The Management Script: A Practical Tool for Teaching Management Reasoning
Andrew S. Parsons, MD, MPH, Thilan P. Wijesekera, MD, MHS, and Joseph J. Rencic, MD

Abstract
Management reasoning, a component of clinical reasoning, has become an important area for medical education research given its inherent complexity, role in medical decision making, and association with high-value care. Teaching management reasoning requires characterizing its core concepts and identifying strategies to teach them. In this Perspective, the authors propose the term “management script” to describe the mental schema that clinicians develop and use in medical decision making. Management scripts are high-level, precompiled, conceptual knowledge structures of the courses of action that a clinician may undertake to address a patient’s health care problem(s). Like illness scripts, management scripts have foundational elements that are shared by most clinicians but are ultimately idiosyncratic based on each clinician’s unique history of learning and experience. Applying management scripts includes 2 steps—(1) management script activation and (2) management option selection—which can occur reflexively (unconsciously) or deliberately (consciously), similar to, respectively, the System 1 thinking and System 2 thinking of dual process theory. Management scripts can be taught for different conditions by using management script templates, educational scaffolds that provide possible courses of action to address a health care problem at any stage. Just as learners use system-based or organ-based frameworks to generate a differential diagnosis, students can use a generic management script template early in training to develop management scripts for specific problems. Future research directions include exploring the role of management scripts in medical education and quality improvement practices.

While diagnostic reasoning and management reasoning are inextricably linked, the vast majority of clinical reasoning literature has focused on the former. In an effort to increase the medical education community’s understanding, Cook and colleagues recently defined management reasoning as “the process of making decisions about patient management, including choices about treatment, follow-up visits, further testing, and allocation of limited resources.” They also identified some key differences between diagnostic and management reasoning. For instance, diagnostic reasoning is a classification task, usually results in a single diagnosis, operates independently of context, and does not require patient interaction, whereas management reasoning is a task of shared decision making and monitoring, can result in multiple solutions, depends on context (e.g., patient, provider, system preferences), and requires patient communication. As part of the call for more research on management reasoning, educators have highlighted the importance of understanding the cognitive processes involved, strategies for teaching it, and tools for prioritizing multiple management plans. To provide a framework for studying and teaching management reasoning, we propose the term “management script” to describe the mental schema that clinicians develop and use in medical decision making. We acknowledge that some might prefer to use the term treatment script instead of management script. We favor the latter because, as we demonstrate below, it is inclusive of diagnostic testing and thus translates better to learners’ oral and written presentations. In this Perspective, we explain the definition, application, and teaching of management scripts in the context of current clinical reasoning terminology (Table 1).

Defining “Management Script”: A Comparison to Illness Scripts
Script theory explains how human beings learn and develop mental schema through experiences that consciously and unconsciously inform their subsequent behavior. Scripts perform the following functions: they (1) provide structured knowledge necessary for understanding behavioral sequences, (2) enable individuals to integrate new information with existing knowledge, (3) guide memory retrieval, (4) enable predictions about what will happen in the near future, (5) guide actual behavior when activated in specific contexts, and (6) contain knowledge that can usually be applied to explain why a specific action or sequence of actions has occurred or might occur. While an explanation of the cognitive validity of script theory is beyond the scope of this Perspective, Custers has reviewed its validity in detail. In medical education, script theory has been applied usefully to diagnostic reasoning to explain clinicians’ mental representations of disease (i.e., “illness scripts”), has enhanced the understanding of the development of diagnostic expertise, and has become a useful tool for teaching and assessing students’ diagnostic reasoning. Given the cognitive validity and utility of script theory in diagnostic reasoning, we believe there is strong justification for applying script theory to management reasoning in the form of a management script. We define these scripts as “high-level, precompiled, conceptual knowledge...
Table 1

<table>
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<tr>
<th>Term</th>
<th>Definition</th>
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<tr>
<td>Diagnostic reasoning</td>
<td>A classification task that assigns meaningful labels to a constellation of symptoms, signs, and test results to make a diagnosis(8)</td>
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<tr>
<td>Dual process theory</td>
<td>A cognitive psychology theory that describes 2 cognitive systems used for problem solving and decision making: System 1 is intuitive and based on pattern recognition while System 2 is analytical, deliberate, and time intensive(7)</td>
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<td>Hypothesis generation</td>
<td>The cognitive process of developing a list of potential diagnoses for a patient's clinical presentation, which commonly, includes the use of educational scaffolds such as system-based or organ-based frameworks(6)</td>
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<tr>
<td>Illness script</td>
<td>A mental representation of a clinical condition, usually including epidemiology, pathophysiology, and clinical presentation(7)</td>
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<tr>
<td>Illness script selection</td>
<td>The cognitive process of diagnosing a patient with a specific disease by evaluating its fit with the patient's clinical presentation(15-18)</td>
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Management reasoning

Management script

Management script template

Problem representation

Thresholds

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<td>structures(8,10,11) of management options and decisions that are learned through study and experience and activated or triggered in specific contexts. Comparing and contrasting illness scripts and management scripts can provide insight into their similarities and differences.</td>
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| Both illness scripts and management scripts are mental schema (e.g., organizing scaffolds) that facilitate either reflexive decision making (e.g., for hypoglycemia, give 1 ampule of Dextrose 50) or deliberate decision making based on careful analysis of risks and benefits (e.g., thrombolytics in a borderline hypotensive patient with pulmonary embolism).(9,12-20) Like illness scripts, management scripts are rooted in pathophysiological and clinical medical knowledge, much of which is shared by most clinicians within a given specialty (e.g., give aspirin for an acute myocardial infarction). Although their foundation is common knowledge, management scripts are ultimately idiosyncratic, based on each clinician's unique history of learning and experience (Supplemental Digital Appendix 1 at http://links.lww.com/ACADMED/A592). For example, a clinician might choose trimethoprim–sulfamethoxazole for cellulitis because a prior patient developed *Clostridoides difficile* with clindamycin. Thus, management scripts are not an algorithm of interventions that a provider must perform (as advanced cardiac life support algorithms are), just as not every patient with a disease will present with all of the symptoms and signs in a clinician's illness script. Management scripts are activated by the specific problem or diagnosis at hand (Figure 1). Such activation may occur either unconsciously or consciously, similar to, respectively, the System 1 thinking and System 2 thinking of dual process theory.(21-24) A general problem will trigger a general management strategy (e.g., if hypotension → then intravenous normal saline), while a more specific problem will trigger a more specific management strategy (e.g., if septic shock → then intravenous normal saline, plus antibiotics). Clinicians experienced with a given problem or disease have well-defined, readily reproducible management scripts for straightforward cases, particularly when their diagnostic or treatment preferences align with patient preferences. However, in clinical practice, such stereotypical management reasoning occurs infrequently because contextual factors, such as comorbidities or patient preferences,(4) often require clinicians to modify their management decisions. For this reason, management scripts are also consistent with the principles of adaptive expertise; that is, clinicians cannot rely on a known solution (i.e., routine expertise) but must adjust to the situation with learning and innovation.(25-28) With every patient encountered, clinicians develop more nuanced management scripts and prepare for future learning.(29)

Applying Management Scripts: Use in Clinical Practice

Once a management script is activated through diagnostic reasoning,(30) clinicians then select from their idiosyncratic management script menus for the specified problem, a process we term *management option selection* (Figure 2). For instance, a patient presenting with melena with a blood pressure of 85/50 would lead a clinician to consider unconsciously and/or consciously diagnoses like peptic ulcer disease, gastritis, and variceal bleed. Concurrently, the differential diagnosis would activate a management script for upper gastrointestinal bleed and lead to rapid selection of essential management options, such as large-bore peripheral venous catheters, volume resuscitation, a complete blood count (with type and screen), a proton pump inhibitor, and/or a gastroenterology consultation.

Although the selection of some management options is reflexive
or straightforward, the selection of other management options might be complex, requiring System 2 processes (e.g., navigating diagnostic uncertainty, studying multiple reasonable interventions, considering patient preferences) before making a shared decision. For instance, a clinician, concerned about the risk of pulmonary edema, might be hesitant to administer a fluid bolus to a patient with an initial blood pressure measurement of 85/50 if the patient has a history of congestive heart failure. If the repeat blood pressure is 60/40 and the medical history includes gastrointestinal bleeding, the clinician’s management script for hemorrhagic shock will likely include not only administering a fluid bolus but also rapidly preparing for other interventions. However, the physician would have to avoid transfusing blood products if the patient has a personal reason to avoid transfusions (e.g., religious affiliation) or a biological condition that precludes their use (e.g., immune reaction).

Management option selection is based on the probability of disease in relation to the estimated harms and benefits of the test or the intervention while also taking patient preferences into account. The probability of disease at which a clinician, considering those estimations and preferences, needs further testing to determine whether a set of symptoms is (or is not) a disease is called the threshold to test, and the probability of disease at

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**Figure 1** Schema illustrating how management scripts, or the conceptual knowledge structures of the courses of action that a clinician may undertake to address a patient’s health care problem/s, could evolve to become more focused as the diagnosis is further defined.

**Figure 2** Conceptual model demonstrating the relationship between diagnostic reasoning and management reasoning. Once a management script is activated, clinicians will select from their idiosyncratic management script menus to address the specified problem, a process termed management option selection.
which treatment is indicated is called the threshold to treat. High-value decision making requires accurate estimates of disease probability, as well as accurate estimates of the harms and benefits of relevant tests and interventions. In the future, clinical decision support, possibly incorporating artificial intelligence, may aid in such estimations and enhance clinician management reasoning. Until (and even after) such support is more widely available, a robust and nuanced management script may represent a crucial first step. Even if a management script does not entirely disentangle the complex management possibilities for a patient, it will provide a clinician with possible management options before initiating the shared decision-making process.

### Table 2

**Recommended Components of a Management Script Template**

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<th>Component</th>
<th>Description</th>
<th>Examples</th>
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<tr>
<td>Laboratory studies</td>
<td>Biological samples of a patient analyzed for information about a patient's genetic or physiological condition; sometimes obtained from a procedure.</td>
<td>Basic metabolic panel, urinalysis</td>
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<tr>
<td>Imaging studies</td>
<td>A radiological intervention creating a visual representation of the internal structures of a patient's body</td>
<td>Magnetic resonance imaging (MRI), computed tomography (CT), X-ray, ultrasound</td>
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<tr>
<td>Procedures</td>
<td>Any medical or surgical intervention where an instrument is introduced on (noninvasive) or into (invasive) the body for diagnostic or therapeutic purposes; usually requires completion of a formal consent form</td>
<td>Lumbar puncture, paracentesis, colonoscopy, electromyography, electrocardiogram</td>
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<tr>
<td>Specialists/ consultants</td>
<td>Health care professionals asked to provide their expert medical opinion regarding a patient's care</td>
<td>Cardiology, social work, physical therapy consults</td>
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<tr>
<td>Medications</td>
<td>Any substance, chemical, or drug administered to treat a patient's health problem</td>
<td>Oral morphine, subcutaneous morphine, intravenous morphine</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Evaluating a patient's physiologic parameters on a regular basis or assessing a patient's response to treatment</td>
<td>Vital signs, neurological checks, intake and output, daily weights, therapeutic response</td>
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There are numerous strategies for teaching management script templates (Table 3). For instance, in a basic science lecture on giant cell arthritis, the instructor could make a comment or create a slide noting that a management script template for this form of vasculitis should include an erythrocyte sedimentation rate, a C-reactive protein, temporal artery biopsy, and glucocorticoids. Clerkship students, who are expected to provide more specific plans on rounds, would be encouraged to flesh out their management script templates for the type of steroids (i.e., prednisone or methylprednisolone) and the associated consultations (i.e., rheumatology, ophthalmology, vascular surgery for temporal artery biopsy). Interns, who may be tasked with placing orders for the patient, would be expected to be even more specific about the options in their management scripts for not only steroids (e.g., prednisone 1 mg/kg/day tapered by 10%–20% per week) but also monitoring (e.g., funduscopic exam daily, follow-up with rheumatology 1 week after discharge). Even senior trainees, who might be able to quickly recall potential treatment options, should be encouraged to consider other possible interventions in their management scripts to ensure comprehensiveness. Clinical educators can challenge experienced learners by presenting barriers to familiar testing or treatment plans (e.g., patient has an allergy, patient declines a given intervention, patient has a contraindication, the procedure is not available at this hospital) and asking them to propose a Plan B.

Using the management script template as a structure, learners can build well-rounded management scripts as they improve their knowledge and gain experience with each particular condition. Like the content for early illness scripts of diagnoses, the initial content for management scripts in preclinical learners most often comes from lectures, textbooks, and other information resources, which should be contemporary, evidence based, and peer reviewed whenever possible. Clinical learners should be encouraged to flesh out their management scripts based on the problem lists of actual patients, which will make the management scripts more authentic, memorable, and applicable.

To illustrate, for a patient with unilateral lower extremity edema, an intern might include the interventions of a d-dimer and an ultrasound in their associated management script. Through discussion
Ten Educational Strategies and Associated Examples for Teaching Management Scripts

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<th>Educational strategy</th>
<th>Example</th>
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<tr>
<td>Teach increasingly complex management scripts as learners gain increasing medical knowledge and experience.</td>
<td>Teach management scripts on a specific diagnosis (e.g., urinary tract infection) before transitioning to teaching them management scripts for straightforward (e.g., dysuria) and complex (e.g., fever) chief concerns.</td>
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<td>When teaching about a diagnosis, describe not only the signs and symptoms but also the specific tests and treatments that a clinician would perform to acquire that information.</td>
<td>“When working up a patient with possible iron deficiency anemia, your management script should include a CBC, ferritin, TIBC, iron saturation, peripheral blood smear, and a reticulocyte count.”</td>
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<td>During oral or written presentations, encourage learners to present each of their plans in a consistent management script format to facilitate completeness and organization.</td>
<td>“Try structuring your plan for each problem using the following categories: labs, imaging, procedures, specialists, medications, and monitoring. For example, I’d like to order an X-ray, physical therapy consult, and ibuprofen for this patient’s back pain.”</td>
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<tr>
<td>If learners struggle to generate a management plan for a particular problem, prompt them to consider possible diagnoses, as well as management scripts for each, to widen options into a more complete management script.</td>
<td>“Syncope can invoke many possible management options. To jog our memory, let’s think of some potential causes of syncope and our management script for each diagnosis before deciding on what exactly we will do for this patient. For instance, what interventions would be in our management scripts for cardiac, neurological, reflex, and orthostatic syncope?”</td>
</tr>
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<td>Early in a rotation, encourage learners to prepare management scripts for common and important diagnoses to stimulate recall, especially in time-sensitive situations.</td>
<td>“Before starting this (A, B, C, D) rotation, make sure you have a strong management script for…” A: Nephrology consult: “…acute kidney injury, hyponatremia, and hyperkalemia.” B: MICU: “…respiratory failure, shock, and PEA arrest.” C: Night float: “…insomnia, altered mental status, and constipation.” D: Rapid response team: “…tachycardia, hypoxia, and hypotension.”</td>
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<tr>
<td>Remind learners to widen the options in a management script by following up with colleagues, consultants, and clinical practice guidelines.</td>
<td>“In a patient with an upper GI bleed, I’d be concerned for diagnoses including peptic ulcer disease, gastritis, esophageal varices, which is why my personal management script includes CBC, type and screen, blood transfusion, 2 large-bore IVs, endoscopy, gastroenterology referral, proton pump inhibitors, octreotide, antibiotics, IV fluids, and telemetry.”</td>
</tr>
<tr>
<td>Model your own management scripts and the diagnoses that inform them.</td>
<td>“That’s a good initial plan for this patient with endocarditis. While starting on these interventions, let’s check in with the IDSA guidelines, pharmacist, and infectious disease team to make sure we’re not missing anything in our management script.”</td>
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<tr>
<td>Ask learners if they have any questions about your management scripts.</td>
<td>“Does everyone understand why I considered those management options?”</td>
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<tr>
<td>Personalize your management script to fit your own approach.</td>
<td>“I prefer to break my management script into general testing and treatment options.”</td>
</tr>
<tr>
<td>Remind learners that they do not need to perform every management option in a management script!</td>
<td>“Now that we’ve come up with a list of possible management options, let’s think of which items on the list cross our testing and treatment thresholds.”</td>
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Abbreviations: CBC, complete blood count; TIBC, transferring iron-binding capacity; MICU, medical intensive care unit; PEA, pulseless electrical activity; IDSA, Infectious Disease Society of America; GI, gastrointestinal; IV, intravenous.

on rounds (e.g., “For this patient with inflammatory bowel disease, how might the d-dimer results be affected?”)—plus, targeted reading on the operator characteristics of a d-dimer and patient follow-up—the intern will develop a more nuanced management script.

Strategies for teaching management scripts can be described comparably to the development of System 1 (fast, intuitive, pattern recognition) and System 2 (slow, analytical, deliberate thinking) processes in diagnostic reasoning.21–24 While management reasoning is typically considered a more analytical process than diagnostic reasoning,7 particularly for earlier clinicians, management decisions are sometimes made quickly and intuitively in clinical practice. For example, most physicians seeing a patient with acute onset pleuritic chest pain, hypoxia, and hypotension suggestive of a pneumothorax would immediately include thoracentesis on their management script. Practicing recalling management scripts will allow for transition from System 2 thinking to the more rapid recall of System 1 thinking.

Since early learners are not as familiar with conditions or diagnoses, it can be helpful for them to deliberately think of the prioritized differential diagnosis and then think about the specific interventions for each of those diagnoses. For example, a novice learner creating a plan for a patient with a headache can, first, consider the diagnoses involved (e.g., migraine, tension-type headache, subarachnoid hemorrhage); then, contemplate combined treatment options activated by the management scripts for each diagnosis (e.g., magnetic resonance imaging, computed tomography, lumbar puncture, neurology consultation, acetaminophen, ibuprofen, neurological checks every 4 hours); and, finally, decide whether to select each management option. By contrast, experienced learners might quickly enumerate those same treatment options but should then reflect on the most effective and patient-centered way to apply their headache management script to the specific circumstances of the situation.

Future Directions: Leveraging Differences in Management Scripts

Given the call for more research on management reasoning,2,8 the concept of management scripts warrants additional investigation. Studies should first explore
how management scripts develop and differ across clinicians. While clinicians likely have different management scripts based on their knowledge and experience, how management scripts might vary across demographics (e.g., specialty, location, institution) remains unclear. Management scripts may also change dramatically in different situations (e.g., high-stress vs low-stress environments). One potential research strategy for understanding these differences might be “think-aloud protocols,” through which clinicians explain the management options that they considered in various situations. Studying such exercises in clinical, simulation, and classroom settings might help characterize not only best practices for modeling but also high-yield areas for improvement.

With a better understanding of management scripts, clinicians, students, and systems can harness their potential to improve the teaching and practice of management reasoning. Studies should test if and how the use of management script templates provides benefits and minimizes harms to patients. From a patient safety perspective, management script templates could be used similarly to checklists, encouraging clinicians to consider (though not necessarily perform) certain high-yield interventions for a condition. For example, a randomized control trial could compare patient outcomes of clinicians who had received versus those who had not received a designated management script template for a chief concern such as chest pain, which has high potential for adverse events and variability in management. Quality improvement projects could evaluate whether management script templates impact high-value care, potentially leading to more interventions (e.g., superfluous testing) or fewer interventions (e.g., judicious monitoring). In our opinion, however, the management script template has the most potential in medical education because it could provide a framework to promote future learning and adaptive expertise for learners early in their clinical practice.

**In Sum**

In this Perspective on management reasoning, we propose the “management script” concept to describe schema that clinicians develop and use in medical decision making. Modeled from script theory, management scripts can be defined as high-level, precompiled, conceptual knowledge structures of the courses of action that a clinician may undertake to address a patient’s health care problem(s). Management script application occurs alongside the diagnostic reasoning process in 2 steps: (1) management script activation and (2) management option selection. The use of management script templates may help learners in the basic science courses begin to build management scripts. Their management scripts will broaden with initial clinical exposure and develop even further as they gain more experience and work with complicated patients. Future research directions include exploring the role of management scripts in medical education and quality improvement practices.

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**A.S. Parsons** is assistant professor of medicine and public health sciences, Department of Medicine, associate program director, Internal Medicine Residency Program, and director, Clinical Skills Course and Pre-clerkship Coaching, University of Virginia School of Medicine, Charlottesville, Virginia; ORCID: http://orcid.org/0000-0001-5631-9465.

**T.P. Wijesekera** is assistant professor of medicine, Department of Medicine, director, Clinical Reasoning, and associate director, Educator Development in Clinical Reasoning, Teaching and Learning Center, Yale University School of Medicine, New Haven, Connecticut; ORCID: http://orcid.org/0000-0002-2473-424X.

**J.J. Rencic** is associate professor of medicine, Department of Medicine, and director of clinical reasoning and course co-director, Doctoring 2, Boston University School of Medicine, Boston, Massachusetts; ORCID: http://orcid.org/0000-0002-2598-3299.

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**References**


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40 Korenstein D. Charting the route to high-value care: The role of medical education. JAMA. 2015;314:2359–2361.


