated. Previously described hazardous zones for road crash incidences was overlaid with service gaps to define critical zones and establish fatal crashes outside >1 hour from a facility.	Road traffic only	Patients.	Other (travel time).

2	Balikuddembe et al 2017	LIC 1	Uganda	Urban	Delphi study identifying key factors affecting EMS capacity for RTC response. Uses own framework.	12 experts completed all 3 rounds of this study to identify the 10 most important factors effecting exposure, vulnerability and EMS capacity for RTC victims in the Kampala Metropolitan Area. Participants were road safety police, EMS providers, academics and regulators.	Road traffic only	Prehospital healthcare workers and non-healthcare workers (road safety police, academics and regulators).	Description of barriers and challenges.
2	Patel et al 2017	UMIC 1	Brazil	Urban	Qualitative cross-sectional study using interviews	11 care workers were interviewed - 7 SAMU, 2 hospital nurses, 2 physicians, in Maringa, Brazil to determine causes of delay in prehospital transport of road traffic injury patients to trauma centres. 5 themes for causes of delays and 5 themes for suggested improvement identified.	Road traffic only	Prehospital and facility healthcare workers.	Description of barriers and challenges.
<b>Delay 2 and 3</b>									
<b>2 and 3</b>	Khan et al 2010	Lower MIC 1	Pakistan	Urban	Retrospective registry study. TRISS methodology employed.	Trauma registry data to evaluate effect of time from injury to facility Emergency Department (including inter hospital transfer). Mortality, ISS, RTS and TRISS were all calculated.	All trauma	Patients, tertiary facility and referral mechanisms and patterns.	Mortality. Operative care. Other (time from injury to ED, TRISS probability of survival).
<b>2 and 3</b>	Arreola-Risa et al 1995	UMIC 1, HIC 1	Mexico and USA	Urban	Retrospective review of trauma registry, case notes and ambulance service data.	Comparison between the prehospital and tertiary hospital patient mortalities in Monterrey, Mexico and Seattle. Prehospital data from ambulance services and in hospital data from registry in Seattle and case note review in Monterrey.	All trauma	Patients and tertiary facilities.	Mortality. Defined measure of care process (prehospital interventions performed). Other (ambulance response, scene and transport times).
<b>2 and 3</b>	Zafar et al 2002	Lower MIC 1	Pakistan	Urban	Trauma registry retrospective data review using TRISS.	Reporting of trauma registry data comparing predicted survival to Major Trauma Outcome Study.	All trauma	Patients and tertiary facility.	Mortality. Operative care. Patient disposal. Other (TRISS probability of survival).
<b>2 and 3</b>	Paravar et al 2014	UMIC 2	Iran	Urban	Retrospective trauma registry and EMS case note analysis	Retrospective analysis of patients brought into a single major trauma centre in Iran using registry data and EMS trauma admission forms.	All trauma	Patients and prehospital workers.	Mortality. Defined measure of care process (specified ALS procedures e.g. intubate, IV fluids and prehospital times, dispatch, scene and transportation).

<b>2 and 3</b>	Paravar et al 2013	UMIC 1	Iran	Urban	Retrospective registry study.	Retrospective study of RTC victims transported by EMS to a single centre in Kashan, Iran, using registry data from a data bank and EMS registry.	Road traffic only	Patients and prehospital workers.	Mortality. Length of stay. Defined measure of care process (prehospital phase times; response, scene transfer, and specific interventions e.g. intubation and IV fluids)
<b>2 and 3</b>	Ali Jat et al 2004	Lower MIC 1	Pakistan	Urban	Retrospective medical record review for both TRISS methodology analysis and preventable death panel review.	2 years of all trauma deaths in 1 facility (Aga Khan University Hospital) were entered onto a trauma registry. The probability of survival was calculated using TRISS and the patient records used to create a narrative. A committee then conducted a review to reach consensus on classification of deaths as either not preventable, potentially preventable or preventable.	All trauma	Patients, prehospital and facility healthcare workers, secondary and tertiary facility and referral mechanisms and processes.	Mortality. Defined measure of care process (deviation from best practice). Other (TRISS probability of survival, and avoidable mortality).
<b>2 and 3</b>	Matityahu et al 2014	LIC 1, Lower MIC 2, UMIC 1, HIC 3.	Tanzania, Ghana, Kenya, South Africa, USA, Germany, Israel.	Urban	Retrospective registry and medical record review.	Data from multiple sources including patient charts, patient interviews or any hospital trauma registry, were used for 6 hospitals across the income strata outside the USA, as well as a USA National Trauma Bank dataset. Isolated femur fracture intervals from injury to admission, admission to surgery, surgery to discharge were compared between centres and with country level metrics of development and healthcare.	Fractures or orthopaedics only	Patients and tertiary facilities.	Length of stay. Operative care. Defined measure of care process (injury to admission, admission to surgery and surgery to discharge time intervals). Availability of resource.
<b>2 and 3</b>	Bal et al 2017	UMIC 1, HIC 1	Turkey and USA	Urban	Retrospective case note and trauma registry review comparison between 2 centres.	1 year retrospective case note review comparing demographics and process and outcome patient measures between a tertiary hospital in Turkey and the USA. Paediatric patients in motor vehicle collision and motor vehicle vs pedestrian cases only were studied.	Road traffic only	Patients and tertiary facilities.	Mortality. Length of stay. Operative care. Patient disposal. Defined measure of care process (interventions performed were recorded including intubation, needle decompression, chest tube,

									intra-osseous access, central venous lines, chest compressions, blood, vasopressors, mannitol or equivalent, intravenous fluids).
<b>2 and 3</b>	Hashmi et al 2013	Lower MIC 1	Pakistan	Urban	Prospective registry and retrospective case note review to assess facility trauma care.	Trauma registry data, prospective from 2002, retrospective 1998-2001, was used to provide patient outcome data for trauma cases at a single private referral centre (Aga Khan University Hospital). This was compared pre and post a quality improvement initiative including organisational improvements, a fellowship and resident centred education.	All trauma	Patients and tertiary facility.	Mortality. Operative care. Patient disposal. Defined measure of care process (need for ICU, need for ventilator support). Other (specified complications).
<b>2 and 3</b>	Ibrahim et al 2017	Lower MIC 1	Nigeria	Urban	Retrospective review of trauma registry.	Retrospective review of trauma registry in Lagos State University Teaching Hospital for the prehospital descriptive data of RTC patients. Method of transport to hospital and time from injury to arrival and patient disposal were all reported.	Road traffic only	Patients.	Mortality. Patient disposal. Other (travel times).
<b>2 and 3</b>	Ozguc et al 2000	UMIC 1	Turkey	Urban	Medical records and autopsy reports evaluated retrospectively to assess probability of survival using TRISS methodology.	Use of medical records including autopsy reports to undertake TRISS analysis from a single tertiary centre in Turkey before and after improvements to the organisation of their trauma service.	All trauma	Patients and tertiary facility.	Mortality. Patient disposal. Other (TRISS probability of survival).
<b>2 and 3</b>	Mock et al 1993	Lower MIC 1 and HIC 1	Ghana and USA	Rural	Retrospective medical record analysis.	Retrospective analysis of medical records for all trauma patients in Holy Family Hospital, Berekum, Ghana. ISS was calculated, survival and functional outcomes reported. Time from injury to care as well as any prehospital treatment was reported. This was compared with Harborview Medical Centre Seattle.	All trauma	Patients, secondary and tertiary facilities, referral mechanisms and patterns.	Mortality. Operative care. Defined measure of care process (time from injury to treatment - prehospital delay). Other (disability).
<b>2 and 3</b>	Roy et al 2017	Lower MIC 1	India	Urban	A mixed method study using cross sectional and retrospective data sources including Delphi, case note	Mixed method study Delphi study to define optimal trauma care within their Indian context to inform evaluation of preventability of death. All trauma deaths from 5 urban university hospitals retrospectively abstracted to evaluate ISS (mild, moderate severe and profound	All trauma	Patients, facility healthcare workers, tertiary facilities.	Mortality. Defined measure of care process (contributors to death via

					review and peer review analysis of deaths.	categories). Deaths were peer reviewed based on this criteria and opportunities for improvement evaluated.			Delphi). Other (avoidable mortality).
<b>2 and 3</b>	Hardcastle et al 2012	UMIC 1	South Africa	Urban	Retrospective review of facility referral proformas. Draws on Trauma Society of South Africa guidelines.	A retrospective review of referral proformas entered onto a computerised data base for every external referral to the Level 1 Trauma Unit at Inkosi Albert Luthuli Central Hospital in Durban. Referral patterns across the region described drawing on trauma society of South Africa guidelines.	All trauma	Referral mechanisms and patterns.	Patient disposal. Defined measure of care process (accepted for level 1 trauma centre care).
<b>2 and 3</b>	Deshmukh et al 2012	Lower MIC 1	India	Urban	Prospective case note review, TRISS methodology for probability of survival.	1 year prospective study of all trauma cases attending a tertiary hospital in Pune, India. ISS and RTS were calculated for each and TRISS methodology used to compare outcomes with MTOS and probability of survival.	All trauma	Patients and tertiary facility.	Mortality. Other (TRISS probability of survival).
<b>2 and 3</b>	Sethi et al 2007	UMIC 1	Malaysia	Both	Prospective cohort study using medical records and autopsy/coroner reports.	1 year prospective cohort observational study of 6 facilities (2 tertiary and 4 District General Hospitals) in 2 regions of Malaysia. Outcomes of mortality, disability and musculoskeletal impairment were reported.	All trauma	Patients, secondary and tertiary facilities, and referral mechanisms and patterns.	Mortality. Length of stay. Patient disposal. Other (disability).
<b>2 and 3</b>	Murlidhar et al 2004	Lower MIC 1	India	Urban	Prospective case note review, TRISS methodology for probability of survival.	TRISS methodology following prospective case note review for all trauma patients admitted to trauma ward in a tertiary hospital in Mumbai.	All trauma	Patients and tertiary facility.	Mortality. Operative care. Patient disposal. Other (TRISS probability of survival)
<b>2 and 3</b>	Munoz et al 2014	UMIC 1	Colombia	Urban	Preventable death panel review. Draws on WHO TQIP and American College of Surgeons guidelines.	Preventable death analysis in a University hospital in Colombia classifying deaths as preventable, potentially preventable, not preventable but management could be improved and definitely not preventable.	All trauma	Patients, prehospital and facility healthcare workers, tertiary facility.	Defined measure of care process (deviation from best practice). Other (avoidable mortality).
<b>2 and 3</b>	Yeboah et al 2014	Lower MIC 1	Ghana	Urban	Preventable death panel review. Draws on WHO TQIP.	Panel review of all trauma deaths in a single tertiary centre over 5 month period in accordance with WHO methodology to identify definitely preventable, potentially preventable and non-preventable deaths.	All trauma	Patients, prehospital and facility healthcare workers, tertiary facility.	Other (avoidable mortality).
<b>2 and 3</b>	Zafarghandi et al 2003	UMIC 1	Iran	Urban	Preventable death panel review	Preventable death panel review using 1 year of trauma deaths in two University hospitals in Tehran. Data from prehospital and hospital setting obtained from a prospective data set, along with autopsy results.	All trauma	Patients, prehospital and facility healthcare workers, tertiary facilities.	Other (avoidable mortality).
<b>2 and 3</b>	Haghighiparast-Bidgoli et al 2010	UMIC 1	Iran	Urban	Qualitative study, in-depth interviews of prehospital trauma providers and develops own framework.	15 in-depth interviews (14 male 1 female) of prehospital trauma care professionals by 2 different interviewers one Mar-Dec 07 and the other Jan-Apr 09.	Road traffic only	Prehospital healthcare workers.	Description of barriers and challenges.

<b>2 and 3</b>	Khorasani-Zavareh et al 2009	UMIC 1	Iran	Both	Qualitative cross-sectional study using in-depth interviews. Develops own framework.	36 stakeholders of the post-crash response from both West Azerbaijan Province and Tehran interviewed, including EMS workers, police officers, Red Crescent members, firefighter, public health professionals, ministry of road officials, motorcyclists, road and transportation office, road traffic injury victims. Grounded theory approach used.	Road traffic only	Patients, community members, prehospital healthcare workers, non-healthcare workers (Police Officers, Red Crescent members, firefighter, public health professionals, ministry of road officials, motorcyclists, road and transportation office).	Description of barriers and challenges.
<b>2 and 3</b>	Jagnoor et al 2018	Lower MIC 1	India	Urban	Cross sectional qualitative study using interviews and consultative meetings.	The capacity of the Indian healthcare system to provide effective burns treatment and rehabilitation was assessed through a qualitative study of consultative meetings with 17 health professionals from 7 facilities in 4 different states. Existing treatment strategies and rehab were discussed as well as key barriers and enablers.	Burns only	Community members, facility healthcare workers, secondary care facilities and referral mechanism and patterns.	Description of barriers and challenges.
<b>2 and 3</b>	Zargar et al 2011	UMIC 1	Iran	Both	Qualitative cross-sectional study using FGDs and semi structured interviews. Draws on US Model Trauma Care System.	A narrative presentation of the current situation in Iran for trauma care presented under the headings of the US Model Trauma Care System Plan. 13 FGDs with 20 participants from a variety of non-clinical and clinical backgrounds, as well as semi structured interviews. It is not clear how the data was otherwise analysed or synthesised.	All trauma	Prehospital and facility healthcare workers, secondary and tertiary facilities and non-healthcare workers (academics, police, legal experts as well as clinicians are part of the MoH Medical Education trauma committee), referral mechanisms and patterns.	Description of barriers and challenges.
<b>2 and 3</b>	Latifi et al 2014	UMIC 1	Albania	Both	Cross sectional study using semi-structured, unstructured interviews, FGDs and document review involving multiple stakeholders. Draws on American College of Surgeons guidelines.	This study reports the findings of an unspecified number of semi-structure and unstructured interview and focus groups with "all stakeholders" at the MoH, the University Trauma hospital and ten regional hospitals as well as review of "various documents" including hospital registries and patient charts and the MoH's existing work strategies. This data enabled the study team to apply the 2006 American College of Surgeons Committee on Trauma resources for optimal trauma care of the injured patient to evaluate the trauma system.	All trauma	Prehospital and facility healthcare workers, secondary and tertiary facilities and non-healthcare workers ("all stakeholders"), referral mechanisms and patterns.	Availability of resource. Description of barriers and challenges.

<b>2 and 3</b>	Goosen et al 2003	UMIC 1	South Africa	Both	Narrative review, methodology unclear. Uses own framework of description.	A literature review (narrative) describing the trauma care system in South Africa. Use framework of prehospital, hospital care, interhospital transfers.	All trauma	Patients, prehospital and facility healthcare workers, primary, secondary and tertiary care facilities, referral mechanisms and patterns.	Description of barriers and challenges.
<b>2 and 3</b>	Choi et al 2017	Lower MIC 4, UMIC 4, HIC 5	Pakistan, India, Vietnam, Indonesia, Iran, Thailand, China, Malaysia, Saudi Arabia, South Korea, Japan, Hong Kong, Singapore.	Both	Systematic literature review	Systematic literature review for articles describing trauma care systems in Asian countries from PubMed Jan 05 - Dec 14. English articles containing information on characteristics of trauma care systems in Asia Pacific Countries were included. This therefore is a secondary analysis of published literature to evaluate the presence, absence or scale of pre-determined aspects of trauma care systems or services in each country.	All trauma	Prehospital and facility healthcare workers, primary, secondary and tertiary facilities and referral mechanisms and patterns.	Mortality. Defined measure of care process (EMS response times). Availability of resource.
<b>2 and 3</b>	Quansah et al 2001	Lower MIC 1	Ghana	Both	Individual visit to institutions.	An individual visited health institutions across various districts in Southern Ghana and collected manpower information, means of patient transport, first aid equipment availability, basic supplies for management of injuries, basic facilities for management of injuries.	All trauma	Facility healthcare workers and secondary care facilities.	Availability of resource.
<b>2 and 3</b>	Channa et al 2008	Lower MIC 1	Pakistan	Urban	Travel time analysis to various facilities and survey of facility resources.	Testing of road transport times from 4 points in 5 administrative towns by a private car, timed to drive to each of 3 trauma centres and the nearest of numerous emergency care facilities. Additionally a questionnaire regarding available resources was asked of the senior doctor in each facility.	All trauma	Secondary care facilities.	Availability of resource. Other (travel times).
<b>2 and 3</b>	Zargar et al 2001	UMIC 1	Iran	Urban	Prospective case note review, TRISS methodology for probability of survival.	This study prospectively collected data on all trauma cases presenting to three hospitals in Tehran known to have the largest trauma case load over a 12 month period. Data was collected on multiple parameters including demographics, injury characteristics and outcome. ISS was available for those hospitalised and TRISS methodology calculated observed outcomes relative to those expected from the MTOS data set.	All trauma	Patients, secondary and tertiary facilities and referral mechanisms and patterns.	Mortality. Length of stay. Patient disposal. Other (disability, TRISS probability of survival).
<b>2 and 3</b>	Saleh et al 2018	Lower MIC 1	Egypt	Urban	Prospective patient survey.	This study conveniently sampled trauma cases presenting to the ED of a single centre (Ain Shams University Surgery Hospital) to evaluate time delays to between incident, arrival of help and time to ED presentation. The mean overall prehospital time, arrival of help to arrival at ED, knowledge of the ambulance number and measurement of vital signs on a presentation to ED were reported.	All trauma	Patients, tertiary facility and referral mechanisms and patterns.	Defined measure of care process (initial assessment of vital signs). Other (travel times).



<b>2 and 3</b>	Tachfouti et al 2010	Lower MIC 1	Morocco	Both	Mixed method cross-sectional study using semi-structured questionnaires, interviews and checklists. Draws on WHO ETC and French 2002 Prehospital care standards	A study evaluating the trauma system in the Fez Boulmane region of Morocco. Evaluation involved semi-structure questionnaires, interviews and checklists to assess the emergency call centre, prehospital system and the tertiary facility. WHO ETC and French 2002 standards for prehospital care were used.	All trauma	Prehospital and facility healthcare workers, tertiary facility and non-healthcare workers (head of emergency coordination, head of civil protection agency).	Availability of resource.
<b>2 and 3</b>	Parra et al 2013	At least 2 (UMIC 1, HIC 1), not fully reported.	Colombia and USA	Both	Mixed methods use of teleconferencing for academic discussion model case analysis and electronic surveys to evaluate care processes and structures. Utilises WHO ETC guidelines.	15 case presentations between Feb 09 and Jul10 were conducted via teleconferencing. An electronic survey based on the WHO ETC was sent to each participating institution (2 USA and 5 Latin America). A further survey was sent to evaluate perceived impact on education, trauma system structure, resources, communication and prehospital care.	All trauma	Patients, prehospital and facility healthcare workers, secondary care facilities.	Defined measure of care process (analysis of care processes in difference phases of care, comparison between use of protocols and communications mechanisms between countries was made). Availability of resource.
<b>2 and 3</b>	Chokocho et al 2017	LIC 1	Malawi	Both	A mixed method cross sectional study using FGDs, interviews and checklist surveys.	Two 14 participant FGDs were held in Karonga and Blantyre to evaluate barriers to prehospital trauma care in Malawi. Participants were businesspeople, religious leaders, health care workers, NGO employees, labourers and retirees. A physical resource checklist survey was then administered to a representative of any organisation identified by the focus group that provided prehospital care services. Additional interviews were conducted with national police controller, regional traffic police commissioners, representatives of police and fire services, regional director of national road safety council, a road traffic specialist, central hospital directors and district health officers, clinicians, city health representatives and 2 telecommunications representatives.	Road traffic only	Patients, community members, prehospital and facility healthcare workers, non-healthcare workers (national police controller, regional traffic police commissioners representatives of police and fire services, regional director of national road safety council, a road traffic specialist, central hospital directors and district health officers along the M1 highway, clinicians, city health	Availability of resource. Description of barriers and challenges.

								representatives and 2 telecommunications representatives).	
<b>2 and 3</b>	Remick et al 2014	LIC 1	South Sudan	Both	Cross sectional mixed methods using small group discussion and observation of care. Developed tool from American College of Surgeons guidelines.	Development of tool based on US American College of Surgeons and US Department of Health formed the basis of the tool developed by a working group. Implementation over a 10 day period in Nov 2013 based on small group discussions with leadership, medical providers and patients and observation of care. Care observation limited to SPLA Military Hospital Juba.	All trauma	Prehospital and facility healthcare workers and tertiary facility.	Availability of resource.
<b>2 and 3</b>	Stewart et al 2016	Lower MIC 1	Ghana	Both	Cross sectional study combining modified WHO ETC facility assessment survey data with hospital procedure reported data, open source population and road network data for GIS analysis.	This study uses a subset of orthopaedic trauma related items from the WHO ETC taken from a previously conducted assessment of 40 facilities across Ghana using inspection and structured interviews. It combines this with open source population data for Ghana as well as road network and travel times using GIS methodology. Routine orthopaedic procedure data was also used to categorise facilities as providing basic, intermediate or advanced orthopaedic care. Cost-distance analyses was performed to describe population-level spatial access to orthopaedic trauma care.	Fractures or orthopaedics only	Secondary and tertiary facilities.	Availability of resource. Description of barriers and challenges. Other (travel times).
<b>2 and 3</b>	Nguyen et al 2008	Lower MIC 1	Vietnam	Urban	Cross-sectional household and facility survey. Utilises WHO guidelines for community surveys on injuries and violence.	Household survey and hospital survey to assess rates of injury morbidity and mortality as well as experience of accessing prehospital care and existing prehospital care system.	All trauma	Patients, community members, prehospital healthcare workers.	Mortality. Defined measure of care process (call to EMS, first aid provided, vehicle used for transport). Availability of resource
<b>2 and 3</b>	Lombardo et al 2018	Lower MIC 1	Mongolia	Both	Cross-sectional facility survey with semi structured staff interviews. Draws on WHO ETC, WHO TSSAEEESC and INTACT.	This is a study comprising of a structured survey and semi structured interviews with staff at 10 hospitals across Mongolia. The survey was based on WHO ETC, ESC and INTACT with semi structured interviews with staff helped to understand barriers to care.	All trauma	Primary, secondary and tertiary facilities.	Availability of resource. Description of barriers and challenges.
<b>2 and 3</b>	Macharia et al 2009	Lower MIC 1	Kenya	Both	Cross sectional survey of patients and staff.	A survey of 53 Hospitals both public, faith based and private with questionnaire of >300 road traffic injured inpatients identified from casualty department registers. Facility information was obtained from administrators and most senior clinicians attending to the patients. Access and quality of care for RTC casualties was evaluated.	Road traffic only	Patients, secondary and tertiary facilities.	Length of stay. Availability of resource. Other (disability).

Delay 1, 2 and 3									
1, 2 and 3	Ahmed Al-Attas 2010	LIC 1	Tanzania	Urban	Mixed method study using semi-structured interviews supplemented by a review of medical notes. Develops own framework.	Mixed methods analysis of delays to arriving at tertiary care for 12 months of patients admitted to Kilimanjaro Christian Medical Centre Eye Department with ocular trauma. Quantitative data identified factors significantly associated with delays of more than 24 and 48 hours to presentation. Synthesis of qualitative data from interviews provided detail of patient journeys which allowed development of a map demonstrating mediating factors (similar to barriers and facilitators).	Eye injury only	Patients, referral mechanisms and patterns.	Description of barriers and challenges.
1, 2 and 3	Kristin Kuzma et al 2015	LIC 1	Tanzania	Urban	Qualitative cross-sectional study using interviews.	Convenience sample of 34 trauma patients or surrogate family members presenting or referred to an urban referral emergency department in Tanzania for injury care. A Grounded Theory approach was used.	All trauma	Patients, prehospital and facility healthcare workers, primary facilities and referral mechanisms and patterns.	Description of barriers and challenges.
1, 2 and 3	Wesson et al 2015	Lower MIC 1	Kenya	Both	Qualitative study using both Key Informant interviews and FGDs. Draws on WHO ETC guidelines.	Study combines interviewing 25 Key informant working at tertiary facilities in 2 districts, and 16 FGDs with both urban and rural settings with men, women, youths (18-25), injured persons and HCWs. Results were described in themes of burden of injury, prehospital and hospital care. A constant comparison analysis was used including an inductive-deductive approach.	All trauma	Community members, prehospital and facility healthcare workers, secondary and tertiary care facilities and referral mechanism and patterns.	Description of barriers and challenges.
<b>Delay 3</b>									
3	Ankomah et al 2015	Lower MIC 1	Ghana	Both	Cross sectional adapted WHO ETC facility assessment using staff interviews.	Adapted WHO ETC checklist items including paediatric sized items. 40 facilities across Ghana included. (this is a subset of a larger study using WHO ETC).	All trauma	Secondary and tertiary facilities.	Availability of resource.
3	Arreola-Risa et al 2006	UMIC 1	Mexico	Both	Cross sectional WHO ETC instrument using staff interviews and inspection.	WHO ETC was used as basis for survey of 16 facilities (rural clinics, small hospitals and large hospitals) from 3 states in Mexico. Questionnaires, interviews and facility walk throughs to validate results were performed.	All trauma	Facility healthcare workers, primary, secondary and tertiary facilities.	Availability of resource.
3	Aboutanos et al 2010	UMIC 1	Ecuador	Both	Cross sectional WHO ETC facility assessment using staff interviews and inspection.	27 facilities including referral and district hospitals from several regions were assessed using the WHO ETC guidelines. A team undertook the evaluation in Sep 2007. Administrative and staff interviews across various services and staff groups were complimented by inspections and demonstrations of supplies. Some facilities were revisited at night to validate night staffing.	All trauma	Facility healthcare workers, primary, secondary and tertiary facilities.	Availability of resource.
3	Burke et al 2014	Lower MIC 1	Kenya	Both	Mixed method cross sectional study using	The study utilised a semi-structured tool for key informant interviews of the most senior staff member at each of 60 facilities in the Kisumu and	Trauma as a subset of wider	Facility healthcare workers, primary and secondary	Availability of resource.

					modified WHO ETC and key informant interviews.	Siaya counties of Kenya. The WHO ETC guideline to inform tool and semi-structured interviews. Descriptive frequency analysis and thematic analysis of qualitative data were performed. Assessment of all level 1 and 2 hospitals and stratified sample of rural clinics.	emergency pathologies	facilities, referral mechanisms and patterns.	
3	Cerrada et al 2017	UMIC 1	Venezuela	Unknown	Cross sectional modified WHO ETC instrument using staff interviews and inspection.	An evaluation of 5 hospitals (2 public 3 private) in Libertador, Venezuela through interviews and observation using an adapted instrument from the WHO ETC. The focus was on traffic accidents.	Road traffic only	Facility healthcare workers and multiple secondary care facilities.	Availability of resource. Description of barriers or challenges.
3	Chichom-Mefire et al 2014	LIC 1	Cameroon	Urban	Cross sectional facility assessments based on WHO ETC using staff interviews and observation.	Application of modified WHO ETC checklist to 29 district hospitals in the central region of Cameroon through staff interviews and observations.	All trauma	Facility healthcare workers and secondary facilities.	Availability of resource.
3	Thai Son et al 2007	Lower MIC 1	Vietnam	Both	Cross sectional WHO ETC facility assessment using staff interviews.	This study assessed for improvements in trauma care capabilities in Vietnam through applying the WHO ETC checklist in Mar 2005 across primary, secondary and tertiary facilities in urban and rural locations using staff interviews. This was a repeat assessment assessing for improvements in resource availability.	All trauma	Facility healthcare workers, primary, secondary and tertiary facilities.	Availability of resource.
3	Thai Son et al 2006	Lower MIC 1	Vietnam	Both	Cross sectional WHO ETC facility assessment using staff interviews and inspection.	Evaluation of 23 institutions in Vietnam using the WHO ETC guidelines. Author collaboration with facility staff, physical inspection and self-reporting were used.	All trauma	Facility healthcare workers, primary, secondary and tertiary facilities.	Availability of resource.
3	Razzak et al 2015	Lower MIC 1	Pakistan	Both	Cross sectional WHO ETC facility assessment using staff interviews and inspection and clinician knowledge assessment with questionnaire.	Use of modified WHO ETC across 93 public and 12 private facilities in 4 districts of Sindh province in Pakistan. An assessment of clinician knowledge was performed using a questionnaire.	All trauma	Facility healthcare workers, primary, secondary and tertiary facilities.	Defined measure of care process (physician knowledge). Availability of resource.
3	Shah et al 2015	Lower MIC 1	India	Both	Cross sectional WHO ETC facility assessment (modified) using staff interviews.	Use of modified WHO ETC tool to look at items identified as "technology" related, 32 items for tertiary facilities and 16 for secondary facilities. In addition to 0-3 ratings they also reported factors contributing to deficiencies in these items such as training, staffing, breakdown, user fees, logistics, material shortages, equipment shortages or absence.	All trauma	Secondary and tertiary facilities.	Availability of resource.
3	Shah et al 2015	LIC 1	Nepal	Both	Facility assessment using modified WHO ETC tool with data from staff interviews and direct inspection.	Use of modified WHO ETC tool to look at items identified as "technology" related, 32 items for tertiary facilities and 16 for secondary facilities. Fifty-six small and 29 large hospitals were assessed for availability of these items in the study area. Site visits included direct inspection	All trauma	Primary, secondary and tertiary facilities.	Availability of resource.

						and interviews with administrative, clinical, and bioengineering staff.			
3	Hanche-Olsen et al 2012	UMIC 1	Botswana	both	Cross sectional facility assessments based on WHO ETC using staff interviews and observation.	A modified WHO ETC survey of all 27 government hospitals in Botswana over a 2 year period, based on observation and interview of at least 4 local health care workers (doctor, lab tech, nurse and radiographer).	All trauma	Facility healthcare workers, secondary and tertiary facilities.	Availability of resource.
3	Hanche-Olsen et al 2015	UMIC 1	Botswana	both	Serial cross sectional facility assessments based on WHO ETC using staff interviews and observation.	An assessment of all 27 hospitals in Botswana using interviews, checklist and inspection based on the WHO ETC. The assessment was a follow up second assessment after implementation of a training program BEST "Better and Systematic Team Training". The differences in availability of human and physical resources as well as specific trauma related activities.	All trauma	Facility healthcare workers, secondary and tertiary facilities.	Availability of resource.
3	Rosales-Mayor et al 2011	UMIC 1	Peru	Urban	Cross sectional modified WHO ETC instrument using staff interview.	A modified WHO ETC survey (59/260 items) of 8 facilities through the individual in charge of emergency services at each, across 3 Peruvian cities.	All trauma	Facility healthcare workers, secondary and tertiary facilities.	Availability of resource.
3	Nakahara et al 2009	Lower MIC 1	Cambodia	Rural	A cross sectional phone or mail survey to Health Care workers based on WHO ETC.	A cross-sectional facility survey by phone interview or mail using structured questionnaires at nationally representative samples of 85 Health Centres and 17 Referral Hospitals from December 2006 to April 2007. The questionnaire included a modified WHO ETC checklist, questions on distance for referral and the number of injured patients received and referred during the last 3 months. The association between resource availability and need, i.e. referral distance and number of severely injured patients referred to referral hospitals was assessed.	All trauma	Facility healthcare workers, primary and secondary facilities.	Availability of resource.
3	Mock et al 2006	Lower MIC 3, UMIC 1.	Ghana, Vietnam, India and Mexico	Both	Comparative analysis of cross sectional surveys based on WHO ETC.	Comparison of trauma care evaluations using the WHO ETC checklist from 4 countries between 2003-05. The countries were Mexico, Ghana, India and Vietnam. WHO ETC was applied in 4 countries selected to represent the world's range of geographic and economic conditions.	All trauma	Facility healthcare workers, primary, secondary and tertiary facilities	Availability of resource.
3	Stewart et al 2015	Lower MIC 1	Ghana	Both	Cross sectional modified WHO ETC assessment using healthcare worker survey and direct inspection.	This study used a modified WHO ETC checklist of 32 items of physical resource. 40 facilities were visited, HCWs surveyed and items inspected. Reasons for items not fully available were requested. Deficiencies are described along with the root cause factors and some examples of overcoming these deficiencies where identified.	All trauma	Secondary and tertiary facilities.	Availability of resource.
3	Stewart et al 2016	Lower MIC 1	Ghana	Both	Serial cross sectional facility assessments using WHO ETC and staff interviews with inspection.	This study reports serial assessments of hospitals in Ghana's Southern regions using 28 items from the WHO ETC checklist. Direct inspection and structured interviews were performed at 10 hospitals in 2004 and 32 hospitals in 2014, purposively sampled.	All trauma	Secondary and tertiary facilities.	Availability of resource.

3	Tabiri et al 2015	Lower MIC 1	Ghana	Both	Cross-sectional modified WHO ETC facility assessment using staff interviews and onsite inspection.	A modified WHO ETC survey checklist applied to 92 hospitals in Northern Ghana through interviews with local health personnel and onsite inspection of facilities.	All trauma	Facility healthcare workers, secondary and tertiary facilities.	Availability of resource.
3	Uthkarsh et al 2016	Lower MIC 1	India	Urban	Cross sectional WHO ETC instrument using staff interviews and inspection.	Description of the application of WHO ETC to a single district hospital in Southern India. A cross sectional study of trauma care services using in-depth interviews of hospital stake holders and key informants.	All trauma	Facility healthcare workers, secondary facility.	Availability of resource.
3	McCullough et al 2016	LIC 1	Haiti	Both	Cross sectional facility assessments based on WHO ETC using staff interviews and observation.	12 facilities (6 secondary and 6 tertiary centres) were assessed using the WHO ETC checklist along with the total number of trauma cases presenting to each facility tabulated from emergency room logbooks.	All trauma	Facility healthcare workers, secondary and tertiary facilities.	Availability of resource.
3	Wesson et al 2013	Lower MIC 1	Kenya	Urban	Mixed methods - Key informant interviews to develop patient flow charts and complete WHO ETC checklist assessments.	Based in 2 Kenyan health facilities, one a district level hospital and the other a provincial level hospital, key informant interviews were used to complete the WHO ETC Checklist and develop flowcharts for patient care within the 2 facilities.	All trauma	Secondary and tertiary facilities.	Defined measure of care process (patient flow). Availability of resource.
3	Dewberry et al 2014	LIC 1	Haiti	Both	Cross sectional facility assessments using staff interviews for TSAEEESC survey completion.	This study is an assessment of 7 facilities in the central plateau of Haiti through staff interviews using a version of the WHO TSAEEESC survey modified for trauma. Logbooks were also reviewed.	All trauma	Primary, secondary, tertiary facilities and referral mechanisms and patterns.	Operative care. Patient disposal. Availability of resource.
3	Joseph et al 2016	LIC 15, Lower MIC 14, UMIC 4	Afghanistan, Bangladesh, DRC, Ethiopia, The Gambia, Haiti, Kenya, Liberia, Malawi, Mozambique, Myanmar, Nepal, Niger, Sierra Leone, Somalia, Uganda, Tanzania, Ghana, India, Indonesia, Mongolia, Nigeria, Pakistan, Papua New Guinea, Sao Tome and Principe, Solomon Islands, Vietnam, Zambia, Argentina, China, Fiji, Sri Lanka.	Both	Secondary analysis of database of WHO TSAEEESC facility assessments	Secondary analysis of subset of pre-existing database of WHO TSAEEESC surveys focused on acute burn care. Questions judged relevant were determined by study authors.	Burns only	Primary, secondary and tertiary facilities.	Availability of resource. Description of barriers or challenges.
3	Norman et al 2012	Lower MIC 1	Ghana	Both	Cross sectional study using site	A cross sectional study consisting of facility visit and surveys at 22 facilities purposively sampled	Road traffic only	Facility healthcare workers, secondary	Availability of resource.

					visit and staff surveys based on WHO field manual for capacity assessment of health facilities in responding to emergencies 2007.	using a modified WHO field manual for capacity assessment of health facilities in responding to emergencies (2007), focussing on RTCs. Surveys were administered to key medical officers or other staff. This was supplemented by a literature and internet review.		and tertiary facilities.	
3	Petroze et al 2012	LIC 1	Rwanda	Both	Secondary analysis of reported WHO TSAEEESC facility data and MoH procedural data for associations between procedure frequency and resource availability.	WHO TSAEEESC situational analysis tool survey of 40 district hospitals and comparison with MoH centralised reporting of surgical procedures were used to ascertain the percentage of caesarean section and hernia operations were dichotomised into high and low halves, these two groups were compared for various surgical and trauma capacity features of the facilities. The study examined whether the relative frequency of caesarean sections at a hospital, expressed as a proportion of total operative procedures, may serve as a proxy measure of trauma care capacity. They hypothesised that more trauma capacity would be associated with a lower percentage of c-sections.	All trauma	Secondary facilities.	Other (ratio of hernia operations and CS operations as a percentage of total as a marker for facility capacity for aspects of trauma care). Availability of resource.
3	Clarke et al 2014	UMIC 1	South Africa	Rural	Cross-sectional WHO TSAEEESC survey and retrospective MoH data and operative log review. Draws on Trauma Society of South Africa guidelines.	WHO TSAEEESC survey was conducted in 4 district hospitals of Sisonke, the operative numbers for fracture reduction and laparotomy were calculated from operative registers and compared with expected rates from published literature (LMIC). Trauma epidemiology from the MoH for Pietermaritzburg was included. Each hospital was also given a Trauma Society of South Africa level of trauma care grade.	All trauma	Secondary care facilities and referral mechanisms	Mortality. Operative care. Patient disposal. Availability of resource.
3	Wong et al 2014	LIC 1	Sierra Leone	Both	Secondary analysis of WHO TSAEEESC and PIPES survey data to develop and provide an INTACT score.	This study secondarily analyses hospital data collected from 10 facilities in Sierra Leone in Aug 2011. The INTACT consists of 40 items derived from TSAEEESC and PIPES. They appraised the value of INTACT compared to PIPES by dividing number of items reported present (binary as always available or less than always available) by 40 and multiplying by 10 to have a scale 0-10. Thereby developing and applying of a standardized way of assessing a healthcare facility's capacity to provide adequate trauma care.	All trauma	Secondary and tertiary facilities.	Availability of resource.
3	Da Silva Costa et al 2012	UMIC 1	Brazil	Urban	Retrospective case note review and application of TRISS methodology.	1 year retrospective analysis of trauma cases seen by trauma team in a tertiary hospital in Brazil with application of TRISS methodology. Coroner reports and medical records reviewed to calculate RTS, ISS and TRISS. TRISS probability of survival calculated.	All trauma	Patients, tertiary facility.	Mortality. Other (TRISS probability of survival).

3	Bruni et al 2017	UMIC 1	Guyana	Urban	Qualitative cross-sectional study using FGDs and what's described as a qualitative questionnaire.	A FGD of 10 participants who were members of the trauma team at Georgetown Public Hospital Corporation of who 8 also filled in a qualitative questionnaire. The objective was to establish perceived barriers to optimal trauma team performance to guide future training.	All trauma	Facility healthcare workers, secondary care facility.	Description of barriers and challenges.
3	Haghighparast-Bidgoli et al 2013	UMIC 1	Iran	Urban	Qualitative cross-sectional study using in-depth interviews. Develops own framework.	A qualitative study using in-depth interviews of 15 trauma care practitioners and 20 male motorcycle RTC victims from an orthopaedic ward.	Road traffic only	Patients, prehospital and facility healthcare workers, secondary and tertiary care facilities.	Description of barriers and challenges.
3	Chadbunchachai et al 2001	UMIC 1	Thailand	Urban	Mixed method study with cross sectional physician compliance assessment, retrospective registry data to calculate TRISS probability of survival, and case note review for preventable death panel review.	As part of a participatory action research quality improvement initiative the trauma care in a single regional hospital in Thailand was evaluated. Assessment was through the TRISS probability of survival, preventable death panel review and trauma audit compliance by visiting injured patients at set times to monitor physician compliance using compliance forms.	All trauma	Patients, prehospital and facility healthcare workers, a tertiary facility.	Mortality. Defined measure of care process (physician compliance with audit filter defined aspects of care process). Other (avoidable mortality, TRISS probability of survival).
3	Chadbunchachai et al 2003	UMIC 2	Thailand	Urban	Mixed method study using retrospective registry and medical record data to assess TRISS probability of survival, preventable death panels and Key Performance Indicator review.	Continuing from other studies in this hospital TRISS outcomes, preventable death peer review and performance against developed key performance indicators were studied.	All trauma	Patients, prehospital and facility healthcare workers, a tertiary facility.	Mortality. Operative care. Defined measure of care process (27 Key Performance Indicators listed). Other (complications, unplanned returns to theatre and intensive care).
3	Crandon et al 2008	UMIC 1	Jamaica	Urban	Prospective study of transferred patients with data from medical records, patient, vehicle inspection and transferring team.	A single investigator evaluated all consecutively transferred trauma patients to UHWI over 6 months Jun-Dec 2006. Data from patient, transfer team and previously communicated transfer information were recorded.	All trauma	Patients, prehospital and facility healthcare workers, referral mechanisms and patterns.	Defined measure of care process (documentation of patient parameters by referral team). Availability of resource.
3	Blair et al 2017	Lower MIC 1	Bolivia	Both	Cross sectional survey (PIPES and INTACT) of facility staff.	A survey consisting of PIPES and INTACT as well as 4 additional questions were administered in 20 facilities (with at least 1 operating theatre) in Potosi, Bolivia over a 6 week period June and July	All trauma	Facility healthcare workers, primary, secondary and tertiary facilities.	Availability of resource.



						2014. As well as the individual completing the facility survey, other individuals were approached for the 4 short answer questions. Sites were visited but items were not confirmed with inspection.			
3	Chokotho et al 2016	LIC 7, Lower MIC 3	Burundi, Ethiopia, Malawi, Mozambique, Rwanda, Tanzania, Uganda, Kenya, Zambia, Zimbabwe	Both	Cross sectional telephone or electronic survey based on WHO TSAEEESC of key facility personnel across Central, Eastern and Southern Africa.	Telephone or electronic survey, based on the WHO TSAEEESC, of administrators or other key personnel at 267 of the 992 approached district and referral hospitals across the eastern, central and southern African region. Facilities (secondary and tertiary) were identified from the MoH websites from each country.	All trauma	Secondary and tertiary facilities.	Availability of resource.
3	Wong et al 2015	LIC 8, Lower MIC 8, UMIC 1	Afghanistan, Ethiopia, Gambia, Liberia, Rwanda, Sierra Leone, Tanzania, Uganda, Bangladesh, Bolivia, Ghana, Mongolia, Nicaragua, Nigeria, Solomon Islands, Zambia, Sri Lanka.	Both	Literature review and secondary analysis of reported studies using PIPES or TSAEEESC	Literature search of Medline for published reports of capacity assessments using either PIPES or TSAEEESC capacity assessment tools. 12 common items were reported for the study with the most data in each country.	All trauma	Secondary and tertiary facilities.	Availability of resource.
3	Sharif-Alhoseini et al 2009	UMIC 1	Iran	Urban	Cross sectional study using key informant interviews to quantify facility compliance with Arizona Trauma Centre Standards.	A key individual (Educational Supervisor) was interviewed to report on their institution's compliance with 153 standards from the Arizona Trauma Centre Standards. 43 hospitals in Tehran including all university hospitals were included. Standards were recorded in subgroups and mean percentage compliance was compared across facilities.	All trauma	Secondary and tertiary facilities.	Availability of resource.
3	Mowafi et al 2016	LIC 1	Syria	Unknown	Cross sectional facility surveys during visits with direct inspection	Survey of 94 hospitals in Syria providing surgical care in nongovernment controlled areas. Patient volume, services provided, diagnostic and therapeutic equipment capability, staffing, patient transfer and resupply and funding were all captured.	All trauma	Secondary and tertiary facilities, referral mechanisms and patterns.	Availability of resource.
3	Haider et al 2014	Lower MIC 1, HIC 3	Pakistan, France, USA, Canada.	Urban	Retrospective trauma registry comparative analysis.	A proof of concept study that compares trauma centre data base outcomes, controlled for patient variables known to predict outcome, comparing one HIC centre (France) with one LMIC centre (Pakistan). Both are compared with the North American National Trauma Data Bank. Used observed/expected mortality ratios to compare centres.	All trauma	Patients and tertiary facilities.	Mortality. Other (observed vs expected mortality).
3	Ifesanya et al 2012	Lower MIC 1	Nigeria	Urban	Retrospective medical records review.	A retrospective case note review of all 920 orthopaedic cases at a single secondary care facility in Nigeria in 2005. Burden was described for trauma and non-trauma orthopaedic cases. Cases requiring but not receiving surgical care were described.	Fractures or orthopaedics only	Patients and secondary facility.	Operative care. Other (complications).

3	Kesinger et al 2014	UMIC 1	Colombia	Urban	A retrospective study using administrative procedural codes before and after a Standardised Trauma Protocol intervention.	A retrospective cohort study in a single large trauma centre in Columbia using routine administrative hospital data (designed for billing) to measure changes in specific interventions, length of stay and mortality before and after the implementation of a QI initiative - Standardised Trauma Protocol (STP).	All trauma	Patients and tertiary facilities.	Mortality. Length of stay. Defined measure of care process (blood product transfusion, use of; hypertonic fluids, urinary catheters, arterial blood gases, tetanus vaccine, intravenous catheters, prophylactic antibiotics, analgesia, nasogastric tube, rapid intubation, cervical collars.) Other (ICU stay).
3	Lashoher et al 2017	LIC 1, Lower MIC 4, UMIC 2, HIC 2	Rwanda, Cameroon, India, Vietnam, Pakistan, Thailand, Colombia, Australia, Canada.	Urban	Step wedged prospective study implementing the WHO Trauma Care Checklist using care observations and medical record review.	11 hospitals across the income strata implemented the WHO Trauma Care Checklist Care in a prospective stepped-wedge design (non-synchronously). The primary outcome measure was care process completion, looking at safety critical tasks. Secondary analyses examined mortality.	All trauma	Patients, facility healthcare workers, tertiary facilities.	Mortality. Defined measure of care process (Completion of tasks according to WHO Trauma checklist). Other (complications and missed injury).
3	Scott et al 2017	LIC 1	Rwanda	Urban	Pre and post QI intervention study using ambulance service maintained database for effect on measure of prehospital care processes.	Analysis of a SAMU maintained database in Kigali, Rwanda. 5 measures of injury care process quality identified by SAMU staff were assessed for completion. Continuous quality improvement intervention implemented at midpoint of study and the whether or not process measures were performed was recorded when appropriate. Prehospital quality metrics included supplementary oxygen for hypoxia, intravenous fluids for hypotension, cervical collar placement for head injuries, and either splinting or administration of pain medications for long bone fractures.	All trauma	Prehospital healthcare workers.	Defined measure of care process (5 interventions delivered or not, oxygen, cervical collar, IV Infusion, splinting, analgesia. Targets of >90% were set for each metric.).
3	Stephens et al 2017	LIC 1	Uganda	Urban	Cohort study using patient baseline and 6 month follow up interviews with medical record	A quantitative study of 75 patients who were admitted to a single Ugandan national referral hospital for surgery on lower limb fractures. Data was collated through interviews and review of medical charts. Factors predicting likelihood for	Fractures or orthopaedics only	Patients and tertiary facility.	Operative care. Defined measure of care process

					analysis to evaluate factors predicting surgical fracture care.	having an operation were modelled and the impact of social and financial leveraging on the likelihood of surgical management evaluated.			(definitive surgical repair).
<b>Not mapped to 3 Delays</b>									
<b>Not mapped</b>	Stelfox et al 2012	Lower MIC 3, UMIC 4	Philippines, India, Vietnam, Thailand, Sri Lanka, China, Malaysia,	Both	A mixed method study including pre-meeting survey and recording of meeting discussions for thematic analysis.	A 2 day meeting with 22 participants from 7 LMICs from the Asia pacific region was held. An electronic survey of participants was sent to participants in advance, and the meeting was recorded and transcribed and analysed thematically.	All trauma	Facility healthcare workers, secondary and tertiary facilities.	Availability of resource. Other (QI activity). Description of barriers and challenges.
<b>Not mapped</b>	LaGrone et al 2017	Lower MIC 1 UMIC 3	Bolivia, Peru, Colombia, Ecuador	Unknown	Cross sectional survey of health care workers. Draws on WHO TQIP.	A cross-sectional descriptive study using a questionnaire, including free text responses, administered to health care providers across several levels between Jul 15 and Jan 16 at a conference in Bolivia. 336 health professionals surveyed re TQIP presence in their hospitals. Including, from 4 hospitals in Colombia with contacts of authors, 6 hospitals and one training course in Ecuador where authors had contacts and 10 hospitals in Peru reported to have high trauma volume.	All trauma	Facility healthcare workers, secondary and tertiary facilities.	Other (QI activity).
<b>Not mapped</b>	Fuangworawong et al 2016	UMIC 1	Thailand	Both	Cross sectional survey of key facility leaders. Draws on WHO TQIP.	Survey to selected key individuals within secondary and tertiary public hospitals in Thailand. An electronic or paper survey were used to evaluate 4 elements of WHO TQIPs, M+M, preventable death panels, trauma registries and trauma audit filters. 80/110 hospitals responded.	All trauma	Secondary and tertiary facilities.	Other (QI activity).
<b>Not mapped</b>	LaGrone et al 2017	UMIC 1	Peru	Both	Mixed method quantitative survey and semi structured qualitative interviews of health care providers.	A mixed method assessment of quality improvement activity using quantitative survey data and qualitative semi structured interviews for healthcare providers providing Injury care in Peru. The frequency and types of QI activity were described and themes surrounding barriers to maturation were synthesised and reported.	All trauma	Secondary and tertiary facilities.	Other (QI activity). Description of barriers and challenges.
<b>Not mapped</b>	Zetlen et al 2017	Lower MIC 2, UMIC 11, HIC 8.	Bolivia, Guatemala, Nicaragua, Brazil, Colombia, Costa Rica, Cuba, Ecuador, Mexico, Panama, Paraguay, Peru, Venezuela, Argentina, Aruba, Canada, Chile, Curacao, Puerto Rico, USA, Uruguay.	Both	Cross sectional survey of health care workers focussed on trauma QI activity.	Survey administered in paper form at a conference or electronically via coordinators of professional societies for trauma of healthcare workers from the Americas on the subject of trauma quality improvement. The questionnaire was developed from the literature and a previous survey used at WHO QI courses.	All trauma	Secondary and tertiary facilities.	Availability of resource. Other (QI activity). Description of barriers and challenges.

<b>Not mapped</b>	Blair et al 2017	LIC 15, Lower MIC 16, UMIC 5	Tanzania, Sierra Leone, Afghanistan, Gambia, Liberia, Rwanda, Haiti, Somalia, Malawi, Burkina Faso, Guinea, Niger, Togo, Ethiopia, Uganda, Ghana, India, Vietnam, Cambodia, Morocco, Pakistan, Kenya, Cameroon, Solomon Islands, Mongolia, Nigeria, Bolivia, Ivory Coast, Senegal, Bangladesh, Nicaragua, Mexico, Ecuador, Peru Botswana, Sri Lanka.	Both	A literature review of use of facility capacity assessments in LMICs accompanied by a Delphi study to inform recommendations for how to assess surgical and trauma care capacity. Features WHO ETC, Emergency and Critical Care, TSAAEESC, PIPES and Harvard Humanitarian Index.	A systematic literature search was conducted to identify all papers describing the use of 5 surveys evaluating trauma and surgical care capacity in LMICs. A 2 round electronic Delphi study was then conducted following the literature review to establish expert consensus for recommendations on the conduct of such capacity assessments. Does not advocate the use of a particular tool or framework but examines how these can be implemented.	Trauma as a subset of wider emergency pathologies	Facility healthcare workers, primary, secondary and tertiary facilities.	Availability of resource.
<b>Not mapped</b>	Hardcastle et al 2011	UMIC 1	South Africa	Both	Country specific guidelines - How to assess and accredit trauma centres. Draws on ACS guidelines.	Guidelines for assessing hospitals that want accreditation as a trauma centre with 4 levels available. Guidelines cover human and physical resources as well as governance and research. South Africa specific trauma guidelines based on American College of Surgeons Trauma Centre Criteria. Does not assess the system but classifies hospitals capacity to deliver trauma care.	All trauma	Primary, secondary and tertiary facilities.	Availability of resource.
<b>Not mapped</b>	Stewart et al 2016	Lower MIC 1	Ghana	Unknown	4 round Delphi study to identify audit filters as surrogates for trauma care quality.	4 round Delphi study of individuals with Ghanaian trauma care expertise to reach consensus on audit filters appropriate to use as measures of quality care process.	All trauma	Facility healthcare workers and non-healthcare workers (administrators and policy/evaluation workers).	Defined measure of care process (22 audit filters were developed mapped from triage to Airway, Breathing, Circulation, Disability and Exposure).
<b>Not mapped</b>	Suwaratchai et al 2008	UMIC 1	Thailand	Unknown	Delphi study, via questionnaire, identifying indicators for trauma care process evaluation.	A 2 round Delphi study with 11 experts (general surgeons with 5 years of trauma care experience) to generate indicators for use in audit for care processes in the first 48 hours following trauma.	All trauma	Facility healthcare workers.	Defined measure of care process (development of indicators for trauma care process quality).

**Supplementary Material Table 9 Included study rapid assessment criteria ordered by conceptual delays**

Delay	Author + Year of publication	What methodological strengths and weaknesses were reported by the authors?	If reported, how long did data collection take? (Days)	What comments were made (if any) about the pragmatism or feasibility of this study?	Potentially suitable as an RAP?	Why extractors made this judgment	Does the study triangulate or use multiple data sources?	What (if any) health system intervention is reported?
<b>Delay 1</b>								
1	Aries et al 2007	Strengths - 1) Relatively short time to complete. Weaknesses - 1) Small sample therefore no statistical validity. 2) Patients from a referral hospital therefore less applicable to more rural settings. 3) Did not capture those who never visited hospital in first place. 4) Interpreters used which can reduce impact of patient's expressed views. 5) Interviewer societal position or background may have evoked desirable answers.	90	N/A	Suitable	Study was conducted relatively quickly. Though identifying sufficient patients could cause delay.	No	N/A
1	Spangenberg et al 2006	N/A	N/A	N/A	Unsuitable	Household surveys are highly resource intensive.	No	N/A
1	Nordberg et al 2000	Strengths - 1) Injuries not presenting to facilities are captured. 2) FGDs enabled rich data that would not have been possible from survey alone (though FGDs focussed on aetiology and prevention). Weaknesses - 1) Minor injuries are included and a way of scoring severity would be better. 2) Head of household may not be in and the person at home may not have all the information e.g. grandparent.	N/A	N/A	Unsuitable	Household surveys are highly resource intensive.	Yes - Household Survey and FGDs.	N/A
1	Wu et al 2016	Strengths - N/A. Weaknesses - 1) Cause, type and severity of injury not captured. 2) Survey recall periods limited ability to assess incidence and prevalence. 3) Numbers were small to allow confident estimates and analysis over time.	123	N/A	Unsuitable	As a standalone method this is expensive and resource intensive. If it is simply secondarily analysing survey data already available then there is utility	No	N/A
<b>Delay 1 and 2</b>								
1 and 2	El Tayeb et al 2015	Strengths - 1) High response rate allows generalisability to the population sampled. Weaknesses - 1) Unable to adjust for injury severity effectively in such a study. 2) Subject to recall bias. 3) Social desirability bias to report less traditional healer care perhaps. 4) No health care provider perspectives in the study.	N/A	15 field team members required.	Unsuitable	Household surveys are highly resource intensive.	No	N/A
1 and 2	Mock et al 2001	Strengths - N/A. Weaknesses - 1) Recall period of 1 year may lead to under reporting, less of a problem for more severe injuries. 2) Participants may not wish to report use of traditional healers (social desirability).	182	N/A	Unsuitable	Household surveys are highly resource intensive.	No	N/A
1 and 2	Mock et al 1997	Strengths - N/A. Weaknesses - 1) Under reporting due to memory decay / recall. 2) Survey is a self-report and could not be verified. This could lead to sensitive topics such as domestic violence and suicide not being discussed. 3) Small number of deaths so not well powered to draw conclusions about trauma related deaths.	182	N/A	Unsuitable	Household surveys are highly resource intensive.	No	N/A
1 and 2	Petroze et al 2015	N/A	30	N/A	Unsuitable	Household surveys are highly resource intensive.	No	N/A

Delay 1 and 3								
1 and 3	Orimolade et al 2013	N/A	730	N/A	Unsuitable	2 year data collection in prospective manner is too difficult. Views of those self-discharging may be too narrow.	No	N/A
Delay 2								
2	Bigdeli et al 2010	Strengths - 1) Able to compare road types and response times. Weaknesses - 1) Accuracy of data capture may not be complete. 2) No focus on care quality. 3) Some of the data was incomplete.	730 - retrospective	N/A	Unsuitable	Reliant on established EMS with routine data capture, may be uncommon.	No	N/A
2	Nagata et al 2011	Strengths - 1) One of the first studies to apply GIS in an LMIC. Weaknesses - 1) No link to hospital records and other injury related data. 2) Less severe injuries would not have been reported. 3) Available GIS data was limited. 4) Actual travel times not known and "direct distance" to trauma centres was used.	365 - retrospective	Data was readily available from a police database.	Suitable	GIS methodology and police data secondary analysis is dependent upon existing collated data. Secondary analysis of this will be suitable, but primary collection will not. If a country has a well maintained RTC register then is possible.	Yes - GIS data and police data.	N/A
2	Tansley et al 2015	Strengths - 1) Increasing availability of high quality spatial data. Weaknesses - 1) Unmapped roads could underestimate travel times. 2) Facility utilisation not captured. 3) Injuries don't all take place at place of residence e.g. roads and therefore less validity in using household locations. 4) Service Provision Assessments are periodic and may be out of date.	N/A	There is increasing availability of high quality spatial data.	Suitable	Secondary analysis of open source data is suitable for such studies though dependent on existing facility data in this case. Study relied on pre-existing data collection.	Yes - GIS and Service Provision Assessment.	N/A
2	Vanderschuren et al 2015	Strengths - 1) Allows high risk areas of service gaps can be identified. Weaknesses - 1) Limitations exist in the data accuracy used, including ambulance travel times.	N/A	N/A	Suitable	The availability of pre-existing data on the road network and fatalities is required	Yes - Provincial government data and previous study data.	N/A
2	Balikuddembe et al 2017	Strengths - 1) Use of multi-disciplinary experts. Weaknesses - 1) Expert opinion is subjective. 2) Subjects not initially raised by experts will not have been covered. 3) Definition of expert is subjective.	150	N/A	Suitable	Relatively short time frame and broad view of factors identified although.	No	N/A
2	Patel et al 2017	Strengths - 1) Native interviewers had cultural contextual insight. 2) COREQ qualitative study reporting model followed to improve reliability and accuracy of data collection. Weaknesses - 1) Interviewers were medical students with limited professional understanding. 2) Views were from SAMU and only 1 facility. 2) Views from prehospital and hospital providers differed. 3) Voice from other stakeholders including community members, other facility and dispatch centre workers, private sector and fire department were lacking. 4) Interview transcripts were not verified by participants.	14	N/A	Suitable	Short time frame and limited resource requirement.	No	N/A
Delay 2 and 3								
2 and 3	Khan et al 2010	Strengths - N/A. Weaknesses - 1) Treatment at other facilities not possible to capture. 2) Prehospital deaths may have been caused by	2555 - retrospective	N/A	Unsuitable	Dependent on trauma registry data and a long	No	N/A

		delay but not captured by facility based registry, therefore such a tool may not measure impact of transfer delay.				time period of data collection.		
<b>2 and 3</b>	Arreola-Risa et al 1995	Strengths - N/A. Weaknesses - 1) Single hospital per city. 2) Limited to General Surgery inpatients. 3) Injury Severity Score not possible to ascertain from prehospital records in Monterrey.	365	N/A	Unsuitable	Registry required as well as extensive case note review.	Yes - Ambulance and hospital data sources.	N/A
<b>2 and 3</b>	Zafar et al 2002	Strengths - N/A. Weaknesses - 1) Prehospital deaths are missed. 2) MTOS data set is not calibrated for developing country norms and may not be appropriate.	730 retrospective	N/A	Unsuitable	Registry requires significant resource.	No	N/A
<b>2 and 3</b>	Paravar et al 2014	Strengths - N/A. Weaknesses - 1) Retrospective interrogation of trauma research data bank and quality of data entry / accuracy not guaranteed. 2) Only 1 centre included and therefore may not be generalisable.	365 - retrospective	N/A	Unsuitable	Requires registry and extensive case note review.	Yes - Registry and EMS data review.	N/A
<b>2 and 3</b>	Paravar et al 2013	N/A	365 - retrospective	N/A	Unsuitable	Registry requires significant resource.	Yes - Trauma registry and EMS registry.	N/A
<b>2 and 3</b>	Ali Jat et al 2004	Strengths - N/A. Weaknesses - 1) Potential subjective nature of reviewing deaths.	730 - retrospective	N/A	Unsuitable	TRISS requires registry or similar database. Good medical records are required to facilitate this kind of exercise.	Yes - TRISS analysis from registry and peer review panel from narratives.	N/A
<b>2 and 3</b>	Matityahu et al 2014	Strengths - 1) The authors believe this method validates the use of the delays in phases of femur fracture care as valid clinical indicators of the quality of a trauma system. Weaknesses - 1) Isolated femur fractures difficult to differentiate from polytrauma cases. 2) Many more patients from USA >4,000 than other countries <100 each.	N/A	N/A	Unsuitable	A lot of retrospective data required, likely to be time consuming and human resource intensive to conduct interviews and patient chart reviews. Only feasible if these indicators are pre collected.	Yes - Registry, case note, administrative records and staff survey all employed.	N/A
<b>2 and 3</b>	Bal et al 2017	Strengths - 1) Direct comparison between HIC and LMIC possible despite lack of national trauma registries. Weaknesses - 1) Retrospective, time consuming and limiting the numbers included. 2) Hospitals specialise in paediatric trauma and may not represent practice throughout countries. 3) Transport time and prehospital interventions not recorded. 4) Single centre in turkey. 5) Only 1 year of data.	N/A	N/A	Unsuitable	Not a rapid exercise to retrospectively review >200 case notes.	No	N/A
<b>2 and 3</b>	Hashmi et al 2013	Strengths - 1) Multi-ethnic diverse location serving all socioeconomic backgrounds generalisable to urban LMIC trauma care (esp. S Asia). 2) Used 12 years of data to overcome low annual volume. Weaknesses - 1) Single institution retrospective trauma database analysis. 2) Less than 100 patients per year mean potential selection bias exists and findings may not be generalisable. 3) Follow up only in hospital and no outpatient follow up. 4) 10% missing data for some variables.	4380 - retrospective	N/A	Unsuitable	Such a study requires an established trauma registry.	No	Multi-faceted QI initiative including organisational and patient care improvements such as establishing protocols for massive transfusion. A clinical trauma fellowship and trauma outcomes research programme was established.
<b>2 and 3</b>	Ibrahim et al 2017	Strengths - N/A. Weaknesses 1) Missing data undermine quality and validity of registry.	1095 - retrospective	Trained and experienced researchers employed for	Unsuitable	Collection and management of trauma registry data is very resource intensive	No	N/A

				registry data handling.				
<b>2 and 3</b>	Ozguç et al 2000	N/A	1095 - retrospective	N/A	Unsuitable	Medical record review very time consuming and records may not be of sufficient quality to conduct such analysis.	No	A change in the organisation of the trauma team.
<b>2 and 3</b>	Mock et al 1993	Strengths - N/A. Weaknesses 1) Only hospital data, no population / pre hospital data to match.	1460 - retrospective	N/A	Unsuitable	Retrospective case note review very time consuming.	No	N/A
<b>2 and 3</b>	Roy et al 2017	Strengths - 1) Triangulation with multiple peer reviewers for preventable death. Weaknesses - 1) Neither exact cause of death nor root cause analysis possible with available data. 2) 20% of deaths could not be evaluated due to lack of information. 3) No formal prehospital care system so any errors in that phase of care were not available. 4) Determining whether deaths are definitely or potentially preventable is subjective. 5) Some contributors to death, e.g. DIC, could not be determined from the data. 6) Various other potential complications could not be determined from the data.	548 - retrospective elements	Cumbersome method.	Unsuitable	18 months of data and large numbers involved in this study are a significant undertaking.	Yes - Medical records, peer review and Delphi study.	N/A
<b>2 and 3</b>	Hardcastle et al 2012	N/A	1521 - retrospective	N/A	Unsuitable	Method is dependent on maintained electronic database containing information on referrals to service. This may be lacking in many LMIC facilities.	No	N/A
<b>2 and 3</b>	Deshmukh et al 2012	Strengths - N/A. Weaknesses - 1) TRISS does not accurately predict survival of trauma patients in the developing countries.	365	N/A	Unsuitable	1 year prospective study not rapid.	No	N/A
<b>2 and 3</b>	Sethi et al 2007	Strengths - 1) Adjusted for confounders. 2) A potentially valuable data set and variable as a basis for future trauma registries. Weaknesses - 1) Not an experimental design for an effectiveness study. 2) Incompleteness of data especially out of hospital and referring hospital data. 3) Referring patients introduces bias as decisions for transfer are complex and undetermined. 4) Generalisability may be limited due to relatively small number of hospitals. 5) Low numbers of penetrating injuries limits generalisability. 6) Comparison restricted to hospital based care rather than whole system.	365	N/A	Unsuitable	Highly resource intensive to collate all this prospective data.	No	N/A
<b>2 and 3</b>	Murlihar et al 2004	Strengths - 1) Can be used to compare performance over time. Weaknesses - 1) Comparisons with MTOS may not be valid as US is very different to India and other LMIC contexts. 2) Some incomplete data. 3) No autopsy data from railway injuries.	305	N/A	Unsuitable	Very resource intensive.	No	N/A
<b>2 and 3</b>	Munoz et al 2014	Strengths - N/A. Weaknesses - 1) Subjective criteria could be better standardised. 2) Non-electronic records can limit case identification and data extraction. 3) No autopsy records available.	600	Difficulties in engaging people in the process to attend the meetings. With good planning and education this was overcome.	Unsuitable	Probably unsuitable due to large amount of resources required to gather stakeholders together.	No	N/A



<b>2 and 3</b>	Yeboah et al 2014	Strengths - 1) Low cost. 2) Straightforward. 3) Applicable to any country. 4) Stimulating corrective action. Weaknesses - 1) Risk of subjectivity of assessment. 2) Documentation inadequate in most cases. 3) It took longer to convene the panels than originally planned.	150	Straightforward, although took longer to convene than anticipated.	Unsuitable	Time consuming as dependent upon requirements for extracting data and convening experts. May be possible to undertake a smaller number quickly.	No	Changes were made to Emergency Department staffing and training as a consequence.
<b>2 and 3</b>	Zafarghandi et al 2003	Strengths - N/A. Weaknesses - 1) Potential inter-rater variability. 2) Teaching hospitals only included. 3) Lack of prehospital data included. 4) Difficulty accessing autopsy data, missing for most cases.	365 - retrospective	Difficult to get complete data especially from autopsy.	Unsuitable	Resource intensive to collect records in context of LMIC, would require multiple experts to be present.	No	N/A
<b>2 and 3</b>	Haghighat-Bidgoli et al 2010	Strengths - 1) Generates a model that can be applied to other contexts. Weaknesses - 1) 2 different interviewers at 2 different times could lead to inconsistency. 2) Only view of EMS captured and other voices missed.	420	N/A	Suitable	15 interviews lasting maximum of 100 minutes could be rapid although were very spread out in this study.	No	N/A
<b>2 and 3</b>	Khorasani-Zavareh et al 2009	Strengths - 1) Opinions of various actors can be understood. Weaknesses - 1) Number of participants was small. 2) Such studies may not be generalisable to other contexts.	305	45-80 minute interviews. Assisted as author had contacts in the field.	Suitable	This study took a long time but could perhaps have taken less. It's pragmatic in approach.	No	N/A
<b>2 and 3</b>	Jagnoor et al 2018	Strengths - N/A. Weaknesses - 1) No patient voice. 2) All facilities were urban and therefore rural realities unknown. 3) only 4/29 states represented therefore generalisability limited.	60	N/A	Suitable	Quickly conducted with selected key stakeholders covering the whole of the patient care pathway following this specific injury type.	No	N/A
<b>2 and 3</b>	Zargar et al 2011	N/A	N/A	N/A	Suitable	FGDs and interviews with key stakeholders can probably be undertaken quickly and with a broad all-encompassing scope as was done here.	No	N/A
<b>2 and 3</b>	Latifi et al 2014	N/A	N/A	Applicable in LMICs.	Suitable	Although not well reported, a series of interviews, FGDs and document reviews, if well-coordinated, can probably be achieved in a relatively short time frame. Series of interviews with MoH and health care providers could give a broad overview of the key elements present of a trauma system.	Yes - Stakeholder interviews and FGDs and document review.	N/A

<b>2 and 3</b>	Goosen et al 2003	N/A	N/A	N/A	Suitable	A literature review / document analysis is only viable if there has been a certain amount of data published. However this method is unstructured and unreproducible as published here.	No	N/A
<b>2 and 3</b>	Choi et al 2017	Strengths - N/A. Weaknesses - 1) Definitions of aspects of trauma systems and performance vary between published articles. 2) Some studies were national, other were on a much smaller population limiting generalisability. 3) Published articles used only and within time frame 2005 to 2014. 4) Studies describing injury care but not meeting the inclusion criteria were not captured. 5) Not able to find data on all Asian countries. 6) Heterogenous data set.	N/A	N/A	Suitable	A literature review in general for published descriptions of the components of trauma care systems in a place of interest is potentially low cost and could be relatively quick. It depends on published data being available but allows remote evaluation of elements of a trauma system.	No	N/A
<b>2 and 3</b>	Quansah et al 2001	N/A	N/A	N/A	Unsuitable	Report is low quality and unable to replicate method.	No	N/A
<b>2 and 3</b>	Channa et al 2008	Strengths - N/A. Weaknesses - 1) Only weekday afternoons tested, therefore other times of day or week may differ. 2) Emergency care facility resources not confirmed with inspection. 3) Patient outcomes not evaluated.	N/A	N/A	Suitable	This is a combination of basic GIS study and facility assessment survey. Both probably could be undertaken quickly and are pragmatic in approach.	Yes - Measured travel times and facility resources via survey.	N/A
<b>2 and 3</b>	Zargar et al 2001	Strengths - N/A. Weaknesses 1) not taking account of prehospital death.	365	N/A	Unsuitable	Very resource intensive requiring a large number of staff for a long period of time.	No	N/A
<b>2 and 3</b>	Saleh et al 2018	Strengths - N/A. Weaknesses - 1) Lack of trauma registry. 2) Emergency department was temporarily closed at times for maintenance. 3) Cross sectional design limits ability to infer causality. 4) Responses subjected to recall bias and inaccuracy. 5) Prehospital vital signs such as blood pressure, pulse and Glasgow Coma Scale during the transporting phase weren't available. 6) Sample size was small.	120	1) Surveys took average time of 4.82 minutes. 2)Escorting persons (patients' guardians) were surveyed as proxies if patient unable to provide answers.	Unsuitable	Fairly resource intensive to interview patients (although only 5 mins per interview) recruitment is approximately 1 patient per calendar day.	No	N/A
<b>2 and 3</b>	Tachfoui et al 2010	Strengths - N/A. Weaknesses - 1) Reliance on key informants leads to subjectivity of assessment. 2) Private facilities not included. 3) The knowledge of, attitude towards and practice of the emergency	30	N/A	Suitable	Short time frame to conduct, broad view of the system covered.	Yes - Facility and prehospital data from questionnaires,	N/A

		telephone number was not assessed. 4) No patient outcome data was included.					interviews and checklists.	
<b>2 and 3</b>	Parra et al 2013	Strengths - 1) Able to assess dynamic intricacies of actual care provision / process. 2) Low cost software is available to facilitate such international conferencing. 3) Programatising the exercise can identify and develop leaders to advocate for trauma locally. 4) Enables expert input remotely. Weaknesses - N/A.	515	The availability of low cost software can make such exercises feasible.	Suitable	The resources required and ability to conduct remotely would be suitable. Establishing a regular programme may be logistically challenging.	Yes - Teleconference case analysis and electronic survey.	A program of video conferencing which allowed education exchange and was reported to subjectively improve trauma education within their hospitals.
<b>2 and 3</b>	Chokotho et al 2017	Strengths - 1) A diversity of sectors involved in the emergency response were involved including stakeholders with the authority to implement changes. Weaknesses - 1) Not representative of general population. 2) FGD members are engaged adults and may overestimate enthusiasm for engaging with future interventions. 3) Only 2 study sites were chosen and therefore not representative of other areas.	N/A	Participants were from an existing community based research panel or part of a community advisory group.	Suitable	Pragmatic recruitment of FGD participants and then snowballing to organisations and key stakeholders. FGDs only 90mins although other time periods not reported.	Yes - FGDs, Interviews and checklist surveys.	N/A
<b>2 and 3</b>	Remick et al 2014	Strengths - N/A. Weaknesses - 1) Not validated. 2) Military setting only. 3) No other data for comparison. 4) No outcome data for comparison.	10	Safety concerns led to limited locations. Ministry of health engagement required in future studies.	Suitable	Short time frame involving discussions and observation for a combined total of 10 days. Structured assessment of a trauma system.	Yes - Group discussions and direct care observation.	N/A
<b>2 and 3</b>	Stewart et al 2016	Strengths - N/A. Weaknesses - 1) WHO ETC ratings are subjective. 2) Population spatial access does not consider non spatial access barriers such as affordability and acceptability. 3) Disease burden was not matched but rather population.	N/A	N/A	Suitable	Facility survey likely to take some time. However use of MoH routine data to classify facilities and use of open source mapping and population data to describe spatial access is pragmatic.	Yes - Facility assessment, MoH and administrative data and GIS data.	N/A
<b>2 and 3</b>	Nguyen et al 2008	Strengths - 1) Representative population sample chosen. Weaknesses - 1) Proxy reporting subject to recall problems. 2) Population baseline demographics not readily available to allow mortality rate to be adjusted.	61	N/A	Unsuitable	Household survey is very resource intensive although a survey of hospitals asking about the EMS is probably more feasible.	Yes - Household survey and survey in facility / EMS.	N/A
<b>2 and 3</b>	Lombardo et al 2018	Strengths - 1) First evaluation. 2) Compares with WHO guidelines. 3) In-depth interviews provide deep understanding of barriers to care. Weaknesses - 1) Non-randomized design. 2) Absence of robust trauma records.	60	N/A	Suitable	Comprehensive, short time frame, site visits with interviews required limited resources.	Yes - Facility survey supplemented with staff interviews.	N/A
<b>2 and 3</b>	Macharia et al 2009	Strengths - N/A. Weaknesses - 1) Long time lag between study conduct and publishing report (10 years). 2) Facilities were not selected at random limiting generalisability.	365	N/A	Unsuitable	Interviewing current inpatients took a long time in this study for only 300 patient surveys, although an electronic survey could improve this.	No	N/A

Delay 1, 2 and 3								
1, 2 and 3	Ahmed Al-Attas 2010	Strengths - N/A. Weaknesses - 1) As a tertiary centre it does not capture experience for those who never make it to tertiary care. 2) Recall bias. 3) interviewer was staff member and participant may not wish to offend.	365	N/A	Suitable	Resource requirements are low, but incidence of presentation will determine feasibility. In this case 12 months of cases was used.	Yes - Interviews supplemented by case note review.	N/A
1, 2 and 3	Kristin Kuzma et al 2015	Strengths - 1) Qualitative methodology is well matched to the goal of characterising a range of patient experiences, from the time of injury, to arrival at facility, including pre-facility and peripheral facility experiences. Weaknesses - 1) Single facility 2) Swahili interviews analysed in English could introduce inaccuracy. 3) Small sample.	62	Convenience sample.	Suitable	Relatively short time frame to collect data and convenient sample is pragmatic.	No	N/A
1, 2 and 3	Wesson et al 2015	N/A	92	N/A	Suitable	Relatively short time frame and broad perspective of the trauma system (interpreted broadly) obtained.	Yes - facility key informant interviews and community FGDs.	N/A
<b>Delay 3</b>								
3	Ankomah et al 2015	Strengths - 1) Can be compared across other settings. Weaknesses - 1) Subjective 0-3 rating scheme.	N/A	N/A	Suitable	WHO ETC facility assessment considered suitably rapid and pragmatic.	No	N/A
3	Arreola-Risa et al 2006	Strengths - 1) Including larger hospitals meant assessing facilities providing care to over 50% of those injured in each state. 2) Comprehensive. 3) Interviewed range of staff. Weaknesses - 1) Relatively few smaller clinics were included. 2) Much of the assessment is subjective and might vary depending on who answered. 3) Unable to verify skill competency reported. 4) Improvement in resources may not necessarily lead to improved process or outcome for injured persons.	N/A	Visits 3-10 hours each.	Suitable	Multiple site visits of relatively short duration required for data collection. Set framework allows relatively straightforward and standardised assessment.	No	N/A
3	Aboutanos et al 2010	Strengths - 1) The ETC guidelines provide a simple and useful template to assess trauma care capability in variable facilities and international settings. Weaknesses - 1) Skills assessments are subjective. 2) Improving resources may not improve patient outcomes.	30	Simple useful template.	Suitable	Commonly used survey, can be administered quickly. Set framework, many centres were able to be assessed, relatively straightforward assessment.	No	N/A
3	Burke et al 2014	Strengths - 1) Local Kenyan colleague present for data collection functioned as a language and cultural ambassador. Weaknesses - 1) Results not generalisable beyond counties included. 2) Social desirability bias can influence responses. 3) Language and cultural barriers may have impeded understanding. 4) Respondents were senior and may not share opinions of more junior colleagues.	81	N/A	Suitable	Single interview per institution and able to assess 60 facilities in 81 days (including over Christmas) is rapid.	No	N/A
3	Cerrada et al 2017	Strengths - N/A. Weaknesses - 1) Not generalisable as facilities purposively sampled. 2) Numbers of facilities was small. 3) No patient / case level data used. 4) No patient voice / opinion sought.	N/A	N/A	Suitable	Inspection and key staff interviews is likely to be relatively quick to undertake.	No	N/A
3	Chichom-Mefire et al 2014	Strengths - N/A. Weaknesses - 1) Only district hospitals therefore missing tertiary centre capability. 2) Has not assessed timely availability of	28	N/A	Suitable	29 facilities in 4 weeks, each facility taking less	No	N/A

		services. 3) Only one region near the capital assessed, therefore not representative of other regions.				than one day and possibly a few hours only.		
3	Thai Son et al 2007	Strengths - N/A. Weaknesses - 1) Subjective nature of grading 0-3. 2) Facilities chosen may not be representative across the population.	30	N/A	Suitable	Short time frame to conduct, common tool that can allow comparison over time.	No	N/A
3	Thai Son et al 2006	Strengths - 1) Documentation of deficiencies led to improvements. Weaknesses - 1) Subjective nature of grading. 2) Improvements in structure do not necessarily equate to improvements in process and outcome.	N/A	N/A	Suitable	WHO ETC facility assessment considered suitably rapid and pragmatic.	No	The documentation of deficiencies was reported to improve awareness, organisation, planning, and acquisition of resources. A trauma care course was also implemented for staff.
3	Razzak et al 2015	Strengths - N/A. Weaknesses - 1) Often information from a single provider introducing possible bias. 2) Data systems not present so burden of disease were mostly estimates. 3) No information on either patient care in community or during transport. 4) Other districts were not included although 4 districts chosen were to achieve a rural and urban representation.	N/A	N/A	Suitable	WHO ETC is likely to be suitable. Knowledge assessment speed and pragmatism details not really reported but may be a good way to supplement system quality understanding.	Yes - WHO ETC facility assessment and clinician knowledge assessment.	N/A
3	Shah et al 2015	Strengths - N/A. Weaknesses - 1) subjectivity of ratings. 2) Only government hospitals assessed.	N/A	Visits per facility are short, 4-10 hours.	Suitable	WHO ETC facility assessment considered suitably rapid and pragmatic.	No	N/A
3	Shah et al 2015	Strengths - N/A. Weaknesses - 1) Subjective nature of 0-3 ratings. 2) Private sector not included.	N/A	Visits between 4-10 hours depending on facility size.	Suitable	WHO ETC facility assessment considered suitably rapid and pragmatic.	No	N/A
3	Hanche-Olsen et al 2012	Strengths - 1) National perspective. Whole country hospital system covered. Weaknesses - 1) Clinics excluded - important in rural areas. 2) Prehospital care excluded. 3) Private hospitals not covered (although minor role in trauma). 4) Outcomes not reported. 5) Assessments may be subjective.	730	N/A	Suitable	Although the study period was long, this was prior to a separate training exercise. 4 interviews and inspection per facility was likely a short time period using WHO ETC guidelines.	No	N/A
3	Hanche-Olsen et al 2015	Strengths - 1) Multiple people interviewed at each institution to reduce bias. Weaknesses - 1) Limited to hospital based care facilities. 2) Interviews were the source of information and highly subjective. 3) Did not measure patient outcomes. 4) Time delay between assessments and QI activities may attenuate benefit over time without support.	840	N/A	Unsuitable	The data collection took a long time as was done pre and post a TQIP programme implementation.	No	The BEST (Better and Systematic Team Training) intervention of a 1.5 day course for 977 Healthcare workers across the country.

3	Rosales-Mayor et al 2011	Strengths - 1) Using WHO ETC can allow broad and international comparison. 2) WHO ETC as standardised can be repeated to demonstrate improvement over time. Weaknesses - 1) Limited number of facilities selected. 2) Reliant on individual respondent which is subjective.	30	N/A	Suitable	Short time frame, single interview, multiple facilities.	No	N/A
3	Nakahara et al 2009	Strengths - 1) Sampling of facilities done in order to be generalisable and nationally representative. 2) A pilot study validated direct reporting by staff by a period of direct observation. Weaknesses - 1) Trauma outcomes were not reported. 2) The WHO survey was modified. 3) Resources were self-reported by the staff rather than direct observation. 4) There was a failure to interview staff in health centres in low population density areas.	151	N/A	Suitable	Short timescale and remote data collection.	No	N/A
3	Mock et al 2006	Strengths - 1) Tool enables global comparisons to be made. Weaknesses - 1) Methods of identifying in country sites varied limiting generalisability. 2) Private sector not included. 3) Subjective aspects to reporting.	N/A	N/A	Suitable	WHO ETC facility assessment considered suitably rapid and pragmatic.	No	N/A
3	Stewart et al 2015	Strengths - No. Weaknesses - 1) Subjective rating scheme. 2) Not all hospitals took part (1 regional and 1 tertiary did not). 3) Root causes beyond the hospital were difficult to establish.	N/A	N/A	Suitable	As a modified / limited version of the WHO ETC survey with inspection of equipment, it is probably feasible although time for this study was not reported.	No	N/A
3	Stewart et al 2016	Strengths - N/A. Weaknesses - 1) Subjective rating scheme. 2) Northern regions not included. 3) Paediatric items not assessed in 2004. 4) Processes and outcomes not assessed.	N/A	N/A	Suitable	WHO ETC is probably suitable but serial assessments require a long time frame.	No	N/A
3	Tabiri et al 2015	Strengths - N/A. Weaknesses - 1) Burden not established so unable to match resource to burden. 2) Does not consider prehospital care. 3) Infrastructure not assessed.	242	N/A	Suitable	A facility assessed every 2.5 days seems quite quick. Modified version of WHO ETC Tool.	No	N/A
3	Uthkarsh et al 2016	Strengths - N/A. Weaknesses - 1) Limited to a district hospital and does not evaluate prehospital situation, although no formal prehospital care exists.	90	N/A	Suitable	WHO ETC facility assessment considered suitably rapid and pragmatic.	No	N/A
3	McCullough et al 2016	Strengths - N/A. Weaknesses - 1) Lack of rural representation. 2) Data was often subjective from respondent reports and not separately verified. 3) Care process not assessed. 4) Total trauma burden not assessed (no registry).	90	N/A	Suitable	A survey of major facilities was accomplished relatively quickly providing an overview of facility resources to provide care.	Yes - Facility survey supplemented by logbook data.	N/A
3	Wesson et al 2013	Strengths - 1) Combining flowchart and WHO ETC checklist can be a useful approach for other facilities. 2) Effective, low-cost assessment. Weaknesses - 1) Limited to the facility and did not consider pre- and post-hospital elements of the trauma system. 2) Patient outcomes unknown. 3) Only two hospitals in Kenya were studied.	90	N/A	Suitable	Short data collection incorporating process description with the ETC checklist focussing on equipment.	Yes - Combining qualitative process flow chart with ETC checklist quantitative variable.	N/A
3	Dewberry et al 2014	Strengths - N/A. Weaknesses - 1) Only 1 region assessed, might not be representative. 2) Resource availability is subjective.	N/A	N/A	Suitable	Could be quick involving the TSAEEESC survey.	Yes - Facility survey supplemented by logbook data.	N/A

3	Joseph et al 2016	Strengths - 1) The WHO TSAAEESC is convenient , available and practical. 2) Validated survey tool, allows comparison between countries and rapid assessment. Weaknesses - 1) Burn severity is a spectrum and there may have been inconsistencies in how respondents completed the survey. 2) Survey is not randomly administered, subject to selection bias, sample sizes across the groups is not equal and the facilities may not have been visited to validate the findings. 3) Distinction in the survey between supplies and equipment is not clear. 4) Inhalation injuries and the requirement for ventilatory support was not addressed. 5) Specialist burn nursing was not included in the survey. 6) The resources in the survey tool are not exhaustive for those required to undertake acute burn management.	N/A	Convenient, available and practical.	Suitable	TSAAEESC is a survey that could be undertaken relatively quickly. However this study is secondary analysis of existing database of survey results and therefore depends upon the availability of this data.	No	N/A
3	Norman et al 2012	N/A	122	N/A	Suitable	The survey and site visit approach has overlap with other assessments used although focus is also on multiple casualty RTC scenarios.	Yes - Survey, visit and desk review.	N/A
3	Petroze et al 2012	Strengths - 1) C-Section data is widely recorded and therefore available and able to monitor changes over time. Weaknesses - 1) Very dependent upon birth rate, CS percentage of live births and local and national policies. Difficult therefore to compare between different populations as a standardised metric. 2) Urban and rural rates differ significantly even within Rwanda. 3) As surgical capacity increases and district hospitals acquire trained surgeons and obstetricians, the use of %CS may not adequately report overall surgical capacity.	N/A	C-Section data is routinely recorded.	Suitable	Metric is probably easy to obtain but validity remains in question, especially when applied in a population for the first time.	Yes - TSAAEESC survey data and MoH procedural data.	N/A
3	Clarke et al 2014	Strengths - N/A. Weaknesses - 1) Mortality rate likely to be underestimate as pre hospital deaths would not be captured by the hospital records if taken straight to mortuary.	182	N/A	Suitable	A TSAAEESC survey and collection of MoH data is potentially rapid. An operative log interrogation would perhaps require to be maintained, ideally electronic, to interrogate effectively.	Yes - MoH data, TSAAEESC survey, operative log review.	N/A
3	Wong et al 2014	Strengths - 1) Quick relative to other assessments e.g. WHO ETC. 2) Easily interpretable and standardised (binary responses and scale 0-10). Weaknesses - 1) Developed by consensus of a limited number of surgeons. 2) Prehospital care not assessed. 3) Data for this assessment was from 1 country and included only 1 tertiary centre. 4) As used previously collected data, c-collar data not initially available. 5) A binary score will not pick up gradual improvements on the way to always available.	31	Quick.	Suitable	Quick and standardised. Quickly provides a snapshot of the trauma resources of a health care facility.	No	N/A
3	Da Silva Costa et al 2012	Strengths - 1) Using TRISS is established and standardised methodology. Weaknesses - 1) Obtaining accurate and complete data was difficult for this retrospective case note review. 2) The trauma team did not look after 1/4 of trauma deaths, therefore this population not studied.	365 - retrospective	Incomplete medical records and coroners reports limit the completeness of assessment.	Unsuitable	Retrospective case note review is not rapid. However if TRISS can be calculated from an existing trauma registry then could be quickly applied.	No	N/A

3	Bruni et al 2017	Strengths - N/A. Weaknesses - 1) Small sample size (did not mention saturation) 2) Feasibility of suggestions for improvement not established.	N/A	N/A	Suitable	Although not reported this was quick to complete although detail of insight limited.	No	N/A
3	Haghighat-Bidgoli et al 2013	Strengths - 1) Patient and professional views incorporated. Weaknesses - N/A.	120	N/A	Suitable	35 interviews in total within 4 months	No	N/A
3	Chadbunchachai et al 2001	Strengths - 1) A PAR process engaged healthcare workers with the process. Weaknesses - N/A.	182	N/A	Unsuitable	3 different methods are described. TRISS registry analysis requires a registry. Death panel review is probably too time consuming. Visiting patients 4 times per week for 6 months is also too time consuming as used in physician compliance monitoring.	Yes - Physician compliance, TRISS and preventable death panel review.	The study compares outcomes over 3 time periods to assess improvement as a result of the participatory action research process including developing the audit filter and staff engagement.
3	Chadbunchachai et al 2003	Strengths - N/A. Weaknesses - 1) No weighting applied to key performance indicators and insufficient number to evaluate relative importance for determining patient outcome.	182	N/A	Unsuitable	Resource intensive requiring an established data collection mechanism such as a registry in the case of key performance indicators. Peer review preventable death panel is also time consuming.	Yes - KIP performance, TRISS and preventable death panel review.	Part of a long term quality improvement effort in the same facility.
3	Crandon et al 2008	N/A	182	N/A	Unsuitable	It is resource intensive to collect this prospective 6 month data with someone present every day.	Yes - Medical records, patient, vehicle inspection and transferring team interview.	N/A
3	Blair et al 2017	Strengths - 1) Efficient, easy-to-implement survey designs. Weaknesses - 1) No inspection was undertaken so answers were the unverified opinion of respondent. 2) Translation difficulties with oxygen cylinder (removed) and running water (potable running water) was not removed. 3) Respondents were selected on availability and not representative. 4) Short answer questions were subjective and not verified by surgical logs.	42	Visits lasted 1-4 hours by available eligible respondent. All sites informed by MoH. Feasible, easy to implement.	Suitable	Short visits lasting 1-4 hours based on availability suggests pragmatic approach.	No	N/A
3	Chokotho et al 2016	Strengths - N/A. Weaknesses - 1) Facility list may not have been complete. 2) Low response rate of 27%. 3) Survey response bias, difficulty in identifying member of staff who could answer questions. 4) No direct inspection.	365	N/A	Suitable	A remotely conducted survey has appeal although the low response rate demonstrates the significant limitation in validity.	No	N/A
3	Wong et al 2015	Strengths - N/A. Weaknesses - 1) Published data only. 2) Rely on validity of reported findings. 3) Hospital only focus.	N/A	N/A	Suitable	A review of published literature on the system in question for capacity assessments is	No	N/A



						potentially quick and focused though limited to resource only and relies on such studies being done previously.		
3	Sharif-Alhoseini et al 2009	Strengths - No. Weaknesses - 1) Only University hospitals were considered and government, private and military facilities were not included.	N/A	N/A	Suitable	A single survey/interview with a single individual per facility is potentially quick to complete.	No	N/A
3	Mowafi et al 2016	Strengths - 1) Discrete functions, specific services or specific equipment were reported in contrast to other surveys. Weaknesses - 1) Key surgical service details were not included within the survey. 2) Cross sectional studies in a dynamic conflict situation is unlikely to remain current for long. 3) Limited generalisability to areas of the country not visited. 4) Questionnaire respondent estimates of patient volumes were not in line with observed volumes.	59	Unable to collect data in conflict affected locations held by opposition.	Suitable	Facility based survey completed in short time frame although relied upon trained data collectors familiar with the hospitals.	No	N/A
3	Haider et al 2014	Strengths - 1) Most important covariates reliably recorded in all centres. 2) As few as 7 variables can be used to compare O/E ratios. Weaknesses - 1) Selected HIC and LMIC facilities may not be representative. 2) Only mortality was reported as outcome not complication rates or failure to rescue. 3) Highly variable resources, access and settings may reduce comparability. 4) Resource availability not assessed.	3650 retrospective	Proof of concept of a technique for comparing trauma centres using 7 key and well recorded co-variables.	Unsuitable	This analysis of trauma registry data is dependent on well-maintained longitudinal datasets which may be absent in LMICs (note that a large private facility was chosen rather than a government facility).	No	N/A
3	Ifesanya et al 2012	N/A	365 - retrospective	Only 6/920 medical records were described as incomplete.	Unsuitable	It is unlikely that medical record review could be undertaken quickly. Retrospective notes review may not be applicable in many LIC settings.	No	N/A
3	Kesinger et al 2014	Strengths - 1) Adaptation of routine data collection for measuring intervention effectiveness maybe a temporary solution for institutions without trauma registries. Weaknesses - 1) Lack of clinical details means injury patterns and severity data is not available. 2) Similarly do not know if the protocol was actually implemented correctly e.g. right intervention on right patient. 3) Complications not recorded (LOS is proxy). 4) Single centre study. 5) No long term follow up. 6) data collection period asymmetrical.	690	Trauma registries are rare in LMICs, but able to adapt existing database to act as surrogate measure of trauma care improvement.	Suitable	If such a data set exists already this would be a sensible alternative approach to evaluate certain aspects of facility based care.	No	Implementation of a Standardised Trauma Protocol in the Emergency Department.
3	Lashoher et al 2017	Strengths - 1) Diverse range of centres. 2) Well powered. 3) Demonstrated across multiple sites in multiple countries across the income strata. Weaknesses - 1) Not blinded design. 2) Secular trends or seasonal variations could confound. 3) Inpatients only. 4) No information on comorbidities. 5) No follow up post discharge. 6) Care observation can induce the Hawthorne effect - possible observation bias due to training effect on observers. 7) Medical record accuracy may not be complete.	N/A	Needed observers as medical records unreliable.	Unsuitable	Likely to be time and cost intensive as requires repeated direct care observation, and time to collect sufficient case note data.	No	WHO Trauma Care Checklist implementation for use in all trauma care patients.

3	Scott et al 2017	Strengths - 1) Data was reviewed at monthly ambulance staff meetings discussing attainment and barriers. 2) Interrupted time series design enables the ability to distinguish actual effects from secular trends, the underlying trends that would be expected without intervention. Weaknesses - 1) No patient outcomes measure. 2) LMIC definition of quality prehospital care not established, but selected by staff as believed desirable and already captured. 3) Data self-inputted and not possible to externally validate.	420	Investment in data collection, management and real time feedback were described as minimal. Required leadership engagement.	Suitable	Although this study took a long time, practitioner recorded therapeutic interventions as a marker of care process quality could be employed efficiently.	no	Continuous quality improvement through daily, weekly and monthly discussions.
3	Stephens et al 2017	Strengths - 1) Study was strengthened by the depth of the interviews with study participants and was unique to previous research in this area with its empirical analysis of the differential effects of the included variables. Weaknesses - 1) This is a single-centre study with a relatively small sample size and the determinants of access may not be generalizable to other hospitals or countries. 2) The use of social capital and financial leveraging was self-reported and may under-represent the true prevalence of those factors.	210	N/A	Suitable	1 month worth of cases followed with a single interview seems low resource and quick. However this study was performed over 6 months with follow up at that stage prolonging the data collection.	No	N/A
<b>Not mapped to 3 Delays</b>								
<b>Not mapped</b>	Stelfox et al 2012	Strengths - N/A. Weaknesses - 1) Participants from capital cities and regional centres and may not have generalisable insights. 2) 22 participants may not be sufficient to be representative. 3) Only physicians and nurses included. 4) Mixed methods studies are not frequently used in trauma care literature and may not be well understood.	30	N/A	Suitable	This method is efficient quick to conduct including stakeholders from a variety of countries.	Yes - Survey and discussions.	N/A
<b>Not mapped</b>	LaGrone et al 2017	Strengths - 1) Large scale detailed assessment. Weaknesses - 1) Recall bias, especially for infrequent events. 2) Tendency towards exaggeration of positives if self-reporting practices. 3) Sampling strategy was convenience and varied across the countries. 4) Survey instrument evolved and some countries did not report some metrics. 5) Study reports provider perceptions of impact and no other measure of impact of QI activity.	210	Convenience sample through contacts and meetings. >90% response rate, except for in Bolivia (14%).	Suitable	4 country survey assessment of specific aspect. Convenience sampling and short survey.	No	N/A
<b>Not mapped</b>	Fuangworawong et al 2016	Strengths - 1) >70% response rate threshold meant they felt it was representative. Weaknesses - 1) Response bias though high response rate. 2) No private hospitals (providing 20% of trauma care). 3) Responses not validated in another way. 4) Mostly level 2+3 facilities, although main providers of care. 5) Patient outcomes are not compared. 6) Does not capture primary care.	30	N/A	Suitable	Short time frame, remote assessment mostly electronic.	No	N/A
<b>Not mapped</b>	LaGrone et al 2017	Strengths - 1) Inclusion of Peruvian collaborators at all stages. 2) Dual coding. 3) Use of direct quotes. Weaknesses - 1) Sampling method led to over representation of urban, academic, QI aware individuals. 2) Interviewer was foreign and not speaking the native language possibly influencing responses. 3) Recall bias more likely if M+M events were rare or annual.	210	N/A	Suitable	Survey and interviews of a targeted population within relatively short timeframe (could be done quicker).	Yes - Survey and interviews.	N/A
<b>Not mapped</b>	Zetlen et al 2017	Strength - N/A. Weaknesses - 1) Non random sampling likely to lead to oversampling of urban academic providers at a conference. 2) Overseas conference attendees were more likely to be invited speakers and not representative of routine providers. 3) Majority of LMIC respondents were from Bolivia the host country. 4) Anonymous survey and participants may be commenting on aspects (such as autopsy) about	4	N/A	Suitable	A quick data collection process taking advantage of a concentration of key stakeholders at a regional conference	No	N/A

		which they know little. 5) The practices were reported and not observed and therefore may not be reliable.				though subject to the limitations expressed.		
<b>Not mapped</b>	Blair et al 2017	Strengths - 1) Author perceived strengths and weaknesses of each assessment tool are discussed. Weaknesses - 1) INTACT, GTSET and ACS/COT not included. 2) Expert consensus on tool selection not achieved. 3) The recommendations are expert opinion without stronger evidence.	N/A	Study reports merits of individual assessment tools.	Suitable	This study is providing recommendations to guide trauma care capacity assessment and can inform whether and how to use such tools. However it is not itself the rapid method.	Yes - Literature review and Delphi.	N/A
<b>Not mapped</b>	Hardcastle et al 2011	N/A	N/A	N/A	Suitable	A survey tool with site visit that could be conducted relatively quickly.	No	N/A
<b>Not mapped</b>	Stewart et al 2016	Strengths - N/A. Weaknesses - 1) Developed in Ghana therefore may have limited generalisability. 2) Not related to outcomes but rather process measures.	N/A	N/A	Suitable	Focussing on the audit filters themselves this represents LMIC consensus of process measures that can meaningfully be used to evaluate care quality in this context. Though RAP suitability will depend on the method of application.	No	N/A
<b>Not mapped</b>	Suwaratchai et al 2008	Strengths - 1) Participants from a range of settings. 2) Iterative process. 3) Lack of face to face encounters. Weaknesses - 1) Only indicators related to death used. 2) Limited literature to inform initial indicator list. 3) Choice of consensus is a judgement and other cut off levels could be used.	N/A	Face to face encounters not required.	Suitable	Context specific audit filters of measure that can be used to evaluate care quality in context. Though RAP suitability will depend on the method of application.	No	N/A