Dehiscence, Infection, Seroma, Haematoma (DISH): Development and Validation of a New Classification of Surgical Site Outcomes

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This paper is related to a previous communication at the Australasian College for Infection Prevention and Control (ACIPC) 2025 International Conference: Russo P, Boermeester M, Bond-Smith G, Chen A, Leaper D. Redefining Surgical Incision Outcomes: A Modified Delphi Study to Establish a Novel Universal Classification System. *Infection, Disease & Health* 2025;30:S17-S18.

ABSTRACT

Background: Surgical site outcome (SSO) reporting lacks details of management, focuses on infection, and overlooks dehiscence, seroma and haematoma. An international, consensus-driven classification system applicable to a diverse range of surgical incisions and outcomes was developed to address this gap and standardise the reporting of SSOs.

Method: Concept statements based on a targeted literature review were rated by pan-specialty global experts during a four-round modified Delphi study to create a comprehensive

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classification of SSOs. Reliability and language validation focused on inter-rater agreement and intra-rater reproducibility by experts applying the classification to case vignettes, created using generative artificial intelligence sampling. Cross-domain agreement was evaluated using a patient-level, double entry, interclass correlation coefficient (DE-ICC).

Results: Consensus was achieved on definitions of dehiscence, inflammation/infection, seroma and haematoma ('DISH') within a new classification, comprising five objectifiable grades of clinical intervention (0–4) and four grades of clinical presentation (a–d) for each domain. The DISH 'score' presents all domains collectively, e.g. D1a I2b S0 H0; a snapshot of management and presentation of an incision. Mean patient-level inter-rater DE-ICC was 0.93 (95% confidence interval [CI] 0.91–0.96; median 1.00; very high concordance). Intra-rater DE-ICC was similarly high (mean 0.95; 95% CI 0.93–0.96; median 1.00).

Conclusion: The proposed cross-specialty, global DISH Classification facilitates more comprehensive surveillance and audit of SSOs in clinical practice and research, by standardising reporting of all relevant grades of clinical presentation and management of SSOs. Very high concordance when applied to case vignettes gives credibility to clinical validation and adoption.

INTRODUCTION

Surgical site outcomes (SSOs) are underreported, lack precise information on their clinical management, and focus on surgical site infections (SSIs) while overlooking dehiscence, seroma and haematoma. Existing definitions and classifications for SSOs are limited.

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The definitions and gradings advocated by the United States (US) Centers for Disease Control and Prevention (CDC) for SSIs are the most used.[1,2] However, they focus solely on SSIs,[1,2] failing to capture the burden of other SSOs including dehiscence, seroma and haematoma which are also costly to hospitals and patients.[3] In addition, the CDC classification system relies heavily on subjective clinical judgement, which can be variable across institutions, leading to ambiguity in interpretation.[1,2] This could contribute to incorrect diagnoses and sub-optimal wound management, that can have negative impacts on patient outcomes such as impaired wound healing, increased risk of adverse events and reduced quality of life.[4] The CDC classification system is also merely a descriptive classification of clinical presentation, that does not account for subsequent related management. Standardised tracking of the clinical management of wounds would facilitate comparisons of clinical practice and benchmarking of outcomes between institutions. This could then be used to inform quality improvement.[5] These data may also support research or audit across surgical specialties.

All SSOs can be barriers to optimal healing of surgical incisions and can occur independently or interdependently. Their impact can also vary depending on the surgical specialty and anatomical site. For example, dehiscence can occur without a prior SSI, and its severity increases with the depth of tissue involvement.[6] Dehiscence of an abdominal or sternotomy wound, or after hip or knee prosthetic surgery, can be life-threatening and may require prolonged interventional management. Exposed dehisced wounds are prone to secondary infection.

Seromas and haematomas can also present substantial challenges, depending on surgical specialty. Postoperative seromas are common, particularly after mastectomy,[7] and may require repeated aspiration, interventional imaging, or even open management, all of which may delay adjuvant chemotherapy or radiotherapy, potentially impacting survival outcomes. Haematomas,

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which can range from minor bruising to large collections in soft tissues or visceral cavities, are at risk of becoming infected, leading to abscess formation and sepsis. They may also require emergency surgical intervention to evacuate the haematoma and control bleeding.

A comprehensive classification system that defines and standardises all postoperative incisional outcomes (dehiscence, infection, seroma, and haematoma), irrespective of speciality, procedure or setting, could form a framework to improve SSO reporting and facilitate comparison in research and audit. This study aims to establish and validate an international, consensus-driven classification system applicable to a diverse range of surgical incisions to standardise the reporting of SSOs.

METHODS

The stepwise creation and validation of a new SSO classification was as follows (Figure 1):

1. Evidence-based statements informed by a targeted literature review (TLR)
2. Modified Delphi study
3. Concept SSO classification and debate amongst international experts
4. Final Delphi round and final SSO classification
5. Validation of the language and reliability of the classification by international experts

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1. Evidence-based Statements

A TLR was undertaken to identify key themes and gaps in relation to dehiscence, inflammation/infection, seroma and haematoma. Data from structured and ad-hoc searches of MEDLINE and Embase via Ovid SP, MEDLINE via PubMed, and Google Scholar (Supplementary Information: Appendix 1) were used to develop definition statements for the Delphi study. The TLR was not intended as a systematic review and was scoped to generate concept statements for Delphi discussion rather than provide a definitive evidence synthesis.

2. Modified Delphi study

Concept statements based on the findings from the TLR were rated by a 32-member Expert Panel from 22 countries spanning multiple specialties. This took place over three rounds of anonymous voting, until a comprehensive classification of SSOs was established. Further details of the methodology can be found in Supplementary Information: Appendices 2 & 3.

3. Concept SSO classification and debate amongst international experts

An in-person symposium brought together all panellists alongside other international experts to debate and critique the newly proposed classification system.

4. Final Delphi round and final SSO classification

Feedback from the symposium was used to inform the final version of the classification which was agreed on following a fourth and final round of anonymous voting from the Expert Panel.

5. Validation Study

A follow-up study to validate the reliability and language of the novel classification system was undertaken at a second in-person symposium. The design of this validation study was informed

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by preliminary demonstration exercises performed in the US and Thailand. These exercises were exploratory versus the validation process described below, which was conducted according to a pre-specified protocol (Supplementary Information: Appendix 4).

Validation was assessed via inter-rater agreement (the concordance between participant's scores for the same case) and intra-rater reproducibility (the concordance of a participant's scoring of the same set of cases in reverse order). Nineteen patient case vignettes were created using a rule-based generative artificial intelligence (Gen-AI) pipeline from a constrained 'universe' of allowable vignettes spanning eight 'DISH' (Dehiscence, Infection, Seroma, and Haematoma) scoring domains (four complication domains, each with presentation, P and intervention, I). Using a coverage-driven approach, vignettes were selected using a stratified sampling algorithm that ensured full representation of all allowed within-domain (P, I) pairs; the set also included one all-zero vignette with uneventful healing. Vignettes were structurally capped at a maximum of two active domains to ensure clinical plausibility while limiting the number of cases and minimising rater burden. Ultimately, nineteen patient case notes were generated from the patient case vignettes using Gen-AI and were independently reviewed for face-validity ahead of the study.

A panel of international surgeons and infection control specialists representing a broad range of specialties was convened. Participants received comprehensive training on the DISH scale before completing in-person scoring of the patient case vignettes under controlled conditions across two sessions over two days.

Cross-domain agreement was evaluated using a patient-level double entry intra-class correlation coefficient (DE-ICC), which quantifies agreement on the full eight-component DISH score (vector comprising four domains × presentation/intervention). DE-ICC provides a single

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summary of concordance across the full DISH scoring profile for each patient, capturing whole-profile agreement (overall and cross-domain). DE-ICC directly summarises whole-case agreement across all eight DISH components, aligning with the study's primary objective of cross-domain reliability. Domain-level agreement statistics were reported to support identification of which DISH components drive disagreement and to understand where refinements to the classification or training materials may be required.

Domain-level inter-rater agreement was assessed using Kendall's coefficient of concordance (W). Quadratic-weighted Gwet's AC2 with 95% confidence intervals was computed as a supplementary ordinal agreement metric less sensitive to class imbalance. Both mean accuracy (overall exact agreement) and balanced mean accuracy (macro-averaged across severity levels) were calculated.

Intra-rater reproducibility was assessed using the DE-ICC framework on repeated ratings in the second validation session of the same patient notes, with the order reversed to reduce recall bias from the prior session.

RESULTS

Targeted Literature Review

Table 1 explores the limitations of common systems compared to the new DISH Classification System. The CDC, Southampton Wound Assessment Scale, and ASEPSIS systems were selected as comparators as they were the most widely used and/or cited general SSO-related systems identified in the TLR, making them the most relevant comparators for illustrating gaps in current practice.

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The review also identified variable definitions for dehiscence, infection, seroma and haematoma, demonstrating the need for standardised definitions to ensure consistent reporting of surgical outcomes. Detailed TLR results are in Supplementary Information: Appendix 5.

Modified Delphi Study and Finalisation of Classification

Although consensus was reached on a new classification of SSOs following Round Three of the modified Delphi study, the in-person symposium prompted further refinement (see Supplementary Information: Appendices 6 & 7). A fourth round was initiated, with statements drafted based on those from the previous rounds and symposium feedback. This resulted in the dissociation and independent scoring of clinical intervention and clinical presentation, with five options grading the intervention received (0–4) and four grading the clinical presentation observed (a–d).

The proposed final universal classification, the DISH Classification System for SSOs, is described in Table 2 (clinical intervention/management) and Table 3 (clinical presentation). The final DISH 'score' presents a snapshot of the management received and the presentation of an incision, e.g. D1a I2b S0 H0 (Figure 2).

Validation Study

A second symposium took place in Madrid, Spain, 19−20 February 2026. A total of 64 surgeons and infection control specialists participated, of whom 60 provided full responses in both rating sessions. An example validation case note with step-by-step DISH scoring guidance is provided in Supplementary Information: Appendix 8.

Domain-level inter-rater agreement was consistently high. Mean Kendall's W was 0.96 (range 0.93–0.97). Gwet's AC2 averaged 0.96 (range 0.94–0.99), with all domain-specific 95%

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confidence intervals lower bounds above 0.90, indicating 'excellent' agreement. Mean accuracy across domains was 93% (range 87%–97%), and balanced mean accuracy was 87% (range 77%–95%), suggesting accuracy was not driven solely by the most common severity levels. Mean patient-level inter-rater DE-ICC was 0.93 (95% CI 0.91–0.96; median 1.00), indicating very high concordance in raters' 8-domain scoring profiles for the same patient. Intra-rater DE-ICC was similarly high (mean 0.95; 95% CI 0.93–0.96; median 1.00).

Sensitivity analysis excluding zero-valued observations within each domain and scoring dimension yielded lower mean accuracy across all domains, most notably for dehiscence (intervention; 78%), and infection and seroma (presentation: 77% and 75%, respectively); discrepancies in these domains were similarly noted during the symposium through discussion and following crude analysis of the results. Analysis of feedback was used to make minor edits to the classification's language, which are reflected in the classification shown in Table 2 and Table 3. Full results are detailed in the Supplementary Information: Appendix 9.

DISCUSSION

This study addresses the need for a universal classification system spanning the wide range of SSOs, achieved through international consensus and validation. The comprehensive, cross-specialty global DISH Classification was built on evidence-based and consensus definition and classification for SSOs, specifically dehiscence, inflammation/infection, seroma and haematoma. The system encompasses definitions for each domain, grading severity for clinical intervention and management, and grading severity for clinical presentation. Given differences between specialties, no fixed timepoint to collect DISH is prescribed, though day of discharge and at usual fixed follow-up points are advised. For surgery involving implants, it is recommended that

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the follow-up period over which DISH is recorded should be at least one year, given the potential for delayed onset of complications. However, this may vary based on local postoperative surveillance protocols.

Given the absence of standardised definitions for SSOs in current practice, specifically for dehiscence, seroma and haematoma, there is a need for this novel classification system, that should improve SSO reporting across all surgical specialities. There are currently few classification systems available that allow clinicians to report, classify and grade SSOs they observe. The CDC classification for SSIs, the Southampton Wound Assessment Scale and the ASEPSIS Wound Score system all fail to fully encompass SSOs other than infection, use definitions with limited practical and clinical relevance, lack information about management, and have limited utility for non-surgeons.[1, 8, 9] With the exception of the CDC classification, they also lack applicability to different surgical specialities.[1, 8, 9] It is not possible to compare these classifications directly, as the function and intention of each is different. Table 1 highlights the limitations of existing classifications, and demonstrates why a new classification system was needed to grade SSOs.

The widespread applicability of the DISH Classification System is its focus on creating a 'common language' for recognising SSOs, including their specificity and severity. It allows for the accurate identification of the four domains (dehiscence, infection/inflammation, seroma and haematoma), and their true incidence and severity, thus guiding targeted and effective prevention. Improving the accuracy of identification, reporting and surveillance of SSOs will support the development and implementation of universal guidelines and care bundles across different surgical specialties. Strong inter- and intra-rater reliability in the validation study is supportive of the DISH score being universally applicable in clinical practice. However, the DISH

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Classification System is viewed as a starting framework for future work; clinical validation and prospective studies are needed, and it is anticipated that the DISH Classification System will evolve over time. Pilot exercises across different surgical specialities involving health care providers in many regions are planned or underway, that aim to determine the feasibility, acceptability, and validity of the DISH Classification System in real-world settings.

A systematic approach was used to gather expert consensus, and the anonymity of the process encouraged transparency from participants in this study. The study engaged an Expert Panel of 32 individuals from 22 countries, who represented a diverse group of surgeons across various surgical specialities and infection control specialists, though not all viewpoints may have been represented. These factors strengthen the validity of the final definitions of each domain and support the universal applicability of the proposed DISH Classification System.

A modified Delphi method was adopted rather than the 'pure' Delphi method, that typically requires ongoing rounds until full consensus is achieved,[10] and represents a lower evidence level compared with systematic review and meta-analysis. However, feedback from the in-person symposia, validation study and peer review have further strengthened the DISH Classification System, helping to ensure that it is applicable to all patients and useful to the healthcare community.

Whilst the results of the validation exercise are encouraging, this is not a substitute for clinical validation. Despite efforts to standardise the grading criteria, some degree of subjectivity remains inherent to any ordinal clinical grading system. Patient involvement was not incorporated at any stage of the study, representing a further limitation that will be addressed as a priority in the planned real-world pilot phase. AI generated patient case vignettes represent an 'ideal' case, whilst real-world case notes are likely to be more ambiguous. AI

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generated vignettes allowed standardised control of case content across all scenarios and avoided the consent, privacy and logistical complexity of using real patient data, but future studies will apply the classification to real patient data. Fringe cases were excluded, thereby focusing on the most 'likely' DISH cases healthcare professionals see. Similarly, not all potential specialties could be captured in the generated case notes, which may reduce external validity. Additionally, some specialties were underrepresented on the Expert and Validation Panels; increasing the representation of these specialties is a target of planned real-world pilot studies. The validation exercise was also limited to clinicians only, representing an important but nonetheless incomplete cross-section of expected users. Evaluating use by the wider clinical team, in real-world settings, is an objective of planned real-world studies. Additional analyses, such as role, specialty, native English fluency, setting and learning curve need to be considered.

The proposed cross-specialty, global DISH Classification facilitates comprehensive surveillance and audit of SSOs in clinical practice and research, by standardising reporting of all relevant grades of clinical presentation and clearly objectifiable management of SSOs. Very high concordance when applied to case vignettes gives credibility to clinical adoption and subsequent validation.

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REFERENCES

1. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR, Hospital Infection Control Practices Advisory Committee. Guideline for prevention of surgical site infection, 1999. *Infect Control Hosp Epidemiol* 1999;20:247-280
2. Cho JR, Kim D-W, Shin MJ, Kim ES, Kim HB, Kim MH *et al*. Dual surveillance of surgical site infections using CDC and ASEPSIS criteria: Clinical and economic outcomes in colorectal and small bowel surgery. *World J Surg* 2025;49:3097–3105
3. Hou Y, Collinsworth A, Hasa F, Griffin L. Incidence and impact of surgical site complications on length of stay and cost of care for patients undergoing open procedures. *Surg Open Sci* 2023;14:31–45
4. World Union of Wound Healing Societies (WUWHS). *Strategies to reduce practice variation in wound assessment and management: The T.I.M.E Clinical Decision Support Tool.* Wounds International, 2020. https://woundsinternational.com/world-union-resources/strategies-reduce-practice-variation-wound-assessment-and-management-time-clinical-decision-support-tool/ (accessed 22 Jul 2026)
5. Willmington C, Belardi P, Murante AM, Vainieri M. The contribution of benchmarking to quality improvement in healthcare. A systematic literature review. *BMC Health Serv Res* 2022;22:139
6. World Union of Wound Healing Societies (WUWHS). Consensus Document. *Surgical wound dehiscence: improving prevention and outcomes*. Wounds International, 2018.

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https://woundsinternational.com/world-union-resources/consensus-document-surgical-wound-dehiscence-improving-prevention-and-outcomes/ (accessed 22 May 2026)

7. Fabro EAN, Costa RM, Fernandes MC, Ximenes MA, Nogueira DA, Soares NB *et al*. Seroma incidence and risk factors in women undergoing mastectomies as surgical breast cancer treatment. *Support Care Cancer* 2024;32:688
8. Bailey IS, Karran SE, Toyn K, Brough P, Ranaboldo C, Karran SJ. Community surveillance of complications after hernia surgery. *BMJ* 1992;304:469-471
9. Wilson A, Sturridge M, Treasure T, Grüneberg R. A scoring method (ASEPSIS) for postoperative wound infections for use in clinical trials of antibiotic prophylaxis. *Lancet* 1986;327:311-312
10. Nasa P, Jain R, Juneja D. Delphi methodology in healthcare research: How to decide its appropriateness. *World J Methodol* 2021;11:116-129

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FIGURE LEGENDS

Figure 1. Overview of Studies

Abbreviations: SSO: surgical site outcome

Alt text: A summary flow diagram starting with a targeted literature review followed by modified Delphi Rounds 1-3, an in-person symposium, modified Delphi Round 4, pilot demonstration studies and concluding with the in-person validation study.

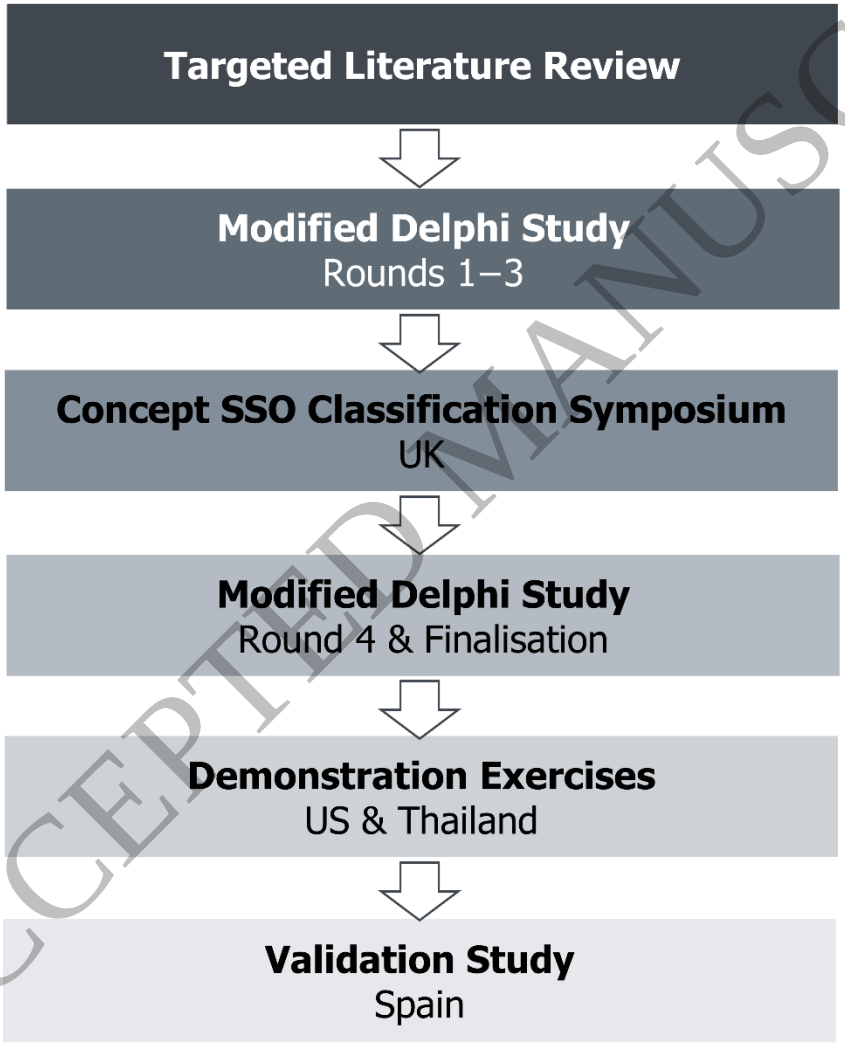

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Figure 2. How to use the DISH Classification System

Abbreviations: D: dehiscence; I: inflammation/infection; S: seroma; H: haematoma

Alt text: A flowchart providing guidance on how to classify using DISH, starting with dehiscence (D), followed by infection/inflammation (I), seroma (S) and then haematoma (H), producing the overall classification 'score'.

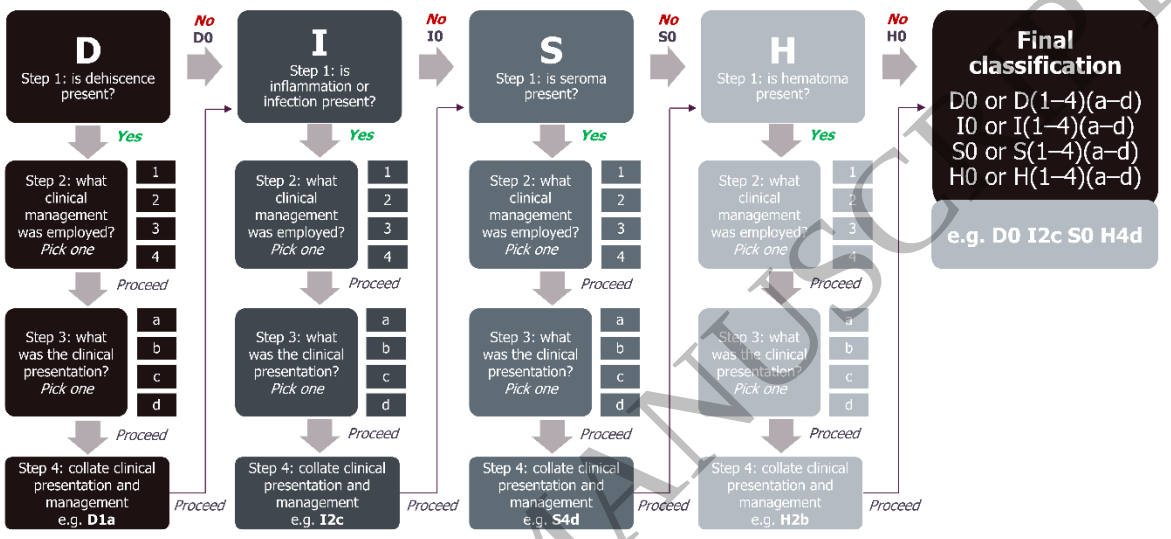

TABLE LEGENDS

Table 1. Illustrative Comparison of Different Surgical Outcome and Infection Classification Systems

Table 2. Proposed DISH Classification System: Clinical Management

Table 3. Proposed DISH Classification System: Clinical Presentation

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Table 1. Illustrative Comparison of Different Surgical Outcome and Infection Classification Systems

Domain	Centers for Disease Control and Prevention (CDC)[1]	Southampton Wound Assessment Scale[8]	ASEPSIS Wound Score[9]	Proposed DISH Classification
Applicability across surgical specialties	Yes	No	Partially	Yes
Includes clinical presentation	Yes	Yes	Yes	Yes
Includes clinical intervention/ management	Partially	No	Partially	Yes
Generates an overview score	No	Yes	Yes	Yes
Can be interpreted by all members of the surgical team	Partially	Partially	No	Yes
Defines and classifies dehiscence (D)	No	No	No	Yes
Defines and classifies infection (I)	Yes	Partially	Partially	Yes
Defines and classifies seroma (S)	No	No	No	Yes
Defines and classifies haematoma (H)	No	No	No	Yes
Domains (D, I, S, H) graded independently	No	No	No	Yes

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Table 2. Proposed DISH Classification System: Clinical Management

	Dehiscence	Inflammation/Infection	Seroma	Haematoma
0	None	None	None	None
1	Patient self-monitoring	Patient self-monitoring	Patient self-monitoring	Patient self-monitoring
2	Local treatment, with or without local anaesthesia	Healthcare professional monitoring; closed incision management; antibiotics optional	Healthcare professional monitoring with or without radiological imaging	Healthcare professional monitoring
3	Surgical re-intervention with general or regional anaesthesia, with simple incisional re-approximation (closure)	Surgical re-intervention with local anaesthesia, or percutaneous drainage; antibiotics optional	Local treatment with local anaesthesia, or percutaneous drainage	Local treatment with local anaesthesia, or percutaneous drainage, or embolisation
4	Surgical re-intervention with general or regional anaesthesia, with complex re-approximation (reconstruction) or leaving wound open (no re-approximation or reconstruction)	Surgical re-intervention, with general or regional anaesthesia	Surgical re-intervention, with general or regional anaesthesia	Surgical re-intervention or radiological intervention with general or regional anaesthesia

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Table 3. Proposed DISH Classification System: Clinical Presentation

	Dehiscence	Inflammation/Infection	Seroma	Haematoma
a	Partial separation of the incision edges with no to minimal fluid discharge	One or more of the following clinical signs of inflammation related to the incision: redness, swelling, heat, pain, or serous exudate	Presence of localised fluid collection related to the surgical incision with no to minimal discomfort or pressure in the affected area	Bruising related to the incision, with or without swelling, but not causing substantial symptoms to the patient
b	Substantial separation of the incision edges, without disrupting fascia or the deep tissue	Two or more of the following clinical signs: erythema or other visible skin colour change, swelling, heat, pain, non-serous exudate; plus one or more of the following: elevated C-reactive protein, increased serum white blood cell count, temperature over 38°C (100.4°F), positive wound or blood culture, gas in tissues	Large fluid collection causing moderate discomfort or pressure in the affected area	Enlarging haematoma causing swelling and pain
c	Extensive separation of the incision edges, involving deep tissue layers	Severe infection related to the incision with systemic signs of sepsis or mono-organ failure	Large fluid collection causing significant clinical signs or symptoms	Significant haematoma causing substantial swelling, pain, and compromising nearby organs or structures
d	Most severe incision dehiscence of all surgical tissue layers with or without organ exposure	Septic shock; Sepsis related multi-organ failure	Chronic walled-off or large fluid collection causing life-threatening symptoms	Significant haematoma, with active bleeding

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