Essay on
a probabilistic consideration of patient-pharmacist relationship

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Introduction

While recommendation of personalized therapies forms the cornerstone of pharmacy practice, effective communication is always essential to reinforce informed consent, patient adherence, and to minimize patient dissatisfaction. Nonetheless, work experiences from most pharmacists indicate a common area of dispute when patients downplay the risk of disease complications, and do not understand the necessity of a number of medical interventions. Although one can usually provide qualitative solutions such as workshops or educational sessions to foster communication skills, it would be of interest to use statistical approaches to explore the underlying mechanisms of such disputes.

Motivation for a probabilistic model

We commence with a simple thought experiment, where a patient and a pharmacist discuss some medical interventions. Both the patient and the pharmacist perceive a probability of a complication, r, and the likelihood to propose or accept the intervention essentially equates to this perception. Since the minds of the patient and the pharmacist are independent, the joint probability that the patient disagrees with the pharmacist's intervention, denoted $P(P_{-}, D_{+})$, is simply the probability that the patient does not believe in the intervention, $P(P_{-})$, multiplied by the probability that the pharmacist believes in the intervention, $P(D_{+})$, such that

$P(P_{-}, D_{+}) = P(P_{-})P(D_{+}) = (1 - r)r.$

In this case, $P(P_{-}, D_{+})$ is a function of r, with $r_{max} = 0.5$ and $max\{P(P_{-}, D_{+})\} = 0.25$. Such result seems to coincide with our intuition, since we are most likely to disagree over issues that are the most ambivalent.

Nonetheless, work experiences are usually inconsistent with this conclusion. Instead, most pharmacists feel harder to convince the patient to prevent an uncommon outcome, such as a side-effect or medication interaction, than more common outcomes such as allergic reactions, such that $max\{P(P_{-}, D_{+})\}$ frequently occurs for $r \ll 0.5$.

One simple way the ameliorate this issue is to consider the likelihood to propose or accept a medical intervention not simply as r, but as a function of r, which we shall call

an objective function. In addition, it would be reasonable to assume that such objective functions are different for the patient and the pharmacist, as there are many ways to interpret risks of complication and to apply them in actual conversations. Let $G(r)$ and $H(r)$ be two such functions for the patient and the pharmacist, which maps the risk of complication to the likelihood to propose or accept a recommendation, such that $P(P_{-}) = 1 - G(r)$, $P(D_{+}) = H(r)$. We then have a generic model, such that
$P(P_{-}, D_{+}) = \big(1 - G(r)\big)H(r)$.

With differentiation, r_{max} and $max\{P(P_{-}, D_{+})\}$ can be obtained by

$$\frac{d}{dr}(P_{-}, D_{+}) = \frac{d}{dr}\big(1 - G(r)\big)H(r)$$
$$= \big(1 - G(r)\big)\frac{dH(r)}{dr} - H(r)\frac{dG(r)}{dr}$$
$$\Rightarrow \big(1 - G(r_{max})\big)\frac{dH(r_{max})}{dr} = H(r_{max})\frac{dG(r_{max})}{dr}.$$

A simple model

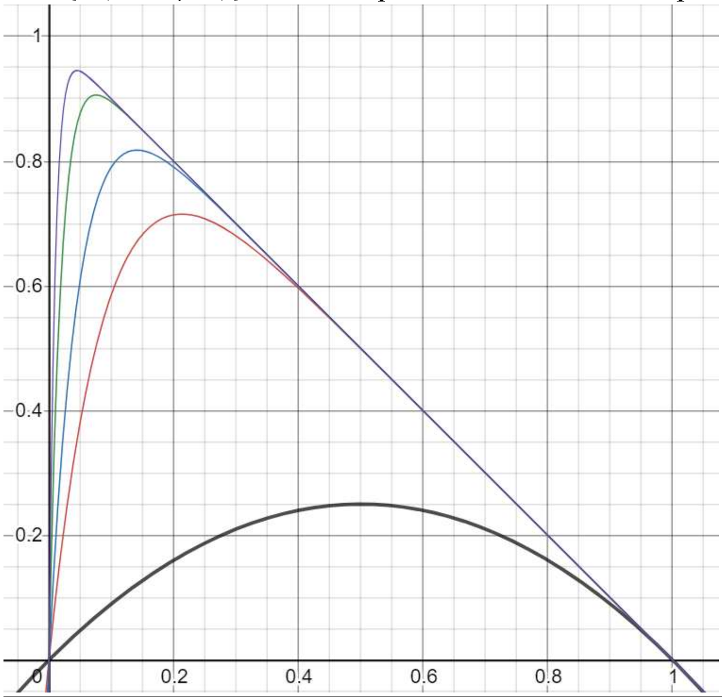
A reasonable way to formulate $G(r)$ and $H(r)$ is from a quantitative description of established controversies in patient-practitioner relationship. One such controversy is the issue of defensive medicine, where practitioners tend to overprescribe therapies and medical examinations defensively in order to minimize litigations on medical negligence. In this case, the actions by the practitioner do not depend on the absolute risk of complication, but rather the risk of at least one complication over the time period of practice. Let n be the number of relevant consultations that the practitioner expects over the perceivable period of practice, we have a model parameterized by n, where

$$G(r) = r,$$
$$H(r) = 1 - (1 - r)^n,$$
$$P(P_{-}, D_{+}; n) = (1 - r)[1 - (1 - r)^n].$$

With differentiation, we derive the maximum of this model, such that

$$\frac{d}{dr}(P_{-}, D_{+}) = (1 - r)[n(1 - r)^{n-1}] - [1 - (1 - r)^n]$$
$$= (n + 1)(1 - r)^n - 1$$
$$\Rightarrow (n + 1)(1 - r_{max})^n = 1$$
$$\Rightarrow r_{max} = 1 - \left(\frac{1}{n + 1}\right)^{\frac{1}{n}}$$
$$\Rightarrow max\{P(P_{-}, D_{+}; n)\} = \left(\frac{1}{n + 1}\right)^{\frac{1}{n}}\left[1 - \left(\frac{1}{n + 1}\right)\right].$$

Overall, we have the trend that when $n \to \infty$, $\left(\frac{1}{n+1}\right)^{\frac{1}{n}} \to 1$, such that $r_{max} \to 0$ and $max\{P(P_-, D_+; n)\} \to 1$. The plot and table below help to visualize these trends.



n	$P(P_-, D_+; n)$	$max\{P(P_-, D_+; n)\}$	r_{max}
1	$(1-r)r$	0.25	0.5
10	$(1-r)[1-(1-r)^{10}]$	0.7153	0.2132
20	$(1-r)[1-(1-r)^{20}]$	0.8179	0.1412
50	$(1-r)[1-(1-r)^{50}]$	0.9063	0.0756
100	$(1-r)[1-(1-r)^{100}]$	0.9454	0.0451

Therefore, as the practitioner becomes more risk-averse to litigation, he attempts to increase the n used for his risk analysis, such that $max\{P(P_-, D_+; n)\}$ occurs for rarer complications, and the value of that probability increases. Intuitively, for a complication so common, the practitioner will almost surely provide an intervention, and the patient would also be receptive of the intervention. Conversely, for a complication so rare, the patient would not accept any intervention, while the practitioner would also think such intervention as unnecessary. The maximum then represents the midpoint where the practitioner views the risk of litigation as substantial, when the patient considers such risk as minor.

Application to pharmacy practice

Despite the simplicity of the objective functions in the aforementioned model, we can easily identify some correspondences with what pharmacists usually encounter in clinical practice. Consider the simple case of recommendation over NSAIDs, where we tabulate the relationship between the frequency of complication and the chance of dispute for some of its side-effects.

Frequency	+	++	+++
Chance of dispute	+	+++	+
Examples	Hepatotoxicity	Risk for asthma	Allergic reactions
	Nephrotoxicity	Risk for stomach ulcer	Stomach irritation

In practice, most patients appreciate the ubiquity of allergic reactions and stomach irritation, and are usually receptive for pharmacist's advice over these issues. In contrast, precautions on risk of asthma and stomach ulcer are elusive for the patients, but essential from the pharmacist's perspective, and these are the usual areas of dispute where patients consider pharmacists to be unnecessarily cautious. Rarer side-effects such as hepatotoxicity and nephrotoxicity are usually not of much concern, to the extent that for most cases, neither the patient nor the pharmacist would raise such issues. Therefore, precautions on asthma and stomach ulcer are the midpoints of the aforementioned model where most disputes occur.

In fact, pharmacists can extend this model liberally to most other medications or diseases, use a systematic approach to recollect memories of dispute in their daily practice, and discover the risk level of complications and precautions at which most disputes ensue. In this way, pharmacists can rationally locate central areas of dispute, be prepared to tackle such issues, and apply their communication skills to resolve such disputes and prevent their escalation into customer dissatisfaction or complaints.

Conclusion

Probabilistic models have the potential to accommodate different objective functions and provide more quantitative insights on patient-pharmacist relationship. Mathematical formulations have been constructed, and a simple model has been proposed, which is reasonably consistent with experiences drawn from actual practice. Nonetheless, there are still substantial rooms of improvement to decide on objective functions that could more accurately encapsulate the nature of patient and pharmacist behavior, and thus provide a more realistic description of what commonly happens in clinical practice.