

Accepted refereed manuscript of: Gibbons L & Stoddart K (2018) 'Fast and Frugal Heuristics': Clinical decision making in the Emergency Department. *International Emergency Nursing*, 41, pp. 7-12. DOI: <https://doi.org/10.1016/j.ienj.2018.04.002>
© 2018, Elsevier. Licensed under the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International <http://creativecommons.org/licenses/by-nc-nd/4.0/>

‘Fast and Frugal Heuristics’: Clinical decision making in the Emergency Department.

Lynda Gibbons and Kathleen Stoddart

Advanced practice roles involve a number of clinical decisions including assessment, prescribing, referring and discharging patients (Appendix 3). The Advanced Nurse Practitioner (ANP) role requires the nurse to be an autonomous independent practitioner. The ANP utilises advanced clinical nursing knowledge and critical thinking skills to independently provide optimum patient care through caseload management of acute injuries and illness within the Emergency Department (ED). Therefore the ANP in the ED is faced with clinical decision making challenges on a daily basis. Good patient care is dependent on high quality accurate and efficient decision making within the unpredictable ED.

Emergency Medicine (EM) is defined by timely and accurate decision-making regarding the saving of life and limb [1], [2]. Many theories have emerged within the literature about clinical decision making from the perspective of analysis of the human thought processes [3]. Elstein (1999) described heuristics as ‘mental shortcuts’ that aid in the clinical decision making process. Within this paper the authors discuss a form of heuristics called *Fast and Frugal* heuristics [4]. The authors then use a case study to illustrate an example of how fast and frugal heuristics can be applied on a daily basis within the emergency setting.

Fast and Frugal Heuristics:

Fast and Frugal heuristics are an invaluable tool when it comes to accurate clinical decision making for patients that present to the Emergency Department (ED). Fast and frugal heuristics refer to decision strategies that are simple in that they exploit evolved or learned human capacities. They signify task-specific decision strategies that are part of a decision maker’s repertoire of cognitive strategies for solving judgment and decision tasks within their environment [8]. Fast and frugal heuristics are also described as ecologically rational meaning that they are not inherently good or bad, but they are accurate relative to the structure of the environment. [5], [6], [7],

[8]. Fast and frugal heuristics consist of building blocks, such as a *search rule* that specifies how information is searched for, a *stopping rule* that defines when an information search is stopped, and a *decision rule* that determines how a decision is made [9]. The descriptive accuracy of fast and frugal heuristics can be assessed by comparing the predicted decisions to the actual decisions. Improving decision-making can be addressed by comparing how people should ideally make decisions with how people actually make them. The analysis of ecological rationality tries to understand in which environments people's reliance on a specific heuristic leads to accurate or otherwise satisfactory decisions, building on Simon's theory that people's decision strategies fit with the environment [20]. Analyzing the environment in which a decision will be taken allows the practitioners to develop decision strategies that are ecologically rational in that specific environment rather than logically consistent. An internationally famous example is the 'Miracle on the Hudson River' (Curkin & Monek, 2009) illustrated, it can be ecologically rational for pilots to ignore the information necessary to estimate the trajectory of an airplane when they can solve the task faster and more safely using a fast-and-frugal heuristic [10].

The conceptual lens of fast and frugal decisions starts from the premise that in situations of uncertainty, accurate decisions do not generally require high effort or complex strategies. This premise, among others, differentiates fast and frugal heuristics from other approaches such as the heuristics and biases framework [11] or the adaptive decision maker approach [12]. According to the latter framework, decision makers rely on heuristics in order to reduce effort. From the vantage point of fast-and-frugal heuristics, reducing effort is not the main goal but rather a welcomed by-product [9]. Green & Mehr (1997) took this one stage further and developed the so-called fast and frugal tree, which is specifically for treatment allocation and ignores all probabilities and asks only a few yes or no questions [13]. Fast and frugal trees make very fast decisions based on only a few pieces of information and ignores all other information. In such an application, fast and frugal trees are non-compensatory in that that once the practitioner makes a decision based on a few pieces of information, no additional information will change the decision. Because they are so simple to use, they have been used in clinical decision making in a number of medical diagnosis such as coronary artery disease [13], as well as diagnosing depression [14]. Fast and frugal trees are not only useful when time is a limiting

factor, but also research has shown that fast and frugal trees can out-predict more complex models in non-human simulations [15].

Fast and Frugal Heuristics in Advanced Nursing Practice:

Musculoskeletal problems account for an estimated 3.5 million ED attendances in the UK each year [16]. This situation is mirrored in Ireland; as injuries continue to be a major public health problem on a daily basis [17]. EM is defined by timely and accurate decision-making and the initiation of life, limb, or eyesight saving interventions [1], [2]. Behind the doors of the ED, the staff like to think that they can handle whatever comes their way without having to think too hard about the situation. [18]. A number of factors, unique to the ED milieu, constrain the decision-making process [19]. In an ideal situation, the healthcare team should have sufficient time, information and resources to make the best possible clinical decision regarding the patient in question. Marewski & Gigerenzer (2012) states that “clinicians making diagnostic decisions are potentially modeled by fast and frugal trees, this branch of heuristics assumes that the decision makers follow a series of sequential steps prior to reaching a decision” [20: pg 78]. These trees ask only a few yes-or-no questions and this then in turn allows for effective decision making within the clinical setting.

The application of fast and frugal heuristics by an ANP within the ED will be discussed using a case study to illustrate this concept in action. (Box 1).

BOX 1

A 42-year-old female, who is employed as an office worker, self presented to the ED on a Saturday afternoon having sustained a twisting injury to her right ankle, when she tripped on a kerb the night before while out socialising. She was partially weight bearing with an antalgic gait. The patient was assessed using the Manchester Triage System (MTS), and as she reported moderate pain (6/10 on the numeric rating scale), she was assigned a category 3 (yellow). Analgesia was administered (acetaminophen 1 g and ibuprofen 400 mg) at triage as per departmental protocol. This patient was then streamed directly to the Ambulatory Care Area (ACA) for ANP assessment.

The patient reported worsening soft tissue swelling and pain the following morning, she denied hearing any noise such as a 'tearing' or 'popping' sound. The patient reported no significant past medical history, no previous ankle injuries, no regular medications and no known drug allergies. At the time of examination, her pain had reduced to 3/10 post analgesia. The patient reported increased pain intensity with activity and that the pain intensity subsides with rest. On examination there was a normal foot cascade with obvious soft tissue swelling and mild bruising over the anterior lateral aspect of the ankle. No wounds or erythema were present. The patient was asked to indicate the site of pain and this was investigated with palpation. Maximal tenderness was elucidated over the anterior talofibular ligament (ATFL). Active and passive range of movement was reduced in all planes due to patient's pain and the obvious soft tissue swelling. Firm end points and no laxity on stressing deltoid and lateral ligaments. Both the dorsalis pedis and posterior tibialis pulses were present and normal and capillary refill was <2 s distally. Normal sensory distribution noted to all the nerves supplying the foot.

Case discussion:

This case (Box 1) highlights a series of fast and frugal heuristics during the patient's visit to the Emergency Department by not only the ANP but also by the triage nurse. After registration, the patient's name was called and the patient was then assessed by the triage nurse, using the MTS [21]. The MTS uses a five level scale for classifying patients according to their care requirements; immediate, very urgent, urgent, standard, and non-urgent. The lady described was assigned a MTS category 3 (yellow), due to the fact that she was in moderate pain with a discriminator of a Limb Problem. Once the triage category was assigned, the patient was asked to take a seat back in the waiting room until the ANP was available. Triage decisions are often complex and are usually made under conditions of stress and uncertainty [52]. There are many factors contributing to the complexity and uncertainty of triage decision-making. The decisions made by a triage nurse are crucial in the initiation of emergency care. Accurate triage decisions must be produced within short time frame (e.g. 2- 5 minutes) and should be consistent with operational strategies and existing triage guidelines [22].

Triage – Fast & Frugal Heuristics:

Three rules are applied in triage as follows:

Search Rule - looking for information from the patient regarding history of event, pain, deformity, weight bearing and going through each descriptor listed.

Stopping Rule – once the triage nurse had answered No to the signs noted under both the red and orange boxes she then moves to the yellow box where the patient answered Yes to moderate pain. The triage nurse didn't need to move on to the green box and the patient was given a MTS Category 3 (Yellow)(Appendix 4).

Decision Rule – the triage nurse arrived at her decision that the patient was in moderate pain and was a MTS Category 3 (Yellow) limb problem and would therefore be streamed to the ANP in ambulatory care within the ED.

Pain – Fast & Frugal Heuristics:

The World Health Organisation (WHO) states that pain guidelines in the ED should be separate from other guidelines, as they lose importance if they form part of other guidelines [23]. Pain is defined by the International Association for the Study of Pain (IASP) as an 'unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage' [24]. These are combined to form the measurement units of a pain ruler with the results used as a key discriminator.

Search Rule – while asking the patient questions in triage and looking for information regarding her injury one of the important questions that the triage nurse asked was in the pain scale (Appendix 1)

Stopping Rule – once the patient had indicated her pain on the analogue pain scale the triage nurse stopped seeking any more information surrounding her pain.

Decision Rule – the triage nurse decided at this point that the patient had moderate pain and warranted analgesia. Analgesia was administered (acetaminophen 1g and ibuprofen 400 mg) as per departmental protocol.

Advanced Nurse Practitioner – Fast & Frugal Heuristics:

Shortly after triage the patient was called by the ANP and shown to the ambulatory care area (ACA) within the ED. A good rapport and open communication with the patient is vital to enable the ANP to gain accurate information. Silverston (2014) states that the importance of history taking cannot be over-emphasized [25], and Holmes and Scullion (2014) suggests that most of the information required to formulate a diagnosis can be obtained from the patient's clinical history [26]. Pritchard (2006) also suggested that clinical decision-making is the ability to sift information to make decisions and then appropriately implement these decisions [27].

Search Rule – the ANP observed the patient walking into the ACA and recognized that she was partially weight bearing with an antalgic gait. The ANP took a history that included history of the presenting complaint. The patient described that she was wearing high heels, had been in a nightclub and was walking to get a taxi when she “missed the kerb and went over on her heels” therefore sustaining an inversion injury. She also stated that she didn't fall and only noticed that her ankle was swollen and painful in the morning when she woke up. This lady had no past medical history, was on no medications, had no known drug allergies (NKDA) and had a pain score of mild 3/10 post analgesia. After taking the history the ANP then examined the patient starting at the proximal fibula and down to the phalanges of the toes taking into consideration the Ottawa Ankle Rules (see Appendix 2). The ANP decided with the application of the Ottawa Ankle Rules that radiographic investigation was not warranted for this patient. . The Ottawa Ankle Rules are an accurate instrument for excluding fractures of the ankle and mid-foot (see Appendix 2). Research has estimated that between 80% and 98% of patients reporting to ED with injuries to the ankle, midfoot, or both, undergo radiography during evaluation, but fewer than 15% of these patients have a significant fracture, resulting in undue health care costs, ED wait times, and radiation exposure [28], [29]. Stiell *et al.*, first introduced the Ottawa Ankle Rules in 1992 as a guideline with which to reduce costs and waiting times in the ED setting in terms of ruling out serious ankle and midfoot fractures in the adult population (see Appendix 2) [30]. With this in mind the ANP answered Yes or No to the criteria set down in the Ottawa Ankle Rules.

Stopping Rule – having answered No to all the criteria it was appropriate to cease the examination and investigations.

Decision Rule – due to the patient having no bony tenderness and tenderness only to the Anterior Talar Fibula Ligament (ATFL) it was diagnosed that this patient had ATFL strain, no laxity noted. Radiographs were not performed due to the Ottawa Ankle Rule recommendations. The Ottawa Ankle Rules are reported (Leddy *et al.*, 2002) to result in a 19% to 38% reduction in radiography costs associated with excluding ankle fractures after sprain injury [31]. The patient was treated symptomatically and discharged home. Initial treatment advised was the mnemonic POLICE, which is now considered best practice rather than the more commonly documented mnemonic PRICE [32] (see Table 2). She was also prescribed a combination drug consisting of paracetamol/codeine 1000/30mgs QDS (Quarter Die Sumendum) for one week. The reasoning behind this analgesic choice was that studies have shown that this combination significantly increases the analgesic effect without increasing the side effects thanks to the synergistic action of the two active substances [33]. The patient was advised to return to ED if she had any concerns.

Table 2 Treatment Mnemonics

POLICE	PRICE
P Protection	P Protection
OL Optimal Loading	R Rest
I Ice	I Ice
C Compression	C Compression
E Elevation	E Elevation

(Gibbons 2016)

Discussion:

Healthcare is characterized by uncertainty [34]. Croskerry (2002) states that the “ultimate cornerstone of high-quality care in the ED is the accuracy, efficacy and expediency of clinical decision making” [19]. Bucknall (2000) states that critical care nurses face a decision-making task every 30 seconds [35]. With 19 million nurses worldwide [34], the potential for iatrogenic harm due to poor clinical decisions could be catastrophic. Banning (2008) suggests that as nurses become more experienced in clinical decision-making, the process becomes easier and increasingly sophisticated [36]. Benner (1984) states that expertise is a function of repeated exposure to many

similar tasks [37]. Brehaut *et al.*, (2007) agree that for novices every decision involves deliberative consideration of relevant signs and symptoms, while experts often appear to make decisions effortlessly [38]. However, Brannon & Carson (2003) found that level of expertise and training did not influence the extent to which heuristics influenced diagnostic decisions [39]. It is noted in the literature that one of the principle factors responsible for diagnostic error is bias [40], [41], [42]. Failed heuristics are also seen as bias [19]. Biases are referred to as ‘predictable deviations from rationality [43]. Croskerry *et al.*, (2013) argues that ‘many biases that diagnosticians have can possibly be recognized and corrected’ therefore making us better thinkers and more accurate practitioners [44]. A biased mind cannot learn everything and is more susceptible to errors compared to an informed mind which relies on heuristic strategies to enable them to strike a balance so as to reduce error due to bias [45].

Case Study Bias – Saposnik *et al* (2016) suggests that, as practitioners, it is crucial to have an in depth understanding, of cognitive and confirmation bias and it’s influence on medical decision making, with the aim to reduce medical errors within practice [51]. ‘Confirmation bias is an issue for clinicians taking the initial history when the first impression steers the history in such a way that the clinician poses questions that confirm the impression and may not ask the ones that might suggest a different diagnosis’ [53]. It would be very easy to allow bias to cloud the judgment of the ANP within the ED. By Saturday afternoon the ANP would usually have seen a lot of patients who had fallen victim to the Friday night social scene and once morning comes, they have realized the extent of their injuries. High heels are also well documented to have severe implications for lateral ankle sprains [46], [47], [48] (Cronin 2014) so it is important that every patient is assessed on an individual basis to minimize any errors.

Conclusion:

However, clinical decision-making is an extremely complex process. Decision making should be both knowledge and evidence based and the ANP should be aware of underlying heuristics, biases and errors that can influence their decision within a busy ED where there are interruptions, distractions and limited resources. ANP are expected to make an extremely high number of decisions during their day.

Heuristics are applied both nationally and internationally within healthcare settings to aid in clinical decision-making. Heuristics make precise and testable predictions and are typically formulated as computational models [49]. Fast and frugal heuristics are composed of simple building blocks that specify how information is gathered, when there is enough information gathered and then processing the information that is gathered to develop good decisions. Empirical studies indicate that humans use fast and frugal heuristics especially when under time pressure, when information search is costly, or when information has to be retrieved from memory [50]. With the use of Fast and Frugal Heuristics the ANP should be able to accurately treat and diagnose patients within the ED in a professional and timely manner.

References:

- [1] Wiswell, J., Tsao, K., Bellolio, M.F., *et al.* (2013) “Sick” or “not-sick”: accuracy of System 1 diagnostic reasoning for the prediction of disposition and acuity in patients presenting to an academic ED. *Am J Emerg Med.* **31**(10):1448-1452.
- [2] March, J.G. Chapter 1. Limited rationality. In: *Primer on Decision Making: How Decisions Happen*. Free Press; 1994:1-56. Available at:
<http://books.google.com/books?id=zydIx15DM2kC>
- [3] Smyth, O., McCabe, C. (2016) Think and think again! Clinical decision making by advanced nurse practitioners in the Emergency Department. *Int. Emerg. Nurs.*
<http://dx.doi.org/10.1016/j.ienj.2016.08.001>.
- [4] Elstein, A.S. (1999) Heuristics and biases: selected errors in clinical reasoning. *Acad Med.* **74**:791–794.
- [5] Dijksterhuis, A. (2004) Think different: the merits of unconscious thought in preference development and decision making. *Journal of Personality and Social Psychology.* **87**. 586–598.
- [6] Gigerenzer, G., & Brighton, H. (2009). Homo heuristicus: Why biased minds make better inferences. *Topics in Cognitive Science*, **1**, 107–143.
- [7] Gigerenzer G. (2004) Fast and frugal heuristics: the tools of bounded rationality. In: Koehler D, Harvey N (eds) *Blackwell Handbook of Judgment and Decision Making*. Oxford, UK: Blackwell, 62–88.
- [8] Todd, P. M., Gigerenzer, G., and the ABC Research Group (2012). *Ecological Rationality: Intelligence in the World*. New York, NY: Oxford University Press.
- [9] Hafenbrädl, S., Waeger, D., Marewski, J.N. & Gigerenzer, G. (2016) Applied Decision Making With Fast-and-Frugal Heuristics. *Journal of Applied Research in Memory and Cognition.* **5**. 215–231.
- [10] Curkin, S., & Monek, B. (2009). Miracle on the Hudson. *ABC News*,
<http://abc7ny.com/archive/6606410/> (accessed 28/07/2017).
- [11] Kahneman, D., Tversky, A., & Slovic, P. (1982) *Judgment under Uncertainty: Heuristics & Biases*. Cambridge, UK, Cambridge University Press ISBN 0-521-28414-7.

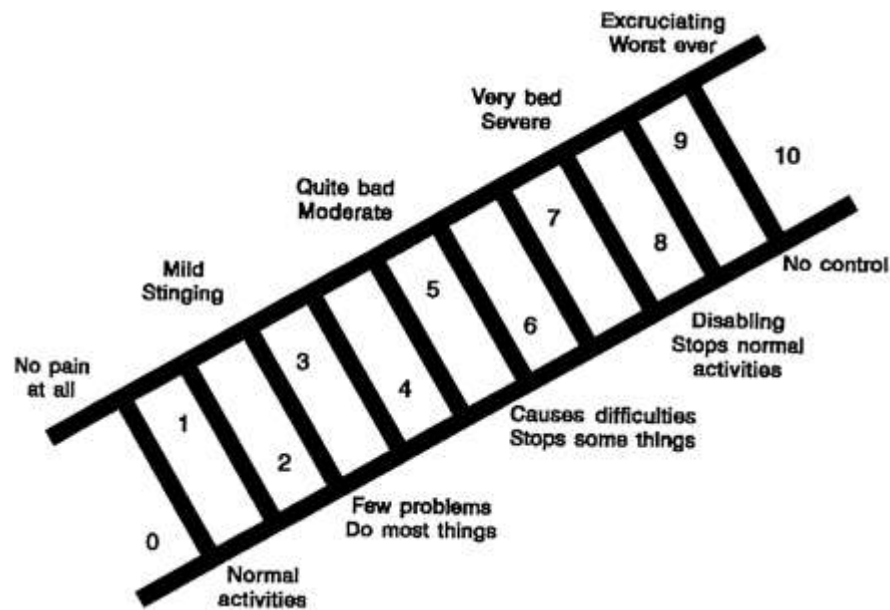
- [12] Payne, J. W., Bettman, J. R., & Johnson, E. J. (1993). *The adaptive decision maker*. Cambridge, England: Cambridge University Press.
- [13] Green L. and Mehr D.R. (1997) What alters physicians' decisions to admit to the coronary care unit? *J Fam Pract.***45**: 219–226.
- [14] Jenny, M., Pachur, T. (2009) Can a fast and frugal tree predict depression? Poster presented at: Annual Meeting of the Society for Judgment and Decision Making; November 2009; Boston, MA.
- [15] Gigerenzer, G., Czerlinski, J. & Martignon, L. (2002) “How good are fast and frugal heuristics?” *Heuristics and Biases: The Psychology of Intuitive Judgment*, Eds. Thomas Gilovich, Dale W. Griffin, and Daniel Kahneman (Cambridge, UK: Cambridge University Press. 559–581.
- [16] FitzSimmons, C.R. and Wardrope J. (2005) Assessment and Care of Musculoskeletal Problems. *Emergency Medical Journal* **22**; 68-76.
- [17] Department of Health and Children (2009) *SLAN 2007, Survey of Lifestyle, Attitudes and Nutrition in Ireland. Injuries in Ireland: Findings from national population surveys*. Government Publications: Dublin.
- [18] Groopman, D.J. (2007) *How Doctors Think*. New York: Houghton Mifflin Company.
- [19] Croskerry, P. (2002) Achieving Quality in Clinical Decision Making: Cognitive Strategies and Detection of Bias. *Acad Emerg Med.* **9** (11) 1184-1204.
- [20] Marewski, J.,N. & Gigerenzer, G., G. (2012) Heuristic decision making in medicine. *Dialogues in Clinical Neuroscience.* **14** (1) 77-89.
- [21] Cronin, J. (2003). The introduction of the Manchester triage scale to an emergency department in the Republic of Ireland. *Accident and Emergency Nursing,* **11**, 121-125.
- [22] Pedro, J.S., Burstein, F., Cao, P., Churilov, L., Zaslavsky, A. and Wassertheil, J (2004) Decision Support in an Uncertain and Complex World: The IFIP TC8/WG8.3 IASP International Conference.

- [23] World Health Organisation (2007) *WHO Normative Guidelines on Pain Management*. Geneva. World Health Organisation.
- [24] International Association for the Study of Pain (IASP) (2012) IASP Taxonomy. “Part III: Pain Yerm, A Current List with Definitions and Notes on Usage” 209-214.
- [25] Silverston, P. (2014) Clinical Assessment and prescribing in minor illness. *Nurse Prescribing* **12**(5): 243–6. doi: 10.12968/npre.2014.12.5.243
- [26] Holmes, S., Scullion, J. (2014) Prescribing for upper respiratory tract infection. *Practice Nursing* **25**(1): 18–22. doi: 10.12968/pnur.2014.25.1.18
- [27] Pritchard, M.J. (2006) Making effective clinical decisions: a framework for nurse practitioners. *Br J Nurs* **15**(3): 128–30.
- [28] Brooks SC, Potter BT, Rainey JB. (1981) Inversion injuries of the ankle: clinical assessment and radiographic review. *Br Med J (Clin Res Ed)*. **282** (6264): 607–608.
- [29] Sujitkumar, P., Hadfield, J.M., Yates, D.W. (1986) Sprain or fracture? An analysis of 2000 ankle injuries. *Arch Emerg Med*. **3** (2):101–106.
- [30] Stiell, I.G., Greenberg, G.H., McKnight, R.D., Nair, R.C., McDowell, I., Worthington, J.R. (1992) A study to develop clinical decision rules for the use of radiography in acute ankle injuries. *Ann Emerg Med*. **21**(4): 384–390.
- [31] Leddy, J.J., Kesari, A., Smolinski, R.J. (2002) Implementation of the Ottawa Ankle Rules in a university sports medicine center. *Med Sci Sports Exerc*. **34**(1):57–62.
- [32] Gibbons, L., Cunningham, P. (2016) Anterior process of the Calcaneum – Not to be missed. *Int. Emerg. Nurs*. <http://dx.doi.org/10.1016/j.ienj.2016.09.001>
- [33] Mattia C, Coluzzi F. (2015) A look inside the association codeine-paracetamol: clinical pharmacology supports analgesia efficacy. *Eur Rev. Med. Pharmacol Sci* 2015;19:507–16.
- [34] Thompson, C., Aitken, L., Doran, D., Dowding, D. (2013) An agenda for clinical decision making and judgement in nursing research and education. *Int J Nurs Stud*; **50**:1720–1726.

- [35] Bucknall, T.K. (2000) Critical Care Nurses' Decision Making Activities in the Natural Clinical Setting. *Journal of Clinical Nursing* **9** (1): 25–35.
- [36] Banning M (2008) A review of clinical decision- making: models and current research. *J Clin Nurs* **17**: 187–95.
- [37] Benner P (1984) *From Novice to Expert*. Addison- Wesley, California.
- [38] Brehaut, J., Hamm, R., Majumdar, S., Papa, F., Lott, A., Lang, E., (2007) Cognitive and social issues in emergency medicine knowledge translation: a research agenda. *Academic Emergency Medicine*. **14**, 984– 990.
- [39] Bannon, L., A. & Carson, K., L. (2003) The Representativeness Heuristic: Influence on Nurses' Decision Making. *Applied Nursing Research*. **16** (3) 201-204.
- [40] Croskerry, P. (2003) The importance of cognitive errors in diagnosis and strategies to minimize them. *Acad Med*. **78**:775–80.
- [41] Klein, J.G. (2005) Five pitfalls in decisions about diagnosis and prescribing. *BMJ*. **330**:781–783.
- [42] Redelmeier, D..A. (2005) Improving patient care. The cognitive psychology of missed diagnoses. *Ann Intern Med*. **142**:115–120.
- [43] Arnott D. (2006) Cognitive biases and decision support systems development: a design science approach. *Info Systems J*. **16**:55–78.
- [44] Croskerry, P., Singhal, G., Mamede, S. (2013) Cognitive debiasing 1: origins of bias and theory of debiasing. *BMJ Qual Saf* .2013 www.doi.org/10.1136/bmjqs-2012-001712. 0:1–7.
- [45] Mousavi, S., & Gigerenzer, G., (2014) Risk, uncertainty, and heuristics. *Journal of Business Research*. **67**: 1671–1678. doi.10.1016/jbusres.2014.02.013.
- [46] Foster, A., Blanchette, M.G., Chou, Y.C. Powers, C.M (2012) The Influence of heel height on frontal plane ankle biomechanics: implications for lateral ankle sprains. *Foot Ankle Int*. **33** (1): 64-69. Doi:10.3113/FAI.2012.0064.
- [47] Zhao, Y. and Wang, G. (2015) Advances on biomechanics and kinematics of sprain of ankle joint. *Zhongguo GU Shang*. **28** (4): 374-377.

- [48] Cronin, N.J (2014) The effects of high heeled shoes on female gait: a review. *J Electromyogr Kinesiol* **24** (2): 258-263. doi:10.1016/j.jelekin.2014.01.004
- [49] Marewski, J. N., & Olsson, H. (2009). Beyond the null ritual: Formal modeling of psychological processes. *Zeitschrift für Psychologie*, **217**(1), 49–60.
- [50] Reimer, T. & Rieskamp (2007) Fast & Frugal Heuristics. From http://web.ics.purdue.edu/~treimer/Reimer_Rieskamp_2007.pdf (accessed 30/07/2017).
- [51] Saposnik, G., Redelmeier, D., Ruff, C.C. and Tobler, P.N (2016) Cognitive biases associated with medical decisions: a systematic review. *BMC Medical Informatics and Decision Making*. **16** (138), 1-14. DOI 10.1186/s12911-016-0377-1 (accessed 11/10/2017).
- [52] Pedro, J.S., Burstein, F., Cao, P., Churilov, L., Zaslavsky, A and Wassertheil, J (2004) Mobile Decision Support for Triage in Emergency Departments. *Decision Support in an Uncertain and Complex World: The IFIP TC8/WG8.3 International Conference 2004*.
<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.83.7297&rep=rep1&type=pdf>
- [53] Pines, J.M (2006) Profiles in Patient Safety: Confirmation Bias in Emergency Medicine. *Academic Emergency Medicine*; **13**(1): 90-94.

Appendix 1: Pain Scale



Manchester Triage Group (2006)

Appendix 2: Ottawa Ankle and Foot Rules

When assessing for ankle fractures. A patient with traumatic ankle pain qualifies for a radiograph if

- point tenderness at posterior edge (of distal 6 cm) or tip lateral malleolus
- point tenderness at posterior edge (of distal 6 cm) or tip medial malleolus
- inability to weight bear (four steps) immediately and in emergency department

Stiell *et al.*, (1992)

Appendix 3: Author and Section Editor's Note

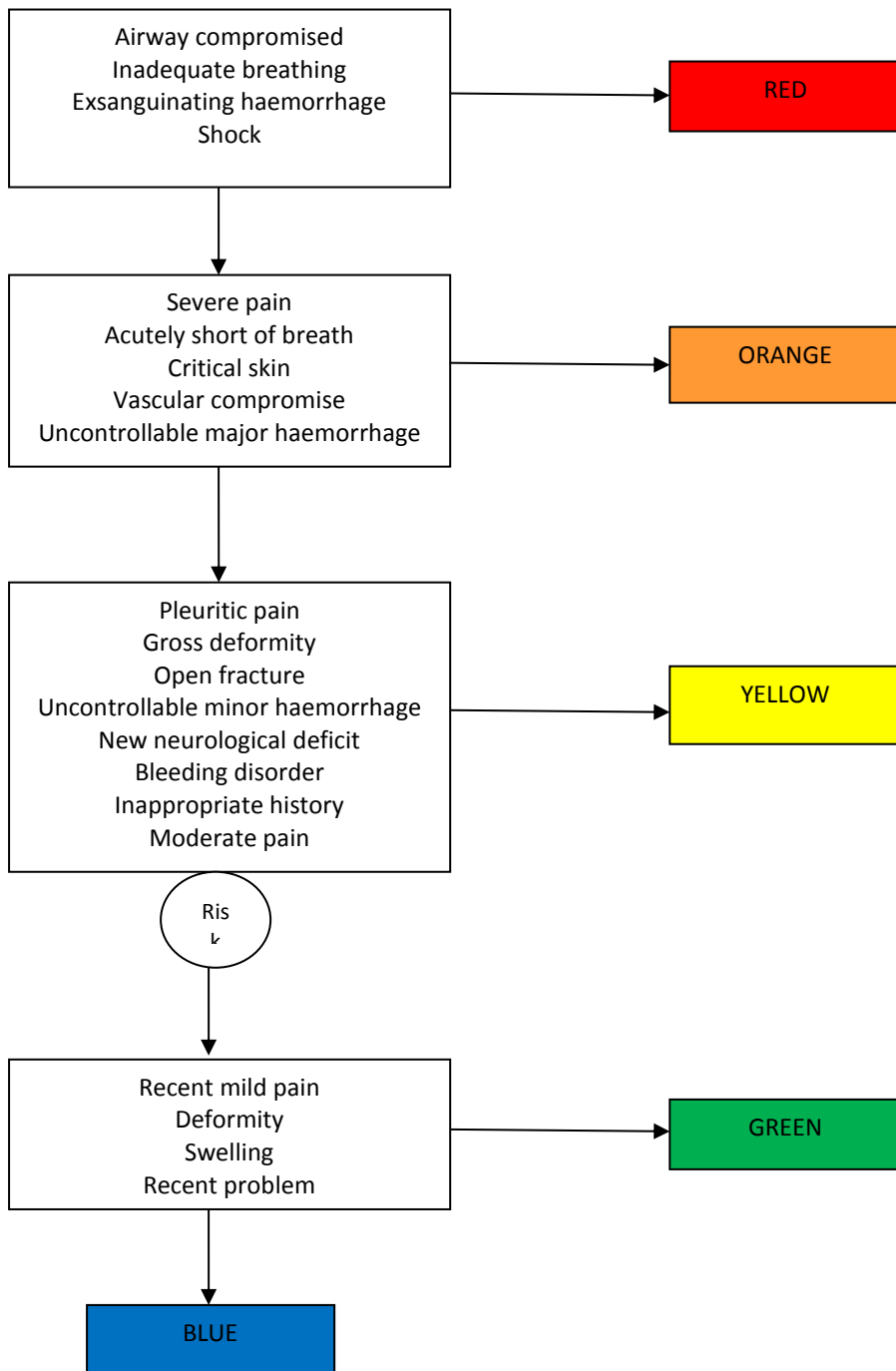
Registered Advanced Nurse Practitioner (RANP):

Is a protected title for a nurse who is on the Nursing and Midwifery Board of Ireland (NMBI) register of Advanced Nurse Practitioners. She/he must have fulfilled the criteria and standards for the specific advanced practice role. These include

- Be educated to master's degree level (or higher)
- Have a minimum of seven years' post-registration experience
- Five years' experience in the chosen area of specialist practice
- Demonstrate competencies relevant to context of practice
- Provide evidence of continuing professional development.

In addition to the registration criteria, the clinical role rests on the four core concepts of autonomy in clinical practice, expert practice, professional and clinical leadership and research.

Appendix 4: Limb Problem (Manchester Triage System)



Manchester Triage Group (2006)