The Poisoning Severity Score: If It Did Not Exist, We Would Have To Invent It

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collected prior to the timepoint of prognostication (otherwise it would be predicting itself).

The Poisoning Severity Score (PSS), described in a review article by Schwarz and co-authors in this issue of JMT [1], is a tool developed by the European Association of Poisons Centres and Clinical Toxicologists (EAPCCT), the International Programme on Chemical Safety, and the European Commission in the 1990s [2]. It was developed to allow comparison between poisoning exposures, has been used in hundreds of studies, and cited over 450 times (Google Scholar cites for Ref. [2]). It has a wide range of applications; is particularly useful to compare outcomes between substances/classes, dose, and exposure types; and allows quantitative evaluation of poisoning morbidity. Additionally, it allows evaluation of risks from emerging poisonings. Importantly, if many sites/countries use the PSS, this allows aggregation and comparison of data. Thus, the PSS is useful for clinical and epidemiological studies, with examples shown in Table 1. It is a summary outcome measure based on the final outcome. It was not designed for prognostic studies. So when it is used this way, it obviously has to be modified to only include information generally

The Narcissism of Small Differences

The PSS classifies poisoning severity as none (0), minor (1), moderate (2), severe (3), and fatal (4). The PSS is seldom used in North America. However, the annual report from the American Association of Poison Control Centers' (AAPCC) National Poison Data System (NPDS) demonstrates that American poison centres are using a very similar scoring system. Where cases are followed to a known outcome, exposures in the NPDS are coded as 0: no effect, 1: minor effect, 2: moderate effect, 3: major effect, and 4: death [28]. We struggled to find published information on how medical outcome severity is classed by NPDS poison control centre staff (however, brief descriptions are provided in Appendix A of the annual report). We obtained the NPDS Coding Users' Manual (Version 3.1) [29] and compared examples given to those in the PSS guidelines. We found that 10/10 examples in the NPDS guide as 'minor effect' would also be classed as 'minor' by the PSS. 12/18 NPDS examples for 'moderate effect' would be classed as 'moderate' by PSS; the remainder are unable to be classified due to insufficient information in the NPDS (e.g. NPDS 'acid-base disturbance' could be minor, moderate or severe on PSS depending on the deviation from normal). All 14 NPDS examples for 'Major effect' would be classed as 'Severe' by PSS. The NPDS and PSS systems appear very similar, with the main difference that the lack of detail in NPDS is likely to reduce inter-rater reliability. A third, new poisoning severity scoring system is currently under development, the 'Toxic Severity Score' (TSS) [30]. Table 2 compares the PSS and NPDS systems and uses metabolic balance as an example, demonstrating the specific

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Table 1 Examples of types of studies where the PSS has been used

Study type	Examples	Example references
Comparative toxicity	Compare severity of different types of exposures e.g. pharmaceuticals vs pesticides	[3]
	Compare different agents within a class e.g. psychotropics, antihypertensives, household products, plants	[4–8]
	Selection of severe/fatal cases for further evaluation	[9]
Predictors of severity	Effect of patient/case characteristics on outcome (e.g. age, gender, exposure intent, time to hospitalisation)	[10, 11]
	Patterns of exposure predicting toxicity e.g. acute on chronic lithium exposure	[12]
Analysis of one agent/class	Effect of dose on toxicity	[13–16]
	Document toxicity for a specific class/substance e.g. paediatric pesticides, baclofen	[17, 18]
Emerging poisoning hazards	New psychoactive substances (NPS)	[19–23]
	Laundry pods	[24]
	Body building/weight loss supplements e.g. 2,4-dinitrophenol (DNP)	[25]
Evaluation of interventions	Evaluate effect of decontamination	[16, 26]
Documentation of trends	Trends in severity over time e.g. paediatric cannabis intoxication	[27]
Aggregation of data from several sources	Multi-centre/multi-country studies, aggregating summary data using the PSS	[8]

parameters in the PSS compared to more general terms in the NPDS manual (see Supplementary Table 1 for a full comparison of components of the PSS and NPDS scoring systems, in addition to proposed elements in the TSS).

Reinventing the Wheel

No clinical severity score can be perfect. In this issue of JMT, Schwarz and colleagues discuss limitations of the PSS [1]. The PSS and NPDS scores are easy to criticise, but much harder to improve on. For clinical research and audit purposes, we need a standardised way to broadly classify the severity of poisonings that does not involve re-examining individual case records to judge what happened. Poisons centres across Europe and elsewhere apply the PSS on a daily basis for every exposure call, indicating ease of use, and a PSS-like system is being used daily in the USA (a similar system appears to be in place in Canada [31]). The PSS and NPDS scoring systems are very similar; indeed, the NPDS stratification was the starting point from which the PSS was formulated. The PSS is more detailed as a result of testing and revision processes done to improve inter-rater agreement [2]. The AAPCC annual report is the most widely cited paper in the field of medical toxicology; it uses the 5-point NPDS score (on which the PSS was based) to report on the relative severity of all drugs, poisoning by age group, by intent, by duration, and by year [28]. Unfortunately, it does not reference any papers on how it was developed or if it was validated.

Thus, we currently have two systems that largely serve the same purpose. Criticisms that apply to the PSS (e.g. subjective variables, using a single tool to describe the breadth of poisonings [1]) apply to an even greater extent to the NPDS system. The proposed TSS items are notable for the fact that they do not include many components that would allow the PSS or NPDS score to be calculated and compared to their new scoring system on the same patients. This makes this process useless for supporting further modifications or validations of either existing score. This could actually be a backwards step; the most likely result three poisoning scores with factions supporting each.

Divided by a Common Language?

The greater problem, not highlighted by this review, is that we already have two widely used poisoning severity scores. All studies using a 5-point poisoning severity scale would benefit from a common scoring system. It would open up a range of new collaborative opportunities across the world. For example, we could compare the severity of various sorts of poisoning between countries based on how they regulate chemicals and pesticides, or their consumer protection laws. A PSS remains the best (i.e. least worst) way to compare poisoning severity across different agents, patient groups, geographic locations, and countries. If there are obvious ways to improve it, then let us all work together to do that. The PSS exists, we do not have to invent it, but together we could reinvent it.

Table 2 Comparison of the PSS and NPDS severity scoring system

	PSS [2]	NPDS [29]
Description of severity grades		
0	<i>None</i> : no symptoms or signs related to poisoning	<i>No effect</i> : The patient developed no symptoms as a result of the exposure
1	<i>Minor</i> : mild, transient, and spontaneously resolving symptoms	<i>Minor effect</i> : Symptoms that were minimally bothersome and resolved rapidly, with no residual disability or disfigurement
2	<i>Moderate</i> : pronounced or prolonged symptoms	<i>Moderate effect</i> : Symptoms that were more pronounced, more prolonged, or more of a systemic nature than minor symptoms. Symptoms were non-life threatening, with no residual disability or disfigurement
3	<i>Severe</i> : severe or life-threatening symptoms	<i>Major effect</i> : Life-threatening symptoms or symptoms that resulted in significant residual disability or disfigurement
4	<i>Fatal</i> : death	<i>Death</i>
Example: Metabolic balance, from [2] and the examples given in the NPDS coding users' manual, [29]	<p><i>Minor</i></p> <ul style="list-style-type: none"> ▪ Mild acid-base disturbances (HCO_3^- ~15–20 or 30–40 mmol/l; pH ~7.25–7.32 or 7.50–7.59) ▪ Mild electrolyte and fluid disturbances (K^+ 3.0–3.4 or 5.2–5.9 mmol/l) ▪ Mild hypoglycaemia (~50–70 mg/dl or 2.8–3.9 mmol/l in adults) ▪ Hyperthermia of short duration <p><i>Moderate</i></p> <ul style="list-style-type: none"> ▪ More pronounced acid-base disturbances (HCO_3^- ~10–14 or >40 mmol/l; pH ~7.15–7.24 or 7.60–7.69) ▪ More pronounced electrolyte and fluid disturbances (K^+ 2.5–2.9 or 6.0–6.9 mmol/l) ▪ More pronounced hypoglycaemia (~30–50 mg/dl or 1.7–2.8 mmol/l in adults) ▪ Hyperthermia of longer duration <p><i>Severe</i>:</p> <ul style="list-style-type: none"> ▪ Severe acid-base disturbances (HCO_3^- ~7.7) ▪ Severe electrolyte and fluid disturbances (K^+ 7.0 mmol/l) ▪ Severe hypoglycaemia (~<30 mg/dl or 1.7 mmol/l in adults) ▪ Dangerous hypo- or hyperthermia 	<p><i>Moderate</i>:</p> <ul style="list-style-type: none"> ▪ Acid-base disturbance ▪ High fever ▪ Methanol ingestion manifesting only anion gap metabolic acidosis ▪ Aspirin overdose with acidosis, anion gap, and no alteration in mental status ▪ Hypoglycaemia with confusion

Compliance with Ethical Standards

Conflicts of Interest The authors declare that they have no conflicts of interest.

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