Weeds' Responses to Questions Raised in Episode 20

1. [41:30] "*I guess the question is do you need to think of the 80 diagnoses for abdominal pain right up front, or is there some diminishing return whereby considering diagnoses 70 through 80 are not worth the time investment up front?*"

Response: Your question illustrates a common misconception about the role of probabilities in medical decision making (both diagnostic and therapeutic). Take the acute abdominal pain example, with its 80 possible diagnoses for acute abdominal pain. The misconception is that these possible diagnoses should be prioritized for diagnostic consideration based on the probability of their occurrence in the general population. That approach means that "diagnoses 70 through 80" should not be considered "right up front"; rather, they should be deferred until more common diagnoses are investigated first.

Such reliance on probability is accepted practice. Yet, this reliance "is fraught with risk, because it can easily divert attention from the diagnostic possibilities most applicable to the individual patient." *Medicine in Denial*, p. 24. Identifying the most applicable possibilities must begin with considering *all* possibilities. Failure to do so necessarily creates risk of overlooking diagnoses that might well be high-probability for the patient at hand. Protecting against that risk is manifestly "worth the time investment up front," because the right tools make the investment completely feasible.

This is clearly illustrated by the case study in part II.A of *Medicine in Denial*. A teenage girl's chief complaint was severe fatigue. She endured months of diagnostic futility as her condition worsened. The correct diagnosis "did not make the list [of diagnoses to consider] until it was nearly too late to save the child's life." The correct diagnosis turned out to be Addison's disease, a rare condition. In retrospect, this diagnosis seemed "obvious" because the girl had several "classic manifestations" of the disease at or near the outset of care. Yet this simple linkage between the available evidence and the correct diagnosis went unrecognized.

The diagnostic process was crippled by misguided reliance on the unaided mind, with its limited capacity to process detailed information and its bias in favor of population-based probabilities. As *Medicine in Denial* explains (p. 24):

> In the general population, Addison's disease is indeed rare. But in the tiny subpopulation of patients with a combination of findings like fatigue, hypotension, weight loss, abnormal pigmentation, dehydration, nausea, and abdominal pain, Addison's disease is common (perhaps almost universal). People with this pattern of findings are not identified as a subpopulation in the medical literature and thus do not fit into the usual "evidence-based" mode of analysis.
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> As applied to individuals, knowledge about large populations is useless, indeed misleading, until other, more individually applicable knowledge is first taken into account.

The aphorism among physicians — "When you hear hoof beats, think horses, not zebras" — completely misses the point. If the physician is in central Africa, then the aphorism should be just the opposite — "think zebras, nor horses." The point is that context is paramount. Context determines whether a possible diagnosis should be regarded as probable or improbable for a unique patient.[1]

This contextual awareness requires detailed data collection up front, but that investment – that scientific discipline – pays off. It enables rapidly identifying the diagnostic possibilities potentially applicable to the unique patient at hand, while filtering out extraneous possibilities (see the diagram on p. 73 of *Medicine in Denial*). Inaccuracy in that threshold analysis can cause life-threatening delay and enormous waste, as the Addison's disease case illustrates.

See part VII of *Medicine in Denial*, especially pages 184-87, for further discussion of why population-based knowledge must be subordinate to patient-specific data in decision making about unique individuals.

2. *"I'm not sure I'm willing to take the doctor out of the initial history-taking phase, which Dr. Weed is quite happy to do."* (30:40) In discussing this point, you observe that *"there is so much in the history that is not binary,"* suggesting that only the trained physician is able to elicit "nuances" beyond a yes or no answer.

Response:

A. Although not discussed during the podcast, Couplers enable the patient to answer not sure/uncertain as well as yes or no, when responding to questions in the history-taking phase. Moreover, Couplers require the patient "to select from pre-defined, careful descriptions of myriad details." The presence or absence of these details represents medically significant nuances for initial analysis of the presenting problem. "The descriptions from which the patient selects may be pictorial as well as textual. And Couplers allow the patient and practitioner to annotate each yes/no/uncertain response with free-text descriptions." See *Medicine in Denial*, pp. 79, 81. Thus, inputs to Couplers go far beyond simplistic binary choices. Unlike practitioners, Couplers capture countless nuances with scientific precision, bringing order, transparency, context, and rich detail to data inputs.

[1] You recognize precisely this point later in your discussion (at 46:00) when you observe, "Are some physicians thinking of number 80 on the shortness of breath list? Well sure, I mean if somebody came to a physician in the United States and they had fever, rash, and some sore throat and perhaps a bit of arthritis or arthralgia, nobody would be thinking rheumatic fever. But here in New Zealand it's number 1 or 2." That kind of knowledge can be captured in Couplers and made available to patients and practitioners anywhere in the world who may be completely ignorant of the prevalence of rheumatic fever in New Zealand. For example, a diagnostic Coupler for shortness of breath could include a finding on countries the patient has lived or traveled in. The underlying knowledge net could include global disease prevalence data. The Coupler would match the patient's response on residence/travel locations with the knowledge net, and the Coupler output would recognize the New Zealand connection as making rheumatic fever a more-likely-than-normal diagnostic possibility for the patient's shortness of breath.

B. The *outputs* generated by Couplers similarly capture nuances to enrich medical decision making. Rather than binary choices, the outputs list the full range of diagnostic or management options worth considering for the individual patient. The options are presented in a way that helps prioritize further action. For example, rapidly progressing disorders are usually listed first, and then the options are ranked by how well positive findings match with expected findings for each option (for example, an option where 4 of 5 expected findings are positive would be listed ahead of an option where 4 of 8 expected findings are positive). Clicking on each option displays the associated positive and negative findings elicited from the patient history, physical exam and initial lab tests. Also displayed is commentary with relevant details to take into account (for example, expected interactions among different problems and therapies, guidance on how to interpret findings, possible variations from "typical" cases, description of what patients may experience over time, complications to watch for), all supported by citations from the medical literature.

C. These capabilities address your concern about capturing nuance, and they do so in a way that is far superior to the traditional unstructured, unrecorded, variable discussions between the patient and physician. For example:

- A hurried physician may not have time to explore uncertainties when the patient is not comfortable with (or the physician is skeptical of) a yes or no response. The physician can easily lose track of the issue and never get around to the follow-up exploration.
- Cognitive bias and time pressures may make a physician unreceptive to a patient's uncertainty. Physicians have a tendency to interpret whatever the patient says as whatever the physician expects. See *Medicine in Denial*, pp. 199 and 202 (discussing those who "quote what is in the book and deny what is in the bed" and the "human need to deny uncertainty"). Uncertainty is a nuance that is easily suppressed. As one of you acknowledged (at 42:12), "maybe that's part of the problem a lot of the time, is that maybe we're not honest that we're actually guessing."
- If the patient completes the Coupler questionnaire in advance, the practitioner can review the Coupler output to identify any uncertain responses from the patient and then discuss each one in detail. If the practitioner is skeptical of a yes or no response from the patient, then the practitioner can probe the basis for the patient's response. Moreover, a Coupler can be set to generate different lists of diagnostic or management possibilities by treating each "uncertain" response, or all of them, as negative (they are treated as positive by default). This capability helps the patient and practitioner assess the significance of each uncertain finding and prioritize follow-up action. For example, their assessment could lead the patient and practitioner to focus attention on a particular finding of importance and monitor whether or not that finding clearly emerges over time. This monitoring should be part of the care plan, and ongoing SOAP notes should record the results. The results might take the form of the patient's "subjective" self-observation of pain, for example, or "objective" lab results ordered by the practitioner, or patient-generated data from personal medical devices, or the practitioner's observations of the patient in follow-up physical exams.
- Sometimes an "uncertain" response is necessary because the data point is unknown to the patient — for example an item of family history, or entries in old medical records. In these situations, an "uncertain" finding with an explanatory free text

note informs everyone of the situation. There is no ambiguity in how to interpret absence of a positive finding (was it negative or was it never checked?). See *Medicine in Denial*, pp. 60, 137.

(See also p. 77 of *Medicine in Denial*, comparing the Google search approach.) As to your general point about "taking the doctor out of the initial history-taking phase," that leads to the second point that needs a response.

3. *"I do think there is therapeutic value to somebody human telling their problems to another human being."* (34:35).

Response: It is undeniable that personal interaction between the patient and practitioner can have therapeutic value. But therapeutic detriment can also result from that human interaction. Time pressures may cut discussion short, in contrast to a patient's taking as long as necessary to carefully complete a lengthy Coupler questionnaire in advance of the encounter. Moreover, practitioners vary widely in their interpersonal skills. Not all of them are sensitive or attuned to all the subtleties and non-verbal clues involved in face-to-face discussion. Cultural divides between patients and physicians may hinder communication. Patients are sometimes more comfortable with entering intimate, sensitive details on a computer than with telling them to a person.

Moreover, all patients and practitioners benefit from habitually using Coupler tools to facilitate their human interaction. They each need the tools simply to remember all the details to cover. Once the tools lay that foundation, the patient and practitioner can then focus their interaction on points that need an in-person dialogue. Their dialogue is informed by the patient's thinking involved in prior data entry, by the practitioner's observation of the patient's wording, body language and demeanor, and by the further thinking naturally evoked in both patient and practitioner during their dialogue. Using Couplers thus enables a productive division of labor and synthesis of inputs among the patient, practitioner and the external tool.

Above all, the external tool enables reconceiving the roles of patients, physicians and other practitioners. Physicians justify their authority over medical practice in part by their supposedly vast learning from their formal education. Yet, nothing assures the physicians will retain or effectively apply their learning in practice. Indeed, as one of you acknowledged, "The vast majority of what I learned in medical school I no longer use and no longer remember" (29:45). External tools can fill that gap.

Moreover, the value of patients "telling their problems to another human being" cannot be fully realized if that human being must be only a physician. Physicians are not selected for their interpersonal skills and cultural compatibility with their patients, they are expensive, they are insufficiently available, their training fails to instill the necessary standards of care, and they are not subject to ongoing enforcement of those standards.

Those standards include habitual use of knowledge coupling tools for reliable collection of detailed, problem-oriented data. Those standards also include specific manual and observational skills in conducting physical exams. Physician training and credentialing are

notorious for failing to assure that physicians acquire and maintain those skills at a high level.

In contrast, non-physician practitioners could have rigorous training and periodic credentialing in the specific skills needed for particular roles. The range of roles open to any individual would depend on which skills he or she masters.

Moreover, all practitioners and patients could escape the tunnel vision imposed on physicians by specialization. Medical specialties are generally defined by body systems. Patient problems, however, routinely cross such specialty boundaries. That is, practitioners must routinely consider multiple specialties in to order to handle presenting problems in a reliable and complete manner.

That is exactly what Couplers are designed to facilitate. New, problem-oriented specialties could evolve, based on the use of corresponding Couplers or groups of Couplers. Imagine, for example, diabetes management as a specialty (as distinguished from the conventional specialty of endocrinology). Training would involve developing the relevant physical exam and other procedure/equipment skills, plus supervised practice using a Coupler for diabetes management (see *Medicine in Denial*, Appendix A.1, on a clinical trial of such a Coupler). This supervised practice would occur over time with patients of increasing complexity. Trainees would explore the literature presented by Couplers as part of their problem-solving activities with patients. These trainees would become diabetes specialists. They would develop deep and broad experience with thousands of patients, encountering much of the variability in the diabetic population and being constantly informed by the literature cited in Couplers.

That experience, together with Couplers, would enormously enhance dialogue with patients. Each patient could discuss the pros and cons of decisions and what to expect in the future based on the wealth of precisely relevant information offered by the diabetes Coupler plus the practitioner's wealth of concrete experience with thousands of other, more-or-less similar patients. Experienced practitioners would spontaneously develop intangible "tacit knowledge" about diabetes along with personal knowledge of each patient's individuality, physical and psychological. See *Medicine in Denial*, pp. 112-113, 223. Thus the patient-practitioner dialogue would be deeply informed by intangibles that are not captured in Couplers. Moreover, these experienced practitioners would be a source of new insights for research and continuous improvement of Couplers.

There is no reason these practitioners need to be physicians, and there is no reason to believe that conventional physician training would produce superior performers. Some may disagree with these assertions, but we will never know without a Coupler-driven system of problem-oriented care. Only such a system would enable physicians to demonstrate their superior performance. More importantly, it would enable continuous improvement of the performance of all practitioners.

4. *"These Couplers seem to be single complaint-derived. … " (33:00) And so these Couplers seem to be geared towards single complaints."* (34:00). From this you seem to conclude that Couplers are not suited for multi-problem patients.

Response: On the contrary, multiple Couplers are typically used on a single patient with multiple complaints or other abnormalities requiring investigation. One of these might be viewed as the "chief complaint." But there is no reason to use only the Coupler applicable to the chief complaint. A fundamental principle of the problem-oriented medical record (POMR) is that all the patient's medical problems should be identified and taken into account when developing a complete problem list. This means analyzing all significant abnormal findings that may be identified in a complete initial workup (history, physical and lab tests). Couplers can be developed for all such findings, whether or not they are regarded as complaints requiring separate diagnostic or therapeutic attention. This means that using multiple Couplers on a single patient is normal practice.

In addition, different Couplers can be used in succession depending on what is revealed or not revealed. Suppose, for example, a patient is experiencing abdominal pain. Different diagnostic Couplers have been built for acute abdominal pain of sudden onset, and other abdominal pain, recent or long-term. If the case is borderline, then one would normally run the acute abdomen Coupler first, followed by the abdominal pain Coupler. If neither of these Couplers identifies a clear diagnosis, and if the abdominal pain is accompanied by persistent diarrhea or vomiting, then the diarrhea or vomiting Couplers should be run.

To get a sense of the range of Couplers that would typically be used in primary care, see the list of available Couplers at pp. 19-21, "Opening the black box of clinical judgment, Part I: A Micro Perspective on Medical Decision Making, eBMJ: Data Supplement - Part I, 1999 November 13; 319(7220), http://www.bmj.com/content/bmj/suppl/2000/11/14/319.7220.1279.DC2/dc2.pdf. This is far from a complete list of what ultimately needs to be developed. But it sufficient to show that multiple Couplers would frequently be used for a single patient. Incidentally, one user (Charlie Burger) reported that the Couplers available to him in the late 1990s covered more than 80% of the patient problems encountered in his primary care practice.

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Finally, we should comment on your use of the term "artificial intelligence." We disagree with applying this term to knowledge coupling software. In doing so, you use the term loosely to refer to any software that performs tasks otherwise performed by the human mind. But those tasks fall into two very different categories, which you do not distinguish:

(1) Deterministic tasks, such as sorting, arithmetical calculation, linking related items in a database, and other tasks executable as step-by-step instructions, exhaustively performed;

(2) Indeterminate tasks, such as vision, use of language, driving vehicles, and other tasks that cannot be translated into step-by-step instructions executable by traditional software.

The term "artificial intelligence" is properly used to refer to software for the second category, not the first. Software for the second category is at the cutting edge of computer science. It is designed for indeterminate problems otherwise handled by human intelligence. The problems are indeterminate because rules are unclear, information is incomplete, and a step-by-step approach would be either not definable or prohibitively

time-consuming for even the most powerful computers. See generally Christian and Griffiths, *Algorithms to Live By: The Computer Science of Human Decisions* (2016).

In contrast, LLW's knowledge coupling handles the first category of tasks. Because those tasks are deterministic, the software is well-defined, predictable, and transparent in its operations. These characteristics give it reliability and trustworthiness that neither human nor artificial intelligence can offer.