

Using the Delphi Method to Establish a Novel and Universal System for Classifying Indications behind Delayed Abdominal Closure

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ABSTRACT

Introduction: Delayed fascial closure is a common lifesaving feature of damage control laparotomy but may result in serious complications. Accordingly, it should only be applied when required; however, a paucity of guidelines and framework for research makes knowing when this is challenging. This study aims to evaluate a classification system that facilitates the categorization of clinical reasoning behind delayed fascial closure.

Methods: A literature search on open abdomens in trauma or acute care surgery over 5 years ($n = 185$) were simplified into 11 unique scenarios. The Delphi method was employed to capture expert opinions from 202 clinical experts internationally. Participants classified each scenario into one or more of three categories—anatomic, physiologic, and/or logistic reason to leave the abdomen open. This is based on a classification system previously proposed by our group. Three rounds of the survey were distributed, with supplemental information provided between rounds, as per the Delphi process.

Results: In the first round, 600 international surgeons and intensivists were approached with 168 responses. In round 2, 24 of 55 traumatologists responded, and in round 3, 10 of 30 trauma surgeons responded. At the end of round 3, a strong consensus for appropriate classification ($\geq 95\%$) was achieved for scenarios 1 and 2, consensus approval ($\geq 75\text{--}94\%$) for scenarios 3, 6, and 10, and majority approval ($\geq 50\text{--}74\%$) for the remaining scenarios.

Conclusion: This study demonstrates the universality of a classification system for delayed fascial closure in damage control surgery. The previous absence of such a system has been a barrier in the effective study of delayed abdominal closure, given that indications can be widely disparate for the same procedure. Laying this foundation will allow trauma researchers to better understand delayed abdominal closure and ensure its optimized application or lack thereof.

Keywords: Abdomen, Abdominal injury, Abdominal trauma, Blunt abdominal trauma, Damage control, Damage control surgery, Emergency general surgery, Emergency surgery, Open abdomen, Open abdominal.

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INTRODUCTION

Intentionally leaving the abdominal fascia open is a key component of damage control laparotomy.^{1–4} Approximately 15–25% of all severely injured patients subjected to a trauma laparotomy are ineligible for primary fascial closure at the conclusion of the index operation.^{5–7} Therefore, delayed fascial closure has become a standard part of the trauma and acute care surgeon's armamentarium. Notwithstanding its widespread application, the fundamental indications for the appropriate use of the staged laparotomy approach are poorly defined.^{2,4–9} The need to establish consensus indications was made clear by a meta-analysis reporting over 1,000 indications for damage control surgery.⁴ Furthermore, the indications for delayed fascial closure and those for damage control surgery are often applied interchangeably. In many instances, however, delayed fascial closure can be used outside the context of the conditions that call for damage control surgery.

Patients who undergo delayed fascial closure may incur serious complications including enteroatmospheric fistulas, fascial retraction with loss of abdominal domain, and massive incisional hernias, despite advancements in the management of the open abdomen.^{9,10–15} A meta-analysis involving 3,000 patients subject to the open abdomen approach demonstrated that the average rate of primary fascial closure was only 62%.¹² Previous studies showed that social and

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physical performances are significantly jeopardized in open abdomen patients discharged with a chronic incisional hernia, compared to those discharged with their fascia closed primarily.^{9,11,12} These findings underscore the importance of prudent use of the delayed fascial closure approach. However, this intent is thwarted by the lack

of a practical classification system that could provide a common language to define and communicate about the implementation and advancement of the delayed fascial closure technique.

Our group has proposed a classification system that introduces a practical and comprehensive approach to delayed fascial closure which could be applied to facilitate decision-making and promote appropriate use of this strategy.³ According to this, classification of the indications to leave the fascia open can be divided into three categories: anatomic, physiologic, and logistic.^{3,16} Anatomic reasons pertain to the inability to bring the fascial edges together at the index operation or creating unwarranted risks of abdominal compartment syndrome, physiologic reasons relate to systemic dysfunction, and logistic reasons refer to anticipated surgical reinterventions in the abdomen. These categories occur either as a single reason or in any combination.

One of the challenges in developing a classification system is that its application will ultimately be determined by individual clinical judgment. As a corollary, it would have to capture the perspectives of physicians with multiple levels of expertise. The Delphi method is a useful tool in that setting, combining opinions from multiple experts through surveys to obtain group consensus where the available literature is scarce.^{17–19} The Delphi technique has been used extensively in social sciences and healthcare research to achieve consensus areas. Some of its many capabilities include the development of quality indicators and create clinical practice guidelines.^{17–19} Its ability to engage panels of experts in an iterative process is especially useful for advancing the development of novel concepts and approaches, which would normally be a long-term process comprising isolated focus groups and marginal progress. Classically, the first round collects open responses from experts and informs the development of Delphi questionnaires. An educational intervention such as reporting previous rounds is constructed and experts are surveyed again to determine if a consensus is achieved.¹⁹

The aims of the present study were twofold: to assess the degree of consensus for our delayed abdominal fascial closure classification system; and to gauge the thoroughness of our classification system leveraging the opinion of experts in multiple fields (intensive care, trauma, and acute care surgery).

METHODS

Literature Search

A systematic search on Medline and Embase to identify articles published over 5 years on open abdomens in trauma and acute care surgery that included a reason for delayed abdominal closure (Appendix 1) was performed.

Scenario Development

Over 100 research articles and case reports pertaining to delayed closure of the abdominal wall fascia at the end of a laparotomy were reviewed by two researchers. Clinical indications for delayed fascial closure were recorded and each case was simplified into a generic scenario. These scenarios were compared to each other and consolidated into a list of unique situations. In case of a conflict, scenarios were kept separate.

Survey Development

Eleven distinct clinical scenarios that would justify leaving the abdominal fascia open at the end of a laparotomy were developed from the information contained in the selected publications from

the literature review. These scenarios were used in the survey distributed to a group of 600 trauma and acute care surgeons and intensivists from around the world. Physician contacts were obtained from membership of the Abdominal Compartment Society, the Canadian Collaborative on Urgent Care Surgery, and the Brazilian Trauma Society. For each scenario, physicians were able to select one or any combination of the three indications for delayed abdominal fascia closure (anatomic, physiologic, and logistic); a classification system previously proposed and described by our group.³ Moreover, an option specified as "Other" was included with a free text box if a participant felt that the indication for delayed abdominal fascial closure in a particular scenario was not appropriately encompassed within these three options. The participants were asked to write in the free text box what they believed would be the alternative indication for that scenario. Subsequently, the information written in the free texts were independently assessed by two reviewers, and consensus was achieved in which case the text was either classified as a new indication for the open abdomen or included in the three preexisting categories. Lastly, participants were provided the option to select, "this is never a reason to leave the abdomen open," if they felt that the case described in any scenario was not an indication for delayed fascial closure. Participant information including demographics, years of experience, and practice type were also collected.

Delphi Process

Three rounds of survey distribution were planned. The first distribution of this survey was named round 1. The survey was issued to 600 physicians including intensivists, general surgeons, and trauma surgeons from several different countries. The results of round 1 were reviewed. Ambiguous information/wording in any scenario was adjusted for subsequent rounds to ensure they reflected only one clinical indication for delayed fascial closure, rather than ambiguity that could have another proposed indication. This is recognizing that there are clinical scenarios where more than one indication may be present, however, for the purposes of this study and evaluation of this classification system, the survey was intended to provide scenarios with one primary indication.

In round 2, the scope was narrowed to experts including just 55 trauma and acute care surgeons and trauma intensivists. Scenarios were refined to provide clarity where respondents from the first round reported ambiguity. The results from this round were recorded and interpreted as previously described.

The results of the previous rounds were shared with the study participants in the third and final round. Subsequently, participants completed the survey based on their understanding of the previous results. The experts surveyed in the third round included only 30 trauma and acute care surgeons. This approach was aimed at restricting the third round of the survey to the surgical specialists most likely to use the open abdomen strategy. Consensus analysis of all three rounds was subsequently performed.

Consensus analysis was defined according to previously published consensus standards. The ranges of agreement from the highest to lowest were: strong consensus (100–95%), consensus approval (≥ 75 –94%), majority approval (≥ 50 –74%), and no approval ($< 50\%$).^{19–22}

RESULTS

A total of 185 unique articles were identified in the literature review. Articles that described a scenario requiring the use of delayed

facial closure were included (Flowchart 1). A total of 19 articles were included and the indications were used to devise the clinical scenarios for the Delphi survey.

The Delphi survey was distributed as described above. A total of 202 responses were received at the end of the three rounds. Experts from 39 different countries participated in the survey (Table 1). The response rates were 28% in round 1, 44% in round 2, and 33% in round 3. Nineteen experts participated in two different rounds, and 10 in all three rounds. One hundred thirty-four (80%) surgeons and 34 (20%) intensivists responded in round 1, 19 (79%) trauma surgeons and five (21%) trauma intensivists responded in round 2, and 10 trauma surgeons who participated in both previous rounds responded in round 3. Additional demographics of the participants and their experience with managing open abdomens are shown in Table 2. The findings of the survey indicated that over 75% of respondents agreed on a common indication for scenarios 1, 2, and 10, using our proposed classification system.

Scenario 1 had 100% consensus agreement as physiologic being the reason to leave the abdominal fascia open. Scenario 2 had consensus approval of 96% in the second round and 80% in the final round.

In round 1 of scenario 3, 32% of participants indicated that the case described was not a reason to leave the abdomen open. Therefore, prior to round 2, authors revised the scenario to clarify the clinical scenario. In round 3, the agreement increased significantly to 100% of participants indicating there was a reason to leave the abdomen open, with consensus approval of anatomic being the reason to keep the abdomen open.

Scenario 4 interestingly achieved majority approval with physiologic in round 2, and majority approval logistic in round 3; however, in rounds 2 and 3, logistic and physiologic, respectively, did not achieve any consensus.

Scenario 5 had a majority of approval, identifying a logistic reason to leave the abdomen open. Similarly, scenario 6, had a majority of approval as logistic being the reason to leave the abdomen open. In round 1, the consensus was 63%, increasing to 100% in round 3.

Scenario 7 also had a majority of approval, identifying logistic as the reason to leave the abdomen open. Similarly, scenario 8 had majority approval in the first and third rounds as a logistic reason to keep the abdomen open.

Scenario 9 showed an equipoised response among the three categories, achieving majority consensus of 50% in the third round. The results of scenario 10 demonstrated consensus approval over all three rounds with anatomic reason to leave open the abdominal wall fascia ranging from 86 to 92%. Scenario 11 showed an interesting response pattern where each round showed a different result. In the first round, logistic was the most frequent answer, in the second round physiologic, and in the third it was anatomic. Majority approval of 70% was achieved in the third round with anatomic indication to keep the abdomen open.

The option specified as "Other" was infrequently selected by the participants (1–2%) throughout the rounds of the survey. Only two participants selected that option in round 3 but did not provide any additional reason. All written responses that followed the option "Other" were reviewed by experts and were deemed to be encompassed by one of the anatomic, logistic, and physiologic reasons for delayed closure of the abdominal fascia, which was also selected by the participant. Furthermore, all participants who selected the option "Other" for a specific scenario concomitantly selected at least one of the three aforementioned reasons for that same scenario.

Overall, strong consensus of $\geq 95\%$ was achieved for scenarios 1 and 2. Consensus approval ($\geq 75\text{--}94\%$) was achieved for scenarios 3, 6, and 10. The remaining scenarios had majority approval ($\geq 50\text{--}74\%$) in the third round of the Delphi process.

DISCUSSION

The scenarios described in this study encompass multiple indications for delayed abdominal closure, guided by the literature search. Subject-matter experts were able to classify these scenarios into one of the three proposed categories—anatomic, physiologic, and logistic—achieving at least a majority of agreement in all scenarios, and strong consensus in 3 of 11 cases.

Given the iterative nature of the Delphi process, changes were made to the scenarios between survey rounds. Between rounds 1 and 2, the scenarios were reworded to clarify that the open abdomen technique was in fact applied in each scenario. This was in response to feedback that the survey appeared to inquire if the respondent would use the open abdomen approach in a particular scenario and, if so, which indication it was categorized into. However, the intent

Flowchart 1: PRISMA flow diagram

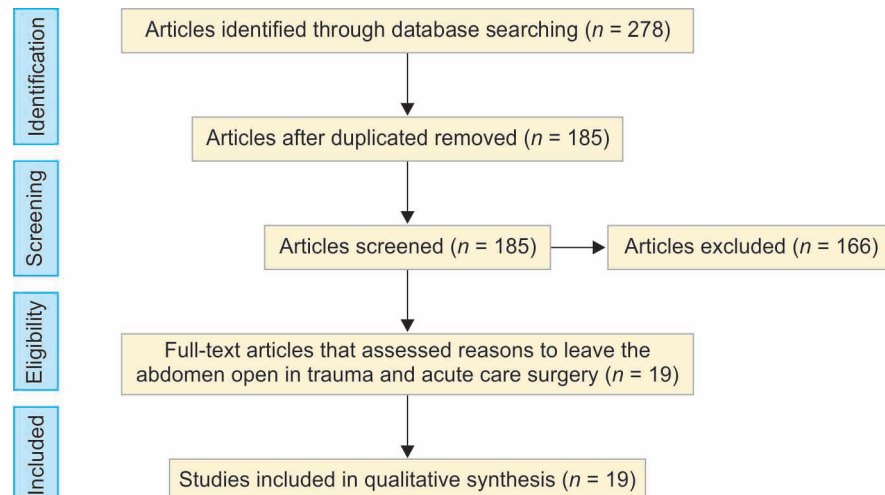


Table 1: Demographics of survey respondents

<i>Demographic variable</i>	<i>Number of respondents</i>		
	<i>Round 1</i>	<i>Round 2</i>	<i>Round 3</i>
	<i>n = 168</i>	<i>n = 24</i>	<i>n = 10</i>
Country of participant			
Algeria	1		
Argentina	7		
Australia	2	2	
Austria	1		
Belarus	2		
Belgium	7	1	
Brazil	78	5	
Canada	6	2	10
Columbia	2	2	
Czech Republic	1		
Estonia	3	1	
Finland	2	2	
France	1		
Great Britain	1		
Greece	2		
India	2		
Indonesia	1		
Iran	1		
Ireland	2		
Israel	2		
Italy	1		
Japan	1		
Korea	2		
Latvia		2	
Macedonia	1		
Netherlands	8		
Peru	2		
Poland	1		
Portugal	2		
Qatar	1		
Romania	1		
Saudi Arabia	3		
South Africa	4	1	
Spain	4		
Sweden	2	1	
Switzerland	2		
United States	7	5	
United Kingdom	1		
Venezuela	1		

Contd...

Contd...

Demographic variable	Number of respondents		
	Round 1	Round 2	Round 3
	<i>n = 168</i>	<i>n = 24</i>	<i>n = 10</i>
Age of survey participants			
25–34	18 (11)	1 (4)	0
35–44	67 (40)	3 (13)	2 (20)
45–54	43 (26)	9 (38)	4 (40)
55–64	28 (17)	4 (17)	4 (40)
65–74	11 (7)	7 (29)	0
75 or older	1 (1)	0 (0)	0
Estimated open abdomens managed per year, by survey participant			
0–5	53	2	0
5–10	43	5	2
10–15	29	4	3
15–20	8	1	3
>20	35	12	2

Table 2: Aggregate responses from the 1st, 2nd, and 3rd rounds of the online Delphi questionnaire. Reformulations between rounds are underlined, and deletions are in italic

Scenario	Reason to leave abdomen open (response percent)	Round 1	Round 2	Round 3
		<i>n = 168</i>	<i>n = 24</i>	<i>n = 10</i>
		<i>n (%)</i>	<i>n (%)</i>	<i>n (%)</i>
1. At the end of an abdominal operation the patient is severely physiologically unstable and required packing of the liver as a damage control procedure. The surgeon decided to use the “Open Abdomen” strategy. What reason or reasons would best define the indication to leave the abdomen in this case?	Anatomic	39 (23)	5 (21)	2 (2)
	Physiologic	133 (79)	23 (96)	10 (100)
	Logistic	64 (38)	5 (21)	4 (40)
	Not a reason to leave the abdomen open	9 (5)	0 (0)	0 (0)
2. At the end of an abdominal operation a patient has a pH <7.0, is hypothermic <34°C, lactate >7.5 mmol/L, bicarbonate is ≤20 mEq/L, and received >20 L of crystalloids I.V. The surgeon decided to use the “Open Abdomen” strategy. What reason or reasons would best define the indication to leave the abdomen in this case?	Anatomic	26 (15)	1 (4)	3 (30)
	Physiologic	137 (82)	23 (96)	8 (80)
	Logistic	15 (9)	0 (0)	0 (0)
	Not a reason to leave the abdomen open	17 (10)	0 (0)	0 (0)
3. Leaving the abdomen open at the end of an operation in a patient receives massive blood transfusion, characterized by more than 50% of the patient’s total blood volume in 4 hours, and more than 20 L of crystalloid. Massive bowel edema ensues, and the surgeon decided to use the “Open Abdomen” strategy. What reason or reasons would best define the indication to leave the abdomen in this case?	Anatomic	34 (20)	1 (4)	9 (90)
	Physiologic	89 (54)	18 (75)	2 (20)
	Logistic	16 (10)	2 (8)	1 (10)
	Not a reason to leave the abdomen open	53 (32)	5 (21)	0 (0)
4. At the end of an operation laparotomy packs were left in the retroperitoneum abdomen for bleeding control (oozing) in a coagulopathic patient. Therefore, the surgeon decided to use the “Open Abdomen” strategy. What reason or reasons would best define the indication to leave the abdomen in this case?	Anatomic	22 (13)	1 (4)	1 (10)
	Physiologic	97 (58)	19 (79)	3 (30)
	Logistic	50 (30)	6 (25)	6 (60)
	Not a reason to leave the abdomen open	26 (15)	3 (13)	0 (0)

Contd...

Contd...

Scenario	Reason to leave abdomen open (response percent)	Round 1	Round 2	Round 3
		n = 168	n = 24	n = 10
		n (%)	n (%)	n (%)
5. At the end of an operation laparotomy packs are left to tamponade intra-abdominal or pelvic bleeding in the abdomen and pelvis for bleeding control. Therefore, the surgeon decided to use the "Open Abdomen" strategy. What reason or reasons would best define the indication to leave the abdomen in this case?	Anatomic	39 (23)	7 (29)	2 (20)
	Physiologic	31 (18)	14 (58)	2 (20)
	Logistic	118 (70)	17 (71)	7 (70)
	Not a reason to leave the abdomen open	14 (8)	0 (0)	1 (10)
6. At the end of an operation for small bowel necrosis, the gastrointestinal tract is left in discontinuity (blind loops) for a "second look" because of questionable bowel perfusion. Therefore, the surgeon decided to use the "Open Abdomen" strategy. What reason or reasons would best define the indication to leave the abdomen in this case?	Anatomic	63 (38)	9 (38)	3 (30)
	Physiologic	37 (22)	14 (58)	7 (70)
	Logistic	105 (63)	15 (63)	10 (100)
	Not a reason to leave the abdomen open	13 (8)	0 (0)	0 (0)
7. Leaving the abdomen open at the end of an abdominal operation for intraabdominal sepsis the surgeon felt that additional abdominal "washouts" were required to obtain definitive source control. Therefore, the surgeon decided to use the "Open Abdomen" strategy. What reason or reasons would best define the indication to leave the abdomen in this case?	Anatomic	29 (17)	3 (13)	0 (0)
	Physiologic	58 (35)	7 (29)	2 (20)
	Logistic	106 (63)	14 (58)	7 (70)
	Not a reason to leave the abdomen open	32 (19)	4 (17)	2 (20)
8. Leaving the abdomen open at the end of an abdominal operation for debridement of severe necrotizing pancreatitis the surgeon felt that additional debridement of the pancreatic necrosis would be necessary in the upcoming days. Therefore, the surgeon decided to use the "Open Abdomen" strategy. What reason or reasons would best define the indication to leave the abdomen in this case?	Anatomic	53 (32)	7 (29)	3 (30)
	Physiologic	60 (36)	9 (38)	1 (10)
	Logistic	86 (51)	9 (38)	6 (60)
	Not a reason to leave the abdomen open	35 (21)	4 (17)	1 (10)
9. A temporary vascular shunt was applied to a major abdominal artery to maintain distal perfusion. Therefore, the surgeon decided to use the "Open Abdomen" strategy. What reason or reasons would best define the indication to leave the abdomen in this case?	Anatomic	48 (29)	8 (33)	3 (30)
	Physiologic	41 (24)	4 (17)	2 (20)
	Logistic	83 (49)	13 (54)	5 (50)
	Not a reason to leave the abdomen open	30 (18)	1 (4)	1 (10)
10. A patient sustained full thickness loss of a significant part of the abdominal wall caused by trauma. Leaving the abdomen open at the end of an operation when the remaining fascial edges do not come together (unbridgeable fascial defect). Therefore, the surgeon decided to use the "Open Abdomen" strategy postponing definitive closure. What reason or reasons would best define this indication to leave the abdomen in this case?	Anatomic	145 (86)	22 (92)	9 (90)
	Physiologic	15 (9)	0 (0)	0 (0)
	Logistic	9 (5)	1 (4)	0 (0)
	Not a reason to leave the abdomen open	13 (8)	0 (0)	1 (10)
11. There is extreme visceral edema at the end of an abdominal operation. The surgeon felt that the risk for the development of Abdominal Compartment Syndrome was high if the fascia were closed primarily. Therefore, the surgeon decided to use the "Open Abdomen" strategy postponing definitive closure. What reason or reasons would best define this indication to leave the abdomen in this case?	Anatomic	48 (29)	12 (50)	7 (70)
	Physiologic	41 (24)	16 (67)	3 (30)
	Logistic	83 (49)	0 (0)	1 (10)
	Not a reason to leave the abdomen open	30 (18)	0 (0)	0 (0)

of this study was to provide a clear indication for open abdomen and poll experts regarding their interpretation of the indication. Accordingly, wording similar to, "the surgeon used the open abdomen

technique..." along with the intended clinical indication (e.g., bleeding, sponges, etc.) was added to each scenario to explicitly state that the open abdomen approach was taken, and to provide the

clinical context why. The option to select “Not a reason to leave the abdomen open” was retained in the case that respondents disagreed with the clinical decision to continue with delayed abdominal closure. These clarifications saw a decrease in the responses suggesting there was no indication to close the abdomen in rounds 2 and 3. Only scenario 3 maintained a high response (>20%) of not a reason to close the abdomen in round 2. Once again, the scenario was clarified and the authors added “bowel edema” as the clinical indication for delayed abdominal closure. This may explain why there was a change in consensus from physiologic to anatomic reason between rounds 2 and 3. Nonetheless, consensus approval was achieved for scenario 3 in both these rounds.

Limitations of this study include those that are corollaries of the Delphi process: the approach is subjective and based on the experiences and opinions of the polled respondents. In order to reduce bias, a range of respondents from around the world with varying levels of experience and practices were sent the survey. Moreover, a standard level of consensus does not exist as it can depend on sample size, research objective, and resources available. Literature suggests significant rates of consensus range from 51 to 80%, which was applied in this study.^{19–22} Another consideration is that while the proposed classification model has been validated in this study, it is not necessarily the optimal model for delayed abdominal closure. Nonetheless, given the paucity of literature in this domain, this serves as the best current classification model and a starting point for additional efforts.

Validation of this proposed model provides a platform to standardize the discussion and research regarding delayed abdominal closure. Often applied in dire circumstances, morbidity and mortality secondary to delayed abdominal closure are high at baseline. A common approach to all delayed closures is not appropriate; for example, a logistic open abdomen for a planned takeback is managed far differently than an anatomic concern for compartment syndrome. However, the clinical circumstances, decision-making, and outcomes cannot be directly compared given the vastly different nature of the underlying cause—yet there has not been a standardized way to discuss these cases. The adoption of this now-proven classification model will help facilitate these discussions, with the intention of improving the application, morbidity, and mortality of delayed abdominal closure.

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APPENDIX 1:

Search results for articles published in the last 5 years on traumatic and nontraumatic open abdomen on Medline and Embase

<i>Search engine</i>	<i>Search (S) terms</i>	<i># Retrieved</i>
Nontrauma		
Medline	S1 ((damage control laparotomy or damage control surgery).ti, ab. or Abdominal Injuries/su or Abdomen/su or Laparotomy/ or general surgery/) and open abdomen*.ti, ab.	397
Medline	S2 (Non-trauma* or Nontrauma* or Non trauma*).mp.	12,180
Medline	S3 1 and 2	25
Medline	S4 ((intra-abdominal or intraabdominal) adj (infection* or sepsis)).ab, ti. or exp intraabdominal infections/ or sepsis/ or peritonitis.ab, ti.	118,518
Medline	S5 1 and 4	111
Medline	S6 3 or 5	125
Medline	S7 limit 6 to yr="2015 -Current"	41
Medline	S8 7 not (exp animals/not humans/)	41
Medline	S9 limit 8 to letter	0
Medline	S10 8 not 9	41
Medline	S11 limit S10 to English language	40
Medline	S12 remove duplicates from 11	40
Embase	S1 ((damage control laparotomy or damage control surgery).ti, ab. or abdominal injury/ su or abdominal surgery/ or abdominal closure/ or Laparotomy/ or surgical technique/ or general surgery/ or surgery/) and (open abdomen*.ti, ab. or open abdomen/)	702
Embase	S2 (Non-trauma* or Nontrauma* or Non trauma*).mp.	17,741
Embase	S3 1 and 2	28
Embase	S4 ((intra-abdominal or intraabdominal) adj (infection* or sepsis)).ab, ti. or exp abdominal infection/ or sepsis/ or peritonitis/	225,813
Embase	S5 1 and 4	248
Embase	S6 3 or 5	263
Embase	S7 limit S6 to yr="2015 -Current"	94
Embase	S8 7 not (exp animal/not human/)	94
Embase	S9 limit 8 to letter	0
Embase	S10 8 not 9	94
Embase	S11 limit S10 to English language	93
Embase	S12 remove duplicates from 11	92
Total nontrauma (Embase + Medline)		132
Trauma		
Medline	S1 ((damage control laparotomy or damage control surgery).ti, ab. or Abdominal Injuries/ su or Abdomen/su or Laparotomy/ or general surgery/) and open abdomen*.ti, ab.	397
Medline	S2 (Trauma* or Injur*).mp.	1,383,065
Medline	S3 1 and 2	248
Medline	S4 ((intra-abdominal or intraabdominal) adj (infection* or sepsis)).ab, ti. or exp intraabdominal infections/ or sepsis/ or peritonitis.ab, ti.	118,518
Medline	S5 1 and 4	111
Medline	S6 3 or 5	304
Medline	S7 limit 6 to yr="2015 -Current"	89
Medline	S8 7 not (exp animals/not humans/)	88
Medline	S9 limit 8 to letter	0
Medline	S10 8 not 9	88
Medline	S11 limit S10 to English language	86
Medline	S12 remove duplicates from 11	86
Embase	S1 ((damage control laparotomy or damage control surgery).ti, ab. or abdominal injury/ su or abdominal surgery/ or abdominal closure/ or Laparotomy/ or surgical technique/ or general surgery/ or surgery/) and (open abdomen*.ti, ab. or open abdomen/)	702
Embase	S2 (Trauma* or Injur*).mp.	1,969,625
Embase	S3 1 and 2	367

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<i>Search engine</i>	<i>Search (S) terms</i>	<i># Retrieved</i>
Embase	S4 ((intra-abdominal or intraabdominal) adj (infection* or sepsis)).ab, ti. or exp abdominal infection/ or sepsis/ or peritonitis/	225,813
Embase	S5 1 and 4	248
Embase	S6 3 or 5	480
Embase	S7 limit S6 to yr="2015 -Current"	170
Embase	S8 7 not (exp animal/not human/)	165
Embase	S9 limit 8 to letter	0
Embase	S10 8 not 9	165
Embase	S11 limit S10 to English language	164
Embase	S12 remove duplicates from 11	160
Total trauma (Embase + Medline)		146
Total nontrauma and trauma (Embase + Medline)		278
Total nontrauma and trauma (Embase + Medline)—duplicates removed		185