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Medicolegal causal analysis

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Given the explosion of scientific knowledge of recent years, reliance upon relevant and reliable medical evidence and expert testimony has become increasingly important to the legal system in order to render personal injury liability and entitlement decisions. The US Federal Rules of Evidence, Rule 702 states: "If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise" [1]. Despite the principles outlined in the *Daubert* case (*Daubert v Merrell Dow Pharmaceuticals, Inc.*), medicolegal opinions remain to this day a common source of acrimonious and senseless debates, as they often lack the necessary and/or sufficient data, methodology, and logic expected to constitute valid, sound, and generally acceptable scientific evidence.

As indicated by The Medico-Legal Society of Toronto, "Medico-legal reports are essential to the legal process of resolving claims for compensation after personal injury. A full, frank and clearly written medico-legal report will contribute significantly to the proper and just resolution of a claim for personal injuries. It will expedite the process, reduce costs, and frequently preclude the need for a court appearance by a physician" [2]. Furthermore, a quality report will substantially reduce the need for additional independent medical examinations (IMEs). Unfortunately, medical expert testimony and reports are often, at best, only faintly related to scientific evidence. Many medical evaluators choose to testify regarding theories supported simply by their expertise or experience, which, in fact, represents self-interest and/or

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an advocacy position rather than generally accepted scientific standard or evidence. This common situation complicates the trier of fact's task in determining personal injury liability. Sound medical and scientific arguments regarding medical causation are therefore crucial to the legal process.

The 1998 *Concise Oxford Dictionary* defines *causation* as the act of causing or producing an effect. *Causality* is defined as the relation of cause and effect [3]. For the purpose of this chapter, *causal analysis* is the process by which the nature and probability of a relationship between a given event (cause) and a claimed effect is determined. To be legally sufficient, the medical evaluator's opinion as to causation must be based on a "reasonable degree of medical certainty" [4] derived from generally accepted medical and scientific knowledge.

The authors have noted that the complex process of causal analysis is generally poorly conceptualized, understood, or followed in the health care community. The medicolegal causal analysis model presented in this chapter is intended to assist those medical evaluators in need of a method upon which a valid and sound medical causal argument can be developed within the medicolegal context. As Dr. Marcia Angell accurately pointed out in her book titled *Science on Trial*, "The question of causation is, after all, a scientific one" [5]. Medical evaluators should not discard the scientific method when entering the legal arena.

Tort law basics and rules of causation

Some understanding of tort law basics and rules of causation is critical for physicians entering the medicolegal arena. The following brief overview of common law legal concepts of tort law should assist the physician in understanding the legal context in which medical evidence is to be reviewed. While these concepts are general, small variations do exist among jurisdictions.

Restitutio ad integrum

Of all tort law principles, the most fundamental one is referred to as the restoration principle, *Restitutio ad integrum*, which requires placing the plaintiff in the position he or she would have enjoyed, no more or no less, if the defendant had not wrongfully subjected himself or herself to a loss [6]. Although the terms *injury* and *loss* are commonly used interchangeably, injury refers to physical, psychological, and property damage sustained by the plaintiff, whereas loss refers to the adverse economic consequences of an injury (eg, lost earning capacity, medical expenses, etc). The purpose of relief or awards in tort law is to compensate for losses, not injuries.

Status quo ante, thin skull, and crumbling skull principles

In order to determine liability, damages and relief, one must determine to what extent the defendant's wrongful action worsened the plaintiff's

preexisting status. Determining the *status quo ante* is crucial, since it is the standard against which the loss will be measured. Obviously, the role of the medical evaluator is limited to determining the preexisting health status and how it could affect the plaintiff's vocational and socioeconomic status.

Two rules flow from this basic principle. First, the defendant must take the plaintiff as he finds him or her. While the defendant cannot avoid liability associated with a loss partially attributable to a preexisting susceptibility to harm (Egg-shell or thin skull principles), the defendant need not compensate that plaintiff for losses he or she had suffered before the wrongful act nor after, unless these losses are the direct consequences of the same wrongful act. Whereas the first rule is applied retrospectively, the second rule applies the same reasoning prospectively. The second rule is that in spite of losses caused by the defendant's wrongful act, the defendant may not have to compensate for losses that the plaintiff would have suffered in any event from another causal factor (noncompensable losses) [6]. This is sometimes referred to the "crumbling skull principle." The medical evaluator therefore has to establish, with reasonable degree of medical certainty, the claimant's preexisting health state and its natural and probable consequences.

Let us consider the example of an elderly woman with severe osteoporosis who sustains a slip and fall that results in the fracture of several ribs. In this case, we will assume that because of its wrongful conduct, the defendant, a supermarket, is held liable by the court. The defendant is responsible for this loss even though a healthy individual in the same circumstances would probably not have sustained any rib fractures. The defendant must therefore, in this case, take the victim as he finds her (thin skull doctrine). The defendant is not responsible for the preexisting osteoporosis or for natural complications (unrelated to the ribs) prospectively anticipated by this condition. In this example, the preexisting osteoporosis is a nontortious causal factor (crumbling skull doctrine). Under the crumbling skull doctrine, the claimant's "skull" is likely to "crumble" at some point in the future, regardless of any wrongdoing. The defendant would be held liable only for the fact that he or she has hastened or compounded this inevitable misfortune. In conclusion, the defendant can only be held responsible for the direct consequences of his or her wrongful act. One cannot assume *post hoc, ergo propter hoc*—that a loss that simply occurs temporally after the wrongful act therefore occurred because of that wrongful act [7]. The *post hoc, ergo propter hoc* fallacy is a common causal fallacy encountered in medical opinion, and should be recognized and avoided.

The "but for" test and "res ipsa loquitur"

The issue of causation must be established on a balance of probabilities. Typically, actual cause of the accident or cause in fact is found where the "but for," or *sine qua non,* test applies. "But for" the defendant's wrongful act or omission, the plaintiff would not have or probably not have suffered

the loss. In order to establish a sufficient causal relationship, one must demonstrate that the defendant's act or conduct caused or "materially contributed" (beyond the *de minimis* range) to the creation of the injury. In practice, one will frequently encounter situations where multiple sufficient causes and necessary preconditions (or serious risks) to the injury occurring were present. The defendant will be held liable as long as it is demonstrated that the defendant's wrongful act caused or materially contributed to the injury, even though his act alone was not enough to create the injury. It is therefore not necessary to demonstrate that the defendant's act was the sole relevant cause.

Under the U.S. system, proximal cause or legal cause is a social policy consideration. This is a way of deciding whether society ought to hold the defendant automatically liable for *all* the consequences of his act, no matter how improbable or far-reaching, or sever the chain of causation on the basis of foreseeability and intervening events. The proximal cause requirement usually means that the defendant will be liable only for those consequences that are reasonably foreseeable [8].

In their book *Causation in the Law*, Herbert L.A. Hart and Tony Honoré write: "The reasoning on which *res ipsa loquitur* is based is usually, however, stated to be the argument that if the harm is of a sort that does not normally occur unless [the] defendant has been negligent then his negligence is probably the cause of the harm" [9].

The doctrine of *res ipsa loquitur* (literally, the thing speaks for itself; it is self-evident) allows cases to proceed to a jury even when there is no direct proof of negligence, but it is apparent that the injury is a result of negligence. In one case, a man was severely injured by a barrel that rolled out of a second-story warehouse window. The defense attorney argued that since the plaintiff could not know what events preceded the barrel rolling out of the window, he could not prove a warehouse employee was negligent. The plaintiff's attorney asserted that barrels do not normally roll out of windows. The fact that a barrel rolled out of a window was *res ipsa loquitur*—"it spoke for itself"—and indicated that someone was negligent [10].

In the *Zumwalt v Koreckij* decision, the Missouri Court of Appeals stated: "In order to invoke the doctrine of *res ipsa loquitur*, a plaintiff must demonstrate that: 1) the occurrence resulting in injury does not ordinarily happen in the absence of negligence; 2) the instrumentalities that caused the injury are under the care and management of the defendant; and 3) the defendant possesses either superior knowledge of or means of obtaining information about the cause of the occurrence" [11].

Novus actus interveniens

If the elderly woman mentioned earlier were to develop a heart attack (unrelated to her slip and fall) during her period of convalescence, this would alter her current health state and would be referred to as *novus actus interveniens,* "a new intervening act or cause." As this new condition is not

the result of the defendant's wrongful act, the defendant would not be held liable for this additional loss. The medical evaluator must therefore determine whether there are other coexisting or intervening causal factors contributing to the plaintiff's current health state.

The classic example of *novus actus interveniens* is the case of a back injury as a result of a motor vehicle accident. This back injury might not have caused a permanent impairment, but when the injured person rolls off the stretcher because the ambulance attendants were negligent, and his spinal cord is severed, this is a *novus actus interveniens*. The initial back injury was caused by the motor vehicle accident (MVA), but the spinal cord injury was not. The MVA defendant would be responsible for some pain and suffering up to the time of rolling off the stretcher, but any damages thereafter would be the responsibility of the ambulance attendants. The "thin skull principle" would apply here to the ambulance attendants along with standard of care.

Mitigation-of-damages doctrine

Of all tort law principles, the most relevant to health and rehabilitation professionals is the mitigation of damages doctrine. This tort principle imposes a duty on the injured party to take reasonable steps to minimize his or her damages after an injury has been inflicted. A defendant is not liable for any loss that the plaintiff, by exercise of reasonable care, could have avoided. In particular, there is no relief for any loss, which would have been avoided, had the plaintiff sought adequate medical care (including surgery, if available and appropriate).

An injured party therefore has a duty to seek medical care and follow medical and rehabilitation recommendations to minimize his or her damages. The plaintiff is also expected to seek suitable employment if the he or she can no longer perform his or her original employment.

The medical evaluator may be asked to determine whether the plaintiff sought adequate medical care, was compliant with medical treatment or advice provided, and whether any complications could have been avoided by the plaintiff. Failure to comply with the mitigation-of-damages doctrine is an outcome determinant, and should be regarded as a potential causal factor of further loss for which the defendant is not liable.

Apportionment

Since many events are the result of a complex set of causes, there frequently will be nontortious causes contributing to the injury. Apportionment between tortious and nontortious causes is contrary to the restitution principle of tort law. Apportionment is therefore only permitted between tortious causes, as the plaintiff will still be fully compensated for his or her loss by the joint tortfeasors of the wrongful acts.

The application of legal rules of causation, when multiple causes exist and in criminal law, is outside of the scope of this discussion, and is best left

to legal scholars and philosophers. Nevertheless medical evaluators may be asked to provide their opinion when there have been several factors or events that cause or contribute to a condition.

Reasonable degree of medical certainty

As a general rule, a medical opinion must be one of "reasonable medical certainty" to support a finding of causal relationship. The phrases "reasonable degree of medical certainty" and "reasonable medical certainty" are used interchangeably [4]. Some medical evaluators mistakenly interpret medical certainty to mean certainty or the scientific statistical significance of 95 to 99 percent probability, whereas reasonable certainty is a much less stringent and exacting standard. Applying the strictest medical standards in civil cases would be incorrect and unjust. In *Effective Medical Testifying: A Handbook for Physicians*, William T. Tsushima and Kenneth K. Nakano write: "The phrase 'reasonable medical certainty' means more likely than not. In other words, if there is a preponderance—51 percent or more—of evidence in one direction, then the phrase "reasonable medical certainty" is applicable" [12].

It seems that the language "reasonable medical certainty" is not meant to constitute a quantitative opinion so much as a qualitative opinion providing assurance that the testifying expert is reasonably certain of the correctness of his conclusion, recognizing that there can be no absolute certainty in issues of possibilities and probabilities [4].

Benefit of the doubt

The benefit of the doubt is applied in a similar manner to criminal matters as the balance of the probabilities is to civil matters. The former is given only after a judge and/or a jury has heard the whole evidence, only to one accused of a criminal offense, and only if the doubt itself has been demonstrated reasonable. It should be apparent that medical evaluators are never in a position (even in criminal cases) to give the benefit of the doubt to either party [13].

However, some medical evaluators do openly give the benefit of the doubt to one of the parties. This practice reveals an out-of-place kindness and/or unwillingness to take the necessary efforts to adequately support one's opinion. Many more evaluators give the benefit of the doubt without acknowledging what they are doing.

This review of the basic legal rules of causation in single events provides a background for the discussion to follow.

Health Claim Statement

Unsupported opinion versus argument

The exchange of opinions is part of everyday life. However, when an opinion is presented without its reasoning or rationale, it is impossible to

determine whether the opinion deserves our acceptance. Arguments can be distinguished from simple expressions of a personal belief or unsupported opinions by their basic elements: premises and conclusions.

In *Argument Structure: A Pragmatic Theory*, Douglas Walton assigns three essential characteristics to the concept of argument [14]:

1. An argument is a sequence of reasoning; that is, a set of propositions in which some propositions (conclusions) are inferred from others (premises).
2. There is an issue (determined by the context of dialogue in which the argument was used) to be settled.
3. The reasoning is being used to contribute to a settling of that issue.

In this chapter, to facilitate argument and causal analysis we propose the use of a standard format of deductive causal argument called the Health Claim Statement. Obviously, the issue to be addressed by medical evaluators relates to medicolegal causation.

Standard argument structure

During the medicolegal evaluation process, the essential task of identifying all the premises and conclusions of an argument frequently proves to be very difficult. First, claimants do not always express their arguments clearly, often leaving some of the premises unstated on the assumption that the evaluator will know what they have in mind or will not notice their reliance on faulty assumptions. Another reason is that evaluators do not customarily and systematically identify the claimant's assertions or arguments. This lack of clarity can be remedied by reconstructing the claimant's evidence into a standard argument structure that exhibits the logical form of a deductive argument. Let us briefly review the basic concept of argument structure. In the following standard argument structure, each premise is listed on a separate numbered line, followed by an "ultimate" conclusion that follows logically from the premises:

1. First premise
2. Second premise

Conclusion

Of course, the number of premises may vary from one to as many as necessary to accept or reject the conclusion. One must also realize that some premises may not even be supported, meaning that the evidence in support of one of the premises (subargument) cannot be analyzed. The premises and conclusions, connected together as a sequence of inferences, define the reasoning in the argument. The kind of inference used (deductive or inductive) defines the type of argument. At times it will be difficult to rewrite arguments in a standard format, but failure to do so mentally or in writing will make the next step of evaluating the argument all the more difficult.

In a properly formed deductive argument the conclusion logically follows from the premises. If the premises are true, it is logically impossible for the conclusion to be false. When the argument is correctly formed, it is valid, and if the premises of a valid argument are true, the argument is sound [7].

Inductive arguments make a projection based upon the available information; they go beyond what is given in the premises and are based upon probabilities [15].

To decide whether an argument is inductive or deductive one looks at how the premises relate to the conclusion. A deductive argument may contain premises that have been established inductively. However, if the conclusion is formed from the implications contained in the premises (not going beyond the premises), the argument is *deductive*. A deductive argument moves from the general to the specific, leading to certainty. If the premises provide the basis for a projection (going beyond the premises), the argument is *inductive* [15]. Inductive arguments move from the specific to the general.

Health Claim Statement

The conventional medical write-up begins with a succinct statement that identifies the patient and tells what is being sought. The patient's chief complaint stated in the patient's own words is often the most effective descriptive statement to use [16]. A statement of claim is a legal term that refers to a plaintiff's initial pleading in a civil case. The Health Claim Statement can be described as a hybrid between the chief complaint and the statement of claim.

The proposed concept of a Health Claim Statement is analogous to the chief complaint, since it provides the claimant's own description of the personal injury (and indirectly, the loss), cause(s), and reasoning. The World Health Organization (WHO) defines health as a state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity [17]. The term *statement* in Health Claim Statement refers to the claimant's account (medical evidence) of the preexisting health status, the personal injury, its cause(s), and sequelae. The Health Claim Statement aims to define the medicolegal issues.

We propose here that for ease of evaluation the next step should be to reconstruct the Health Claim Statement obtained from the plaintiff into a standard argument format showing its temporal and logical structure within a tort medicolegal and scientific context. We strongly suggest formulating the Health Claim Statement at the outset of the medicolegal interview. The Health Claim Statement will assist in developing the specialized inquiry needed to collect and review the necessary evidence to analyze the causal inferences. See Appendix 1 for an example of a Health Claim Statement questionnaire.

If the medical evaluator does not have the opportunity to obtain direct medical evidence from the claimant, an effort should be made to reconstruct a Health Claim Statement from the plaintiff lawyer's Statement of Claim, the Examination for Discovery, and the available medical evidence,

recognizing that it will not have the same weight of evidence as it would had it been obtained directly from the claimant.

Causal claims that assert there is a causal connection between kinds of categories of events are called general causal statements. General causal statements do not refer to specific events or occurrences. "Smoking cigarettes causes lung cancer" is a general causal statement. Such general causal argument statements are frequently encountered in clinical epidemiology. A discussion regarding standard pattern of argument in general causal statements can be found in *Reason and Argument,* by Richard Feldman [18].

In this chapter, the cause–effect relationship addressed by the Health Claim Statement relates to the causal relationship between a specific event and its specific effect (singular causal argument statement). For the purpose of this chapter, the Health Claim Statement will be limited to the context of a singular accident and personal injury. The cause in fact, or what really caused the accident (eg, non-respect of traffic signals), is generally left to disciplines other than medicine to address.

The claim being made should be written using a standard argument structure that follows a chronological order and its underlying tort law principles.

Health Claim Statement (standard format)

The premises and conclusion are all written as explicit statements, as follows:

1. The plaintiff's preexisting health status did not cause or contribute to the accident itself (premise).
2. The plaintiff's preexisting health status is noncontributory to the personal injury (premise).
3. The defendant's wrongful act contributed to or caused the accident (liability premise).
4. The accident materially contributed to or caused the plaintiff's personal injury (proximal cause premise).
5. The plaintiff has made a reasonable attempt to minimize the personal injury (premise).
6. There are no other causes for the accident and/or personal injury (rebuttal premise).

But for the wrongful act of the defendant (accident), the plaintiff's personal injury would not have occurred (conclusion).

The underlying tort principles for these premises are as follows:

1. *Status quo ante:* This premise deals with the cause in fact of the accident and whether the plaintiff's preexisting health status, such as driving under the influence, caused or contributed to the accident itself.
2. *Status quo ante, thin skull,* and *crumbling skull:* This premise has to do with the proximal cause and whether the plaintiff's preexisting health status has caused or contributed in some way to the personal injury.

3. *Liability issue and cause in fact:* This legal premise addresses the key liability issue or cause in fact.
4. *Proximal cause:* This premise has to do with the proximal cause and damages, or whether the accident has materially contributed to or caused the plaintiff's personal injury. This is a central issue for the medical evaluator to address during causal analysis. If there was a preexisting health condition, one must determine if the accident led to an exacerbation or to an aggravation of the preexisting health condition.
   - *Exacerbation:* Temporary increase in the symptomology of a preexisting condition (flare-up or no new injury). The preexisting health status remains unaltered over time.
   - *Aggravation:* Long-standing effect due to an event, resulting in a worsening, hastening, or deterioration of a preexisting condition (represents additional injury and/or damages).
5. *Mitigation-of-loss doctrine:* This premise deals with the expectation that the plaintiff has taken the reasonable steps to minimize his or her loss. In other words, one evaluates the plaintiff's participation in the medical and rehabilitation (medical and vocational) process.
6. *Novus actus interveniens:* There have been no intervening events (compensable or not) that would cause or contribute to the plaintiff's personal injury. Apportionment becomes a consideration if two or more compensable events contribute to the plaintiff's personal injury.

But for: This is the "but for" singular causal argument conclusion that needs to be analyzed on the basis of the previous premises.

Principle of charity

In his book *Attacking Faulty Reasoning*, T. Edward Damer proposes the principle of charity as follows: "If a participant's argument is reformulated by an opponent, it should be expressed in the strongest possible version that is consistent with the original intention of the arguer" [7].

Once formulated, the medical evaluator must allow the plaintiff to refine the argument further so that it will be the best possible version of the Health Claim Statement that will be analyzed. The medical evaluator may find it useful to review the Health Claim Statement with the plaintiff during and at the close of the evaluation.

Health Claim Statement argument analysis

In order to determine the medical acceptability or validity of a Health Claim Statement, one must formulate a conclusion or judgment resulting from some process or rational reflection on the evidence (provided it is available, necessary, and sufficient). Once the rationale (premises) in support of a health claim has been identified, analyzed, and medically validated, one is in

a much better position to evaluate the validity and soundness of the argument's conclusion.

Bear in mind that if an argument is valid, the only acceptable way to criticize it is to effectively criticize one or more of the premises. To reject an argument, the evidence must support that one or more of the premises is false [18].

Having gathered the plaintiff's information about the accident and having formulated it into a health claim statement standard format, the next step consists of evaluating whether these premises can be supported by carefully examining the documentation available to us. (See Appendix 2 for an example of a Health Claim Statement as it would appear in an IME report). To facilitate this process, we propose the causal analysis model described below.

A necessary condition of an event is a condition, or set of conditions, in the absence of which the event at issue would not occur. Although a necessary condition of an event must be present in order for the event to occur, generally, by itself, it is not sufficient to produce the event. As an example, a car impact is necessary to cause both physical trauma and bodily injury. The presence of the car and of the plaintiff at the site and time of impact is necessary but not sufficient to explain the presence of bodily injury. To produce forces or trauma that can cause bodily injury, the impact must be of sufficient severity.

The medicolegal evaluation process

The medicolegal evaluation process model presented in this chapter is based on existing models, but it differs in content, emphasis, and process. The fundamental new element is the concept of the Health Claim Statement, which is analogous to the Chief Complaints in a medical work-up. As discussed earlier, the Health Claim Statement represents a singular causal argument in its standard form, which exhibits a basic logical structure consisting of premises and a conclusion. This format will assist us in developing the special inquiry necessary to collect and to review the evidence necessary for the causal analysis of the plaintiff's claim.

This model (Fig. 1) involves seven sequential steps and one continuous function of analyzing, validating, and weighing of evidence. The first four steps basically set out the context in which step 5 (causal analysis) will be performed. Conclusion formulation represents the final step in which the available documentation has been both analyzed and integrated in order to determine the validity and soundness of the plaintiff's Health Claim Statement.

Step 1: review mandate and context

The medicolegal evaluation report can be viewed as a method of evaluating the loss exposure necessary for the litigants to resolve their dispute. The medical evaluator may be called upon to prepare a medicolegal report as a

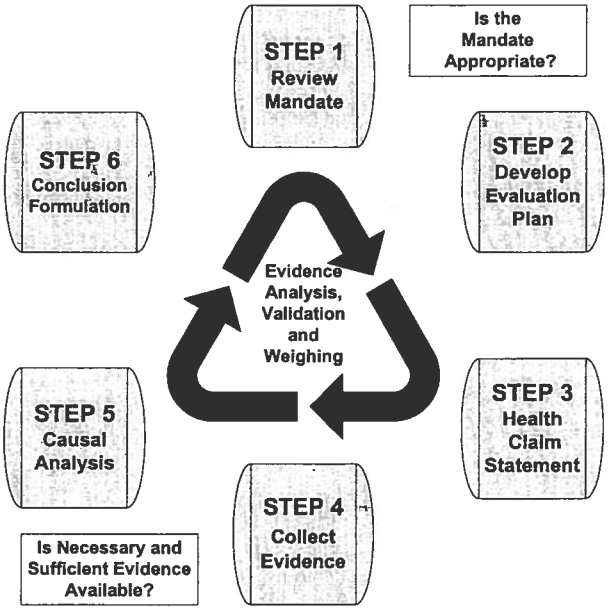

Fig. 1. The medicolegal evaluation process.

treating physician or as an independent medical evaluator for the plaintiff, defendant, or trier of fact from an agency, board, commission, administrative tribunal, or court. Alternate dispute resolution as well as private mediators and arbitrators may also call upon physicians to provide medicolegal evidence. The dispute may be at different stages, in different forums, and under different Federal and State laws and statutes. The physician may be called to testify as a character, medical, or expert witness.

The nature and scope of the medicolegal mandate and the ongoing dispute varies widely. The mandate may range from a very narrow focus on one or two remaining litigious issues (eg, life expectancy, hours of attendant care, etc) to a nonspecific or extremely broad scope (everything being still in dispute). I would caution physicians against taking on the task of performing a medicolegal evaluation without a clear and detailed mandate, as the referral letter generally constitutes the contract between the referring party and the medical evaluator. The purpose of the evaluation should be outlined in the referral letter, as part of this contract. Particular attention should be given to any reference to causation in the referral letter. If no reference is made to causation, the medical evaluator must obtain clear direction as to whether it needs to be addressed. The medical evaluator must limit his discussion and conclusion to the framework of the mandate.

For the purpose of informed consent, it is our practice to tell the referral source that the referral letter will be reviewed with the examinee, if applicable,

since the plaintiff will not always be present. In many instances, a medical evaluator may be asked to provide a considered opinion regarding a situation or condition that does not necessitate the presence of the plaintiff (eg, standard of care, technical issues, etc). A simple file or document review may be sufficient. Occasionally, a medicolegal report can be requested postmortem.

The medical evaluator may be requested to perform a medicolegal evaluation on his or her own or as part of a multidisciplinary team. The medicolegal mandate may relate to issues that are of immediate interest, such as the necessity of a rehabilitation intervention, or address distant future care needs.

Table 1 is a checklist of issues that the medical evaluator should address when reviewing the referral request.

Once a medical evaluator has gone through this list, he or she can decide whether the mandate is appropriate and, if needed, request further direction or simply stop the process.

Step 2: develop evaluation plan

The evaluation plan consists of identifying the steps necessary to achieve the evaluation goal. The evaluation plan consists of identifying the medical evidence that needs to be collected or validated and the process by which this will be accomplished. Sometimes this evaluation plan needs to be formalized as part of an estimate prior to proceeding with the evaluation.

Step 3: standard Health Claim Statement

As discussed earlier, the Health Claim Statement reconstructs the claimant's evidence into a standard argument structure of premises and a conclusion, enabling the medical evaluator to more accurately examine the validity and soundness of the claimant's argument.

Table 1
Checklist of issues to address when reviewing referral request

1.	Medicolegal mandate (referral letter)
2.	Nature and scope of mandate
3.	Appropriate competence, qualifications, skills, training, and experience
4.	Potential conflicts of interest, bias, or lack of neutrality
5.	Necessary and sufficient medical information
6.	Cultural and/or language barriers
7.	Need for accommodations
8.	Need for attendant, chaperone, interpreter, security guard, etc
9.	Need for additional health care professionals
10.	Adequacy and safety of the environment where the evaluation is to take place
11.	Needs for additional space and special equipment
12.	Red flags (violence, disturbing behaviors, legal risk, etc)
13.	Applicable laws and regulations
14.	Realistic timetable and time constraints

Step 4: collect evidence

The next step consists of obtaining the information either through the documentation that has been provided or obtained through the evaluation per se. We favor the use of a questionnaire that facilitates the specialized inquiry required for collecting the data necessary to address the causal issues later. "'Evidence' is information that a party seeks to use in a legal proceeding to prove or disprove a contention or allegation" [19]. For the medical evaluator, this translates as information that does or does not corroborate a given premise of the Health Claim Statement or the plaintiff's self-report.

Quality evidence demands that the information be concise, complete, objective, reliable, relevant, necessary, sufficient, and admissible. What constitutes admissible evidence is addressed by the law and rules of evidence [20].

Step 5: causal analysis

The information that has been gathered is analyzed to look at the relationship between the cause and effect. For the purpose of this chapter, we are limiting the analysis to the accident itself as the claimed proximal cause of personal injury. A three-step method to look at causal relationship was described by Wilmer Cauthorn Smith in his book *Principles of Disability Evaluation* [21]. This "triad of relationship" method consists of three questions that can be easily used by health care providers or treating physicians in their day-to-day clinical and administrative context:

- *Can it occur?* This refers to whether the mechanism is at least probable from a general common sense or medical acceptance standpoint.
- *Does it occur?* Does the literature provide support for the proposed cause–effect relationship?
- *Did it occur?* Are the elements present necessary and sufficient for the cause–effect relationship to be established in this particular case?

The comprehensive causal analysis method outlined later in this chapter is designed for medical evaluators having to address causal relationship issues in a tort framework.

Step 6: conclusion formulation

Conclusion formulation is the last step of the IME process, and consists of the analysis and synthesis of the available information in order to accept or reject each of the premises identified in the Health Claim Statement. This step can only be accomplished once the necessary and sufficient information is available to opine on the validity or medical acceptability of each premise. No medical conclusion should be given regarding the legal liability issue per se (cause in fact) or whether the defendant committed a wrongful act. An exception occurs when the medical evaluator is asked to provide an opinion from another medical professional regarding a wrongful act.

The Health Claim Statement causal analysis model should assist the medical evaluator to render a medically and scientifically sound inference regarding the causal relationship between the accident and personal injury.

Evidence analysis, validation, and weight continuous process

Evidence analysis, validation, and weighing is an ongoing process performed throughout the various steps of the evaluation. Equally important is to identify any necessary information missing and whether the available information is sufficient.

Table 2 outlines a method by which to analyze, validate, and weigh the medical evidence required for the Health Claim Statement argument analysis.

Medicolegal causal analysis

The medicolegal model presented in this chapter as illustrated in Fig. 2 outlines the information that needs to be considered when evaluating the nature and probability of a relationship between an accident and personal injury. As previously discussed, the broad definition of health by the WHO should be used along with the International Classification of Functioning, Disability and Health (ICF) [22]. This will provide the conceptual framework to address impairment as well as functioning and disability issues. Whereas one may examine the information from different perspectives, we recommend following a temporal order similar to the Health Claim Statement; that is, starting from the preexisting health status onward.

Preexisting health status

We find it intriguing when medical evaluators have made no inquiry regarding the claimant's preexisting health status, as if the plaintiff's life had

Table 2
Medical evidence analysis method

1. Evaluate the nature and quality of the data (evidence), and determine the medical acceptability for each premise of the claim:
   - Legibility, objectivity, accuracy, completeness, and relevancy
   - Corroboration, correlation (eg, sites) and consistency (history and examination)
   - Validity and soundness of argument (writing logic)
   - Source and temporality of medical evidence
   - Dichotomous or continuous variables
   - Theoretical or event constructs variables
   - Competence and authority of the source of medical evidence
   - Triad of relationships
   - Cause–effect coherence and congruity
   - Altered state (effect) diagnostic criteria met for this particular individual
   - Medical and scientific validity/framework
2. Evaluate the validity and soundness of the medical claim or argument

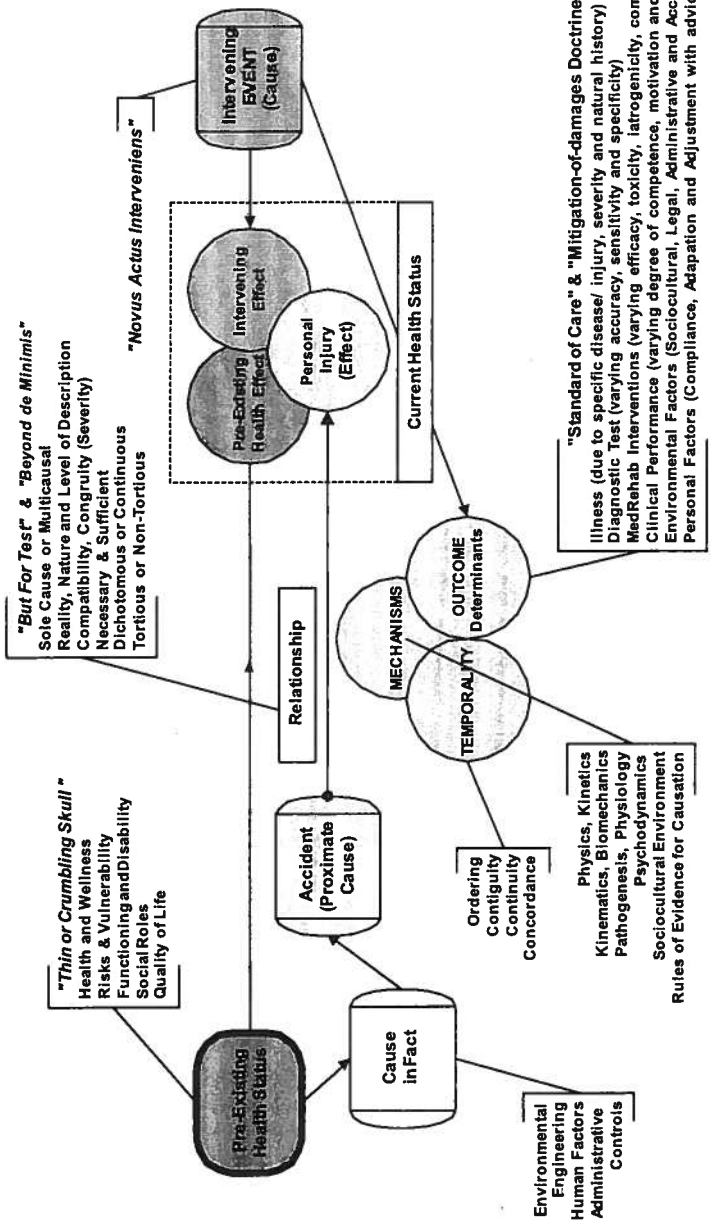

Fig. 2. Medicolegal Causal Analysis model.

started at the time of the accident. Many medical evaluators are content with the information provided solely by the plaintiff and make no attempt to corroborate this information, as if there were no need to corroborate and validate each of the plaintiff's claims. While the general attitude toward the plaintiff should be one of trust, the medical evaluator must nonetheless take necessary and sufficient steps to verify the information. The situation is even worse when objective and factual information is at the medical evaluator's disposal but is missed, ignored, or purposefully omitted. Such behavior can have a devastating effect on a medical evaluator's perceived competence, credibility, and impartiality.

To determine liability, damages, and relief, one must know the plaintiff's preexisting status, since this is the standard against which the loss will be measured. Determining the validity of the first two premises of the Standard Format Health Claim Statement (see boxed text) requires a good understanding of the preexisting health status.

Standard Format Health Claim Statement

1. The plaintiff's preexisting health status did not cause or contribute to the accident itself.
2. The plaintiff's preexisting health status is noncontributory to the personal injury.

A detailed description of the plaintiff's preexisting health status must be corroborated and validated. It should include a general statement on health perception, energy/fatigue, overall quality of life, social function, emotional wellness, role limitations due to memory, emotional or physical problems, cognitive function, physical function, and pain. As uncertainty exists regarding the preexisting health status, it is recommended that as many health records as possible be obtained for review. How many years are necessary in order to have sufficient information is the source of frequent legal debate.

We suggest that the physical, psychoemotional, and cognitive domains be addressed specifically. For the physical domain, one may administer a comprehensive review of systems. We have found that asking about the specific health care providers that the plaintiff has seen also assists in identifying preexisting conditions even though the system review may be noncontributory. For the psychoemotional domain, one may inquire about major loss, life stressors, coping strategies, and support networks. For the cognitive and intellectual domains, one may ask, for example, about learning and problem-solving difficulties.

In addition, the medical evaluator should also determine the plaintiff's preexisting wellness, lifestyle, and personal and environmental factors that potentially have an impact on the plaintiff's activities, social roles, and quality of life.

When a preexisting condition has been identified, the nature and severity of that condition must be quantified along with its associated activity limitations and social impact. We would suggest that nonvocational activities (sports, hobbies, etc) be addressed before addressing activity-related tasks. Furthermore, one must establish the stability of the condition, as it may be getting progressively better or worse over time. This determination is quite important, since a crumbling skull legal argument will depend upon medical evidence substantiating the presence of a progressively deteriorating preexisting condition. Methods of adaptation and accommodation should also be noted along with the presence of environmental barriers.

Personal factors, such as lifestyle or high-risk behaviors, that put an individual at higher risk of being involved in an accident or being injured (eg, alcoholism, drug abuse, criminal activity, violent environment, etc) should be noted.

Specific inquiry about the injury, impairment, and disability claims should be made to identify the plaintiff's past history of recovery, adjustment, and adaptation difficulties.

Cause in fact

The cause in fact can be studied in a number of ways. Accident reconstruction specialists, safety engineers, and risk managers are frequently asked to identify the cause in fact and the systems at fault for risk control and prevention. Cause in fact of an accident is usually related to at least one of four factors.

Environmental factors

Environmental factors can be related to conditions such as fog, slippery roads, poor road or sidewalk conditions, temperature, dampness, and wind.

Engineering factors

Engineering factors can also lead to accidents. For example, in the United States, one just has to think of the recent controversy regarding Firestone Tires and the Ford Explorer. Engineering factors are at the basis of most product liability issues. Common engineering factors include biomechanical risk factors associated with a particular job design.

Human factors

Human factors that can contribute to accidents include fatigue, distraction, inebriation, medical conditions such as loss of consciousness due to epilepsy, heart attack, and any other physiological, mental, or cognitive factor that reduces an individual's ability. The medical evaluator must determine whether a preexisting health condition contributed to the accident itself.

Administrative control factors

In looking at administrative controls, one must take into consideration that sometimes the omission of administrative controls may have horrendous consequences. The presence of dangerous *E. coli* levels in drinking water supplies that was not addressed by a public utility manager resulted in seven deaths and 2000 people becoming ill in Walkerton, Ontario in May 2000. The administrative control was simply not properly followed, and the population was not advised in a timely fashion of the risk of drinking tap water.

The root cause(s) analysis of an accident is generally performed by professionals such as engineers, risk managers, and health and safety professionals. The third health claim statement premise, "The defendant's wrongful act contributed to or caused the accident," is the liability premise, which is for the trier of fact to decide based upon the evidence presented regarding the cause in fact.

The thorough understanding of the cause in fact assists in the analysis of the following Health Claim Statement premises (see box):

3. The defendant's wrongful act contributed to or caused the accident.
6. There are no other causes for the accident and/or personal injury.

Accident (proximal cause)

To analyze the cause–effect relationship, the medical evaluator must first define the characteristics of the accident itself (the alleged proximal cause for the personal injury).

Reality

One must first establish that the accident has, in fact, occurred as described by the plaintiff. This information can usually be corroborated from industrial accident, police, ambulance, and damage reports, and from the referral letter. If the reality of the accident cannot be corroborated, the medical evaluator should state so in his or her report.

Nature

What constitutes an accident depends upon the legislative framework in which the word is defined. From a medicolegal perspective, the nature of the accident is generally clearly outlined in the referral letter. It can be broadly defined as an industrial accident, motor vehicle accident, etc. Generally, more specific details are provided with the referral letter, which should be validated by the plaintiff and the available documentation.

Level of description

It is necessary to determine whether the accident (phenomenon) refers to a concrete or abstract event. Physical phenomena refer to concrete events that are directly and objectively observable, quantifiable, or measurable [23]. The physical damages to a car and anatomical structure or biological measures are all physical levels of description.

In contrast, an accident may also be referred to as an abstract event if it cannot be directly or objectively observed, quantified, or measured. Such abstract or subjective phenomena are typically psychological, perceptual, and cognitive (eg, stress, pain, intelligence, etc).

A singular accident may also be simultaneously both a physical and psychological event [23]. For example, a car accident has a physical level of description in physical, kinematic, and biomechanical terms but may have an abstract level of description such as fear perception, psychoemotional trauma, etc. A review of the accident reconstruction report assists in providing the physical level of description.

Dichotomous or continuous variablex

The medical evaluator must determine whether the accident represents a phenomenon that can be divided into two mutually contradictory categories (dichotomous) or, in contrast, a phenomenon that consists of a theoretically infinite number of points between two opposites (continuous) [23]. An example of a phenomenon that is a dichotomous variable is pregnancy. Pain and suffering are examples of continuous variable phenomena.

Severity

The severity of an accident can be assessed at the two levels of description: physical and perceptual. For example, the physical damages to a vehicle provide some concrete information about the energy and direction of the force at impact. As such, the medical evaluator can usually easily discriminate between a low-velocity impact accident and a high-velocity impact. From a perceptual perspective, one must rely on the plaintiff's subjective account and try to corroborate this with behaviors noted by witnesses, such as police, ambulance attendants, emergency room personnel, etc.

Temporality

The temporality of the accident is important to determine, as the accident must obviously precede the effect. In addition, one needs to understand the temporal sequence and duration of the accident event.

Intervening event(s)

Intervening events can also have contributing effects to the current health status and the personal injury in dispute. The characteristics outlined for accident (proximal cause) also apply when describing one or several inter-

vening events. Necessary and sufficient recent information is crucial to rule out the presence of intervening events such as additional accidents, trauma, illnesses, or life events that contribute to the current health status and its components. A thorough understanding of the intervening event(s) and its effect(s) is necessary to address the following Health Claim Statement premise (see box):

> 6. There are no other causes for the accident and/or personal injury.

Current health status

The determination of the plaintiff's current health status is made in the same manner as suggested under Pre-Existing Health Status. The referral letter (mandate) should indicate what time period should be addressed. Most often, the referral letter requests that the health status at the time of the medicolegal examination be addressed. However, for legal purposes, other time period(s) may be specified.

When analyzing the current health status, one readily recognizes its three contributors:

- Effects of the contribution of the preexisting health status
- Effects attributed to the accident in question (personal injury)
- Effects of any number of intervening events

For the purpose of this chapter, coexisting conditions that were present prior to the accident, whether symptomatic or not, will be considered under the preexisting health status.

Reality

One must establish the reality of the condition, reality being defined as "actually existing as a thing or occurring in fact" [3]. For example, a plaintiff may report having fractured every bone in his body, but the reality is clearly different. A plaintiff may indicate the absence of preexisting or intervening conditions, but the records support another reality. We must, therefore, reconstruct the reality of the current health status and of its three contributors. This can be accomplished by the medical evaluator taking a medical history and performing a comprehensive review of all related documentation.

Reconstruction of the bodily injuries immediately following trauma should be performed with the same attention to detail that characterizes forensic pathologists. An emergency room nursing note about a bruise may turn out to be of great importance later on. The answer to the causal challenge is frequently found in the details.

While the medical evaluator is asked only infrequently to see the plaintiff early following trauma, the best reality check at the disposal of the medical

evaluator remains his or her direct examination of the plaintiff's injury, impairment, and functional limitations. The medical evaluator can then directly quantify the condition at issue through his physical, functional, behavioral, and mental status examination.

Nature

The nature of the current health status should be broken down into its three contributors: alleged personal injury, the preexisting health status and its sequelae, and any intervening events and their consequences. The attribution to any of the three contributors will require validation based upon the available evidence, temporality, and mechanisms.

As health and its attributes are in question, standard terminology should be used to define current health status and its framework (ICD-10, ICF, etc.). When providing a medical diagnosis, the medical evaluator should ensure that generally accepted terminology and coding were used. The degree of medical certainty can be assessed by identifying which diagnostic criteria were met and which were not. Of course, this can only be accomplished if the source of diagnostic criteria has been identified.

Too often medical evaluators will have to evaluate a diagnosis without having any reference to which criteria were used. For example, if one were to diagnose chronic fatigue syndrome, one would expect a reference to the criteria adopted by the Centers for Disease Control and Prevention (CDC). From a medicolegal perspective, having the criteria clearly outlined assists in building a strong case for a specific diagnosis.

If one argues for an aggravation of a preexisting condition, the medical evaluator must be able to identify the specific characteristics of the additional injury or altered state and provide the necessary corroborating evidence.

Level of description

When addressing specific elements, one must classify them as physical or abstract phenomena. Physical examination, imaging, laboratory findings and other objectively observable and measurable means to evaluate anatomical, and biological and physiological conditions, etc will provide a physical level of description and confirm the nature and reality of the physical phenomenon.

In contrast, as indicated earlier, abstract phenomena are theoretical, conceptual, or metaphorical, thus not directly or objectively observable or measurable. Abstract phenomena are subjective, and one must use descriptive terms such as psychological, perceptual, experiential, cognitive, and mental [23].

A visual analog scale for pain is an example of a descriptive method used to indirectly measure pain, an abstract phenomenon. One must be aware that although abstract, a psychological phenomenon cannot exist in the absence of biological activity.

The medical evaluator must also be conscious that personal and environmental factors (physical and abstract) may also be interacting with the physical or abstract phenomenon being studied. Past experience and personal and environmental expectations can play a role in pain perception. Obviously, the objective and measurable nature of physical phenomena makes them easier to analyze, attribute, and apportion.

Dichotomous or continuous variable

The medical evaluator should determine whether the current health status element being analyzed can be classified as a dichotomous or continuous variable. For example, a bone is either fractured or not fractured; a woman is either pregnant or not pregnant. These could be described as physical phenomena that are dichotomous in nature.

Examples of continuous variables include pain, suffering, disability, wellness, and lifestyle, etc. These are abstract phenomena that are clearly continuous in nature; that is, there are an infinite number of points that can be addressed and not simply an "all or none" state, as in the case of dichotomous variables.

Severity

In order to determine the individual contribution of the preexisting health status, presumed cause (accident), and intervening event(s) to the current health status, one must first determine if the medical issue is a dichotomous or a continuous variable, and then address the issue of severity. In the case of a dichotomous variable, the exercise will basically consist of determining the temporality of the event. As it relates to continuous variables, one must determine the severity of the condition and identify its contributors. To determine the contribution of the presumed cause (accident), the medical evaluator should gather the necessary medical evidence on injury severity from the emergency care-related reports. The Abbreviated Injury Scale (AIS), the Injury Severity Score (ISS), and the Glasgow Coma Scale (GCS) are examples of gross measures of injury severity.

While the gross measure of injury severity assists in predicting mortality and morbidity, the medical evaluator must collect as much information as possible for each specific injury, disease, or illness. For each of these conditions the medical evaluator should make some reference to its severity by using generally accepted reference scales.

When describing impairment, The AMA *Guides to the Evaluation of Permanent Impairment*, 5th edition, is a generally accepted reference text which provides a protocol and methodology to rate severity [24].

A number of functional outcome scales can also be used to describe and quantify activity limitations [25].

With regard to a specific medical condition, the presence and/or likelihood of complications should also be addressed by the medical evaluator. This sometimes can be addressed by reference to probability statistics.

Stability

The medical evaluator should determine whether the medical condition is stable or is expected to change over time. For example, the condition may improve from critical to severe, or progress from critical to death. The medical evaluator should also determine whether the medical condition has stabilized; this can be referred to as having reached maximal medical recovery. From an impairment perspective, the term maximal medical improvement can be used. Activity limitation stability can be referred to as having reached maximal functional recovery.

When the condition is not stable, one needs to gather information in order to describe the progression of the symptoms, along with the direction and speed.

Temporality

One should look at whether the time sequence between the accident, injury, and the reported complaint(s) makes any sense. If it is trauma related, then the symptoms normally would manifest themselves almost immediately. Any delay in symptoms could suggest a break in the causal chain. As the injury is getting better, the impairment, activity limitations, and participation restrictions should also be improving within the same time frame. In addition, one would expect the presence of temporal concordance throughout the causal chain.

The onset and duration of the increase in the symptomatology (exacerbation) and its functional impact should be clearly identified and corroborated.

Natural history and prognosis

Understanding the natural history of a specific condition from epidemiological data and literature should be in the mind of the medical evaluator analyzing a specific medical condition, and answer the question "does it occur?" of the triad of relationship. Clinical epidemiology information would assist us in understanding the nature of the relationship and its natural progression and prognosis.

The thorough understanding of the proximate cause assists in the analysis of the following Health Claim Statement premise (see box):

> **4. The accident materially contributed to or caused the plaintiff's personal injury.**

Cause–effect relationship

Before exploring the cause–effect relationship the medical evaluator should ask himself or herself the following questions:

- What is the specific cause–effect relationship that needs to be addressed?
- What are the characteristics of the specific cause–effect relationship?
- What mechanisms are proposed to explain this specific relationship?

These questions assist the medical evaluator to gather the medical evidence necessary to analyze the specific cause–effect relationship. Since

analyzing the cause and effect relationship is a very complex topic, only basic concepts essential to medical evaluators will be covered.

Causal chain and sequence of events

What is the specific cause–effect relationship that needs to be addressed? While this appears to be a simple, straightforward question, the reality may be quite different. The specific cause–effect relationship delineated in the referral letter may not be a singular relationship but may refer instead to a complex causal chain and sequence of events.

For example, what is the relationship between Mr. Jones' fall from a ladder and his alleged inability to return to his preaccident employment? The causal chain and sequence of events must first be broken down into a series of cause–effect relationships. In this particular case, the causal chain and sequence of events is as follows:

As a result of a 10-foot fall from a ladder, Mr. Jones sustained a right femur midshaft displaced fracture that required an open reduction and an internal fixation and orthopedic rehabilitation. The right femur fracture was immediately associated with an anatomical impairment limiting weight-bearing activity and with his continued participation as a commercial painter.

Each individual sequence or link must, therefore, be individually and carefully analyzed, since it will impact on the soundness and strength of the entire causal chain. For each individual event, the relationship with the preceding and following events needs to be individually analyzed, since each of these individual relationships may impact on the soundness and strength of the entire causal chain.

The medical evaluator must be able to distinguish a cause–effect relationship that is singular from one that is, in reality, a part of a complex causal chain and sequence of events. In the medicolegal context, the analysis between accident and personal injury should extend to the entire causal chain and sequence of events; that is, between the accident and the alleged injury impairment activity limitation, participation restriction, and loss of quality of life. The interaction between personal and environmental factors, and these variables should also be explored.

Reality

Prior to addressing the cause–effect relationship, the medical evaluator must define the cause and effect in their simplest elements—abstract and physical. As described earlier, reality is a crucial condition for both the cause (accident) and effect (personal injury). If one cannot confirm the reality or probability of either the cause or the effect, then attempting a more in-depth causal analysis takes us into the hypothetical domain and is probably a futile exercise.

If the validation of the cause and effect is not possible secondary to insufficient information, then the medical evaluator would be well advised to include a cautionary note to that effect when formulating his or her opinion.

Level of description

A cause–effect relationship can be described simultaneously at both physical and abstract levels of description. As illustrated in Fig. 3, events of cause and effect can be simultaneously described at both levels of description. The mechanism used to link the cause and effect must be within the level of description.

As suggested by Fig. 3, an abstract cause cannot produce physical effect [23].

Sole or multiple causes

Once a singular cause–effect relationship and its sequence has been determined within the causal chain, the medical evaluator should clarify whether this relationship involves only one or multiple causes, one or several effects, or a combination thereof. As we have already identified, a current health condition can arise from one or several contributors.

The medical evaluator's role in the study of the cause–effect relationship is to look at each cause individually and determine whether the alleged cause is necessary and sufficient to explain the effect. An analogy would be that gasoline and a working spark plug are both necessary but insufficient by themselves to make an engine work. Both conditions need to be present for the engine to run.

At times, multiple causes may exist that are individually necessary and sufficient to cause a given effect (eg, depressed mood). One sole cause may also be necessary and sufficient to produce multiple effects.

Determining the proportionate contribution of each cause to a specific effect is frequently quite a challenge for the medical evaluator.

Unidirectional, bidirectional, and causal loop

We tend to think of a cause–effect relationship as a unidirectional entity; that is, the cause precedes the effect. However, we need to consider bidirectional relationships where each variable affects the other. Bidirectional relationships are commonly encountered.

An example of a bidirectional relationship involves depressed mood and negative thoughts. This relationship raises the following question: Do the

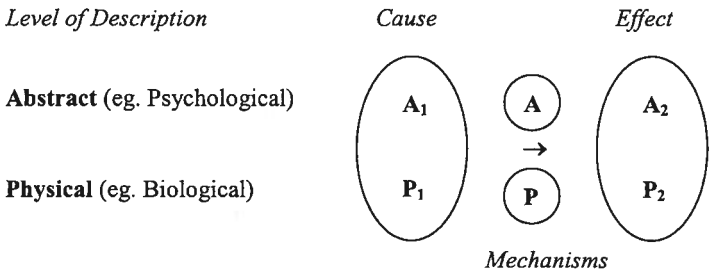

Fig. 3. Cause–effect relationship: dual levels of description.

negative thoughts lead to the depressed mood, or does the depressed mood lead to the negative thoughts? In this case, both variables may affect each other.

Another example is the following: Does the legal environment lead to disability claims or do disability claims lead to the legal environment? Which comes first? In most instances no definite answer will ever be found. When both affect each other in a positive way, we refer to this as a causal loop or healthy cycle, and when the causal loop between two variables leads to deterioration, this is generally referred to as a "vicious cycle."

Furthermore, the terms *cause* and *effect* are relative. A cause in one situation becomes an effect in another. Taken from this view, asking which came first, while interesting, may be unnecessary, irrelevant, or even unanswerable. The answer may depend on where one has entered the causal loop [23].

Dichotomous or continuous relationship

When dealing with relationship, one must address whether this relationship is dichotomous, as in a chance event—"the brick fell off the wall and hit his head"—or whether we are talking about ongoing, continuous relationships such as ongoing work stress that leads to a depressed mood. In this case, these are two continuous variables that are themselves in a continuous relationship.

Degrees of causation

From the Health Claim Statement the medical evaluator should identify the nature of the cause–effect relationship claim. Does the plaintiff allege that the accident is the sole cause, or one of multiple causes of a claimed effect? If there are multiple causes, what proportion of the claimed effect is attributed to each cause?

The nature of the alleged event should be studied to determine whether it is the sole cause or one of many. It must establish whether each individual cause is by itself necessary and sufficient to explain the claimed effect. It is the role of the medical evaluator to determine whether the alleged cause is medically necessary and sufficient to explain the effect. In the case of an exacerbation or flare-up, its contribution will be an increase in symptoms. In the case of an aggravation, the additional injury will need to be described in relationship to the preexisting condition. In any case, based upon the medical evidence, it is for the trier of fact to decide whether the contribution is material.

One must remember that the purpose of the medical evaluation is to determine the probability that a specific event has caused or contributed to a particular effect. To what extent the preexisting health status, the alleged accident, and intervening events each contribute to a specific effect should be addressed by the medical evaluator.

A number of qualifiers describing the relationship between an alleged cause and its alleged effect can be used by the medical evaluator:

- Contributory
- Noncontributory
- Improving
- Exacerbating
- Aggravating
- Precipitating
- Perpetuating
- Maintaining
- Complicating
- Compounding
- Confounding

Stability

Stability needs to be addressed, as it relates to the cause and to the effect. If the cause is ongoing, it may have an ongoing effect, but if the cause has ended, the effect may still persist due to the nature of the condition and/or its mechanism.

Mechanisms

When analyzing a cause–effect relationship, the medical evaluator normally immediately thinks of the mechanism of injury. However, the medical evaluator should refrain from inferring that because a relationship between the accident, trauma, and bodily injury has been validated, the claimed personal injury is its immediate, direct, and logical consequence (Domino Fallacy) [7]. The claimed personal injury refers here to impairment, activity limitations, participation restrictions, and loss of quality of life.

In his book *Clinical Epidemiology: A Basic Science for Clinical Medicine* David Sackett suggests guides and rules of evidence for causation [26]:

- Is the association between the putative cause and the outcome of interest consistent from study to study?
- Is the temporal sequence of exposure and outcome in the right direction?
- Is there a dose-response gradient?
- Does the association make sense?
- Did this treatment cause that adverse effect in this particular patient?

These rules expand upon the triad of relationship previously described by W.C. Smith in *Principles of Disability Evaluation* [27]. We have incorporated into our medicolegal causal analysis model both sets of questions.

Causal chain and sequence of events

To validate a cause–effect relationship, the mechanism of each link of the entire chain of events must be individually determined and validated, as any

singular sequence of events can impact on the soundness and strength of the entire causal chain. For example, if the presence or reality of physical trauma can not be demonstrated or validated, it is then impossible to establish a link between accident and physical trauma and between physical trauma and bodily injury.

The Causal Chain and Sequence of Events along with their mechanisms (physical level of description) are illustrated in Fig. 4. The first sequence of events is the singular relationship between the motor vehicle accident and the physical trauma. The mechanism to explain this relationship is drawn principally from the fields of physics.

The second sequence of events consists of physical trauma and bodily injury or function. The mechanism used to explain this second sequence of events relationship is within the fields of kinetics, kinematics, and biomechanics.

The third sequence of events involves the bodily injury or function and the associated physical impairment. The mechanism used to explain this relationship is drawn from the field of anatomy, physiology, pathogenesis, and pathology.

The fourth sequence of events occurs between the physical impairment and physical activity limitations. Biomechanics and physiology provide the basis to explain the mechanism involved.

The fifth sequence of events occurs between activity limitations and participation restrictions. The mechanism to explain this relationship is drawn from the areas of ergonomics, biomechanics, and exercise physiology.

Lastly, personal and environmental factor interactions with activity limitations and participation restrictions are complex, and so are the mechanisms. These interactions should be analyzed within the ICF conceptual framework.

Fig. 4 describes the Causal Chain and Sequence of Events and their mechanisms at a physical (or biological) level of description. A similar analysis can be done at an abstract or psychological level of description. Abstract personal and environmental factors or phenomena can also interact with activity limitations and participation restrictions.

Reality and level of description

The reality of the Causal Chain and Sequence of Events must first be established before considering any of the proposed mechanisms involved. The proposed mechanisms should correspond to the same level of description—physical or abstract—of the cause and effect being considered.

While the most obvious consequence of physical trauma is the objective and measurable physical damage to body structure, the subjective psychological impact should not be dismissed, as it may be simultaneously present. The medical evaluator should be aware that psychological effects may, in fact, also have resulted from the psychological trauma of the same accident. The description of a car accident can be made at an abstract level using

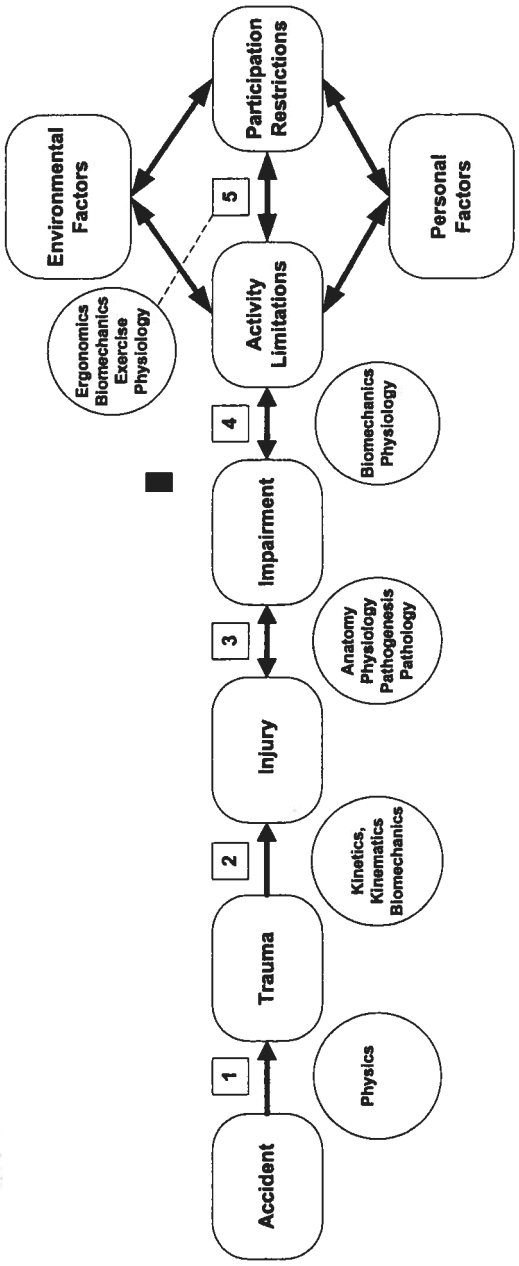

Fig. 4. Causal chain, and sequence of events and mechanisms.

psychological terms such as *fear*. Mechanisms to explain the relationship between psychological trauma and psychopathologic effect come from the field of psychodynamics.

While it is within the domain and scope of mental health professionals and medical evaluators to address psychological mechanisms, all medical evaluators should be aware of (and not minimize) the potential impact of psychological trauma, personal, and environmental factors on activity limitations and participation restrictions [23]. It would also be prudent for the medical evaluator to mention that psychological mechanisms contributing to the currently observed psychoemotional state are best addressed by mental health professionals.

At the physical level of description, an accident can be characterized by its physical properties. Accident reconstruction is useful for this purpose, as are the accident damage reports. A basic understanding of the physics, kinetics, kinematics, and biomechanics is necessary to establish the relationship between the transfer of forces and on the body tissues and their reaction to those forces.

The nature, location, and severity of the bodily injury; its natural history; and its anatomy, physiology, and pathology characteristics provide the basis of a good understanding of the evolution of the medical condition, its potential complications, and sequelae. Biomechanics explains the mechanisms involved between the physical impairment sequelae and physical activity limitations.

The proposed mechanism must be derived from generally accepted medical and scientific knowledge and be directly applicable or very closely analogous to the specific cause–effect relationship at issue. In other words, the reality and relevancy of the proposed mechanism must meet the principles outlined in the Daubert decision and not simply arise from the medical evaluator's personal belief, intuition, expertise, and/or anecdotal experience. A mechanism not scientifically based and reflecting self-interest can seriously jeopardize the credibility of the medical evaluator.

Sole or multiple mechanisms

As many causes can lead to one effect and one cause can have several effects, one or multiple mechanisms may be necessary in order to explain the relationships. In addition, two distinct causes may also share the same mechanism that lead to the same effect. The medical evaluator should be able to explain and substantiate each individual cause–effect relationship mechanism, and indicate what proportion each individual mechanism contributes to a specific effect.

Unidirectional, bidirectional, and causal loop

The medical evaluator must ensure that the alleged mechanism is in keeping with the direction of the cause–effect relationship. In the case of bidirectional

and causal loop, one or several mechanisms may have to be considered along with their interdependence or interaction.

Cause–effect compatibility

Can it occur [21]? Does the association make sense [26]? These two fundamental questions refer to the central issue of mechanism and cause–effect compatibility. If no mechanism exists to explain how and why two events are possibly associated, then there is no causal connection or cause–effect compatibility. In other words, a correlation between two events is necessary but not sufficient to establish a causal relationship. One should not confuse the "what" with the "why", the "why" here referring to the causal mechanism [23].

In order to establish the compatibility of a cause–effect relationship, the concordance of site must be maintained. If an individual has a crush injury to the right great toe, the medical evaluator should expect that the soft tissue injury, physical impairment, and activity limitations arise from the right great toe and not from other unrelated body regions.

Cause–effect congruity

The medical evaluator must ascertain whether there is an increasing risk or severity of the effect (outcome) in association with increased "dose" or duration of exposure (dose-response gradient). This simply means that a high-velocity impact accident is associated with a higher risk of sustaining severe physical injury, severe impairment, and activity limitations. Similarly, a prolonged exposure to high concentrations of a toxic agent is more likely to be associated with health-related problems.

Stability

Determining the presence and stability of the mechanism is central to determining whether maximal medical recovery, maximal medical improvement, or maximal functional recovery has been reached. This determination is therefore useful in formulating the prognosis.

Common fallacies

In their conclusions regarding causal mechanism, medical evaluators occasionally provide fallacious arguments. The fallacies commonly encountered in the medicolegal context include appeal to ignorance, appeal to personal authority, and *post hoc, ergo propter hoc*.

The appeal to ignorance fallacy occurs when a medical evaluator argues that a cause–effect relationship claim is true (or false) because there is no evidence or proof to the contrary [7].

The appeal to personal authority or expert opinion fallacy occurs when a medical evaluator with or without legitimate authority argues that a cause–effect relationship claim is true (or false) without providing any relevant, acceptable, or sufficient ground or rationale to accept or rebut the claim [7].

The *post hoc, ergo propter hoc* fallacy is commonly encountered when the medical evaluator establishes causation solely on the basis of the temporal

relationship between the cause and effect. A temporal relationship is necessary but not sufficient to establish a causal relationship.

Temporality

Ordering

Temporal ordering simply refers to the sequence of the accident following the normal sequence of cause and effect. While this may appear simplistic, the reality is far different. In order to establish the ordering, a thorough knowledge of the preexisting health status is crucial. One may find that compiling a chronology table is particularly useful when dealing with multiple causes and effects. When reviewing the temporal and situational context of a claim, one sometimes finds that the timing of the accident and sequelae were unusually fortuitous. In such circumstances, medical evaluators must be vigilant of possible bias while reviewing the evidence.

Contiguity

Contiguity, which is a close proximity or association in time or space, refers to the delay of onset or appearance of the effect following a cause.

When analyzing temporal contiguity, the entire causal chain should be tested, as one would expect that the sequence of events in trauma should be closely related in time.

Contiguity does not imply that both cause and effect must occur closely to each other. For instance, one would not expect cancer to develop before several years of smoking or until the necessary dose gradient has been reached. In trauma, however, the hammer-thumb principle generally applies. That is, if you hit your thumb with a hammer you would expect an immediate physical and psychoemotional effect.

Continuity

To establish continuity, the medical evaluator must demonstrate a connection between the original personal injury following the accident and the current complaints under current health status. For example, if a person develops lower back pain that lasts 2 to 3 weeks after a car accident and then subsequently is pain-free for 2 years, the new onset of lower back pain 2 years later does not have the presence of continuity that could suggest a causal relationship. On the other hand, a 2-week absence of symptoms would not necessarily represent a break in continuity that would lead the evaluator to doubt the causal relationship. One may refer to a recurrence as opposed to a new condition.

The medical evaluator should also consider whether the plaintiff has complained of the medical condition to health care providers and others on an ongoing basis since the original injury, and has required accommodations or ongoing treatment for the original condition or experienced a

lifestyle change. The evaluator should distinguish between the delay of onset of the clinical manifestations of an injury and delay in reporting.

Delay of reporting to, or consulting with, a health care professional or having the medical condition or complaints documented should be ascertained from a temporal perspective. However, such delays should find their logical explanation and sufficient corroboration.

Continuity is a state of being continuous, an unbroken succession of a logical sequence. One must be able to demonstrate that the condition at issue has been present on a continuous basis. Once healed, it is improbable that the condition will recur. If there is a stop in the evolution, the causal link can no longer be maintained unless it is part of the natural history of the condition (eg, diabetes versus whiplash). It is necessary to determine whether the condition is a recurrence or whether there is a new cause or injury. A new disease has a new cause. The continuity of the condition needs to be correlated by the health care records.

Concordance

The medical evaluator should note whether the natural evolution of a medical condition follows the normal expected time sequence. Temporality of symptoms should not be limited solely to onset but should include progression, recurrence, or resolution. Pathophysiology and biological processes basically dictate the expected healing, medical, and functional recovery times.

Outcome determinants

In his book *Clinical Epidemiology: A Basic Science for Clinical Medicine* David Sackett described a number of outcome determinants [26]. In this chapter, minor changes were made to reflect the medicolegal context in which the medical evaluator reviews the outcome determinants.

Illness (due to specific disease/injury, severity, and natural history)

The first item constitutes illness, which is related to a specific disease or injury, and is attached to a severity with a known natural history. This illness will give us a sense of what effect can be expected as it relates to associated function and disability and the expected timeframe.

Diagnostic tests (varying accuracy, sensitivity, and specificity)

Diagnostic tests have varying accuracy, sensitivity, and specificity, and allow one to clarify the working diagnosis and increase the chance of treating the right illness.

Medical and rehabilitation interventions

The medical and rehabilitation interventions have varying efficacy, toxicity, iatrogenicity, and complications. These treatments must be medically

reasonable according to the diagnosis. Identifying the correct illness is often the first step toward optimizing recovery.

Clinical performance (varying degree of competence, motivation, and barriers)

The clinical performance refers to the degree of competence of the health care practitioner, motivation of the practitioner, and possible barriers that may be present in the therapeutic environment, access of care being one of them.

Performance can also be affected by the presence or absence of case management and the effectiveness of service integration. Meeting the standard of care is important, as this element is often the source of litigation for health care providers.

Environmental factors

Environmental factors may relate to society, culture, legislation, insurance, managed care, administrative controls, and accommodations. Administrative factors, such as reimbursement, can certainly have a determinant effect on the medical and vocational outcome.

Personal factors

Plaintiff compliance, adaptation, and adjustment with treatment and advice are important elements, particularly in a tort environment, since it relates directly to the mitigation-of-damages doctrine. The medical evaluator should also address whether additional interventions and/or accommodations could improve the plaintiff's level of activity and participation. Evaluating rehabilitation interventions is clearly within the domain of the physiatrist. We define rehabilitation as optimizing ability and autonomy.

Personal factors that may also affect medical and vocational outcome include aptitudes, attitudes, personality, social support, cultural background, belief system, age, sex, education, training, work experience, socioeconomic status, and primary and secondary gain.

To determine the validity of premise 5 of the Health Claim Statement, one must have a good knowledge of the steps the claimant has taken to mitigate his loss, such as rehabilitation, looking for work, attending school, etc.

5. The plaintiff has made a reasonable attempt to minimize the personal injury.

Conclusion

Medicolegal causal analysis remains a challenging task, since the information is rarely complete, and time and cost constraints do exist. As such, we recognize that our proposed approach represents an ideal and may be difficult to follow in every case. We hope, nevertheless, that the introduction of the Health Claim Statement and the Causal Analysis Model will make a

useful contribution to IME standards, and reduce the frequency of senseless debates.

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Appendix 1

Health Claim Statement example

Mr. John Smith reported that prior to the February 14, 2002 MVA he was in excellent physical and psychoemotional health, and had no cognitive or activity limitations. He reported no past disability claims and was

Health Claim Statement ***NAME:***

The Claimant's description of his/her pre-existing physical and psycho-emotional health state and its functional impact.

A. Prior Accident/Illness, Health, Activities and Claims

When were you last perfectly well? Immediately before DOL Other:

Did you ever have a disability claim? **Y N** WC, STD, LTD, MVA Other:_____ ☛ **Pre-Existing**
Did you fully recover? **Y N** Any residual pain / problems / restrictions ? **Y N** _____
Did you ever see a chiropractor, physiotherapist, psychologist, orthopedic surgeon or rheumatologist? **Y N**

Prior Physical health? Poor Fair Good V. Good Excellent ☛ **Pre-Existing**
Prior Emotional State? Poor Fair Good V. Good Excellent ☛ **Pre-Existing**
Prior Cognitive (attention, concentration, memory problem solving) problems? **Y N**
Any associated residual activity limitations or restriction in participating in any social role? **Y N**

B. Current Accident Related Injuries or Illness Impact on Activity (Worst to Least)

Accident/ illness has resulted in the following injuries, impairment and limitations. (Indicate if resolved)

#1
#2
#3
#4
#5
#6

*Solely **Y N** as a result of the above accident related injuries and/or illnesses, the claimant reported having the following functional limitations and/or change in roles.*

ADL's
Mobility
Homemaker
Caregiving
Spouse
Worker
Student
Other: ☛ **Functional Screen**

Appendix 1

C. Co-Existing and Intervening Events/Factors ☛ Intervening
Have you sustained any accident, trauma, injuries or disabling illness since the Accident? Y N
Does it interfere with your current activity? Y N How so?

D. Rehabilitation Efforts to Date
What have you done to date to reverse the impact of the accident/illness on your life?

E. Future Needs
What do you expect your future needs to be to increase your autonomy (self-reliance)?
What do you expect your future needs to be to improve function/productivity?

Medical/Surgical
MedRehab
Self-care
Mobility
Homemaking
Caregiving
Accommodations
Attendant Care
At work
At School
Voc. Rehab.

Do you foresee being able to resume your pre-accident social roles? Y N Why?

Do you foresee any long term impact on your quality of life? Y N
Describe:

Can you think of any possible remedy?

Appendix 1 (*continued*)

enjoying an excellent lifestyle with his wife and three children. He reported no contribution on his part to the February 14, 2002 MVA.

Mr. Smith indicated that solely as a result of the February 14, 2002 MVA he currently suffers from severe neck pain and flexibility impairment that prevents him from returning to his previous job as a residential painter. He reported no neck problems predating the February 14, 2002 MVA. Mr. Smith stated that the MVA had no impact on his psychological health.

Mr. Smith indicated that he has participated in a physiotherapy program but has made no attempt to return to his preaccident occupation or to look for alternative employment.

Mr. Smith reported that since the February 14, 2002 MVA he has had no additional accidents, traumas, injuries, or disabling illnesses.