Online Appendix

Proof of Proposition 1

We need to consider 8 cases corresponding to all possible combinations of symptom $s \in \{s_1, s_2\}$ and posterior variances $Var(\theta_1|h_t) \in \{0, c\}$, $Var(\theta_2|h_t) \in \{0, c\}$. The optimal complimentary action given drug d is simply $a(h_t) = \mathbb{E}[\theta_d|h_t]$. We now turn to the optimal choice of drug. The optimal choice of drug for symptom s at history h_t depends on a triple $(s, Var(\theta_1|h_t), Var(\theta_2|h_t))$. The proof of Proposition 1 relies on the One–Shot Deviation Principle (hereafter abbreviated as OSDP) and consists of considering all 8 cases.

1. Consider cases with $(Var(\theta_1|h_t), Var(\theta_2|h_t)) = (0, 0)$.

   Lemma 1 *$d(s_1, 0, 0) = d_1$ and $d(s_2, 0, 0) = d_2$.*

   Proof. By OSDP, $d(s_1, 0, 0) = d_1$ and $d(s_2, 0, 0) = d_2$ iff $1 \geq 0$. ■

2. Consider cases with $(Var(\theta_1|h_t), Var(\theta_2|h_t)) \in \{(0, c), (c, 0)\}$.

   Lemma 2 *$d(s_1, 0, c) = d_1$ and $d(s_2, c, 0) = d_2$.*

   Proof. We prove that $d(s_1, 0, c) = d_1$ for $p_1 \in (0, 1)$. By symmetry, $d(s_2, c, 0) = d_2$ will hold. Suppose, to get a contradiction, that $d(s_1, 0, c) = d_2$. There are two cases to consider $d(s_2, 0, c) = d_2$ and $d(s_2, 0, c) = d_1$:

   - Case: $d(s_2, 0, c) = d_2$. By OSDP, the supposition $d(s_1, 0, c) = d_2$ gives
   $$-c + \delta \geq 1 + \delta(1 - p_1) - \delta c,$$
   which is equivalent to $\delta \geq \frac{1+c}{p_1+c}$. This inequality cannot be satisfied.
   - Case: $d(s_2, 0, c) = d_1$. By OSDP, the supposition $d(s_1, 0, c) = d_2$ gives
   $$-\frac{c\delta p_1}{1 - \delta p_2} + \left(\frac{\delta}{1 - \delta} - \frac{\delta p_1}{1 - \delta p_2}\right) \geq (1 - c) + \frac{\delta}{1 - \delta}.$$
   By OSDP, the supposition $d(s_1, 0, c) = d_2$ gives
   $$-c + \frac{\delta}{1 - \delta} \geq 1 - \frac{c\delta p_1}{1 - \delta p_2} + \left(\frac{\delta}{1 - \delta} - \frac{\delta p_1}{1 - \delta p_2}\right).$$
   Summing up these inequalities, we obtain $0 \geq 2$, which is false.

   ■

   Lemma 3 *$d(s_2, 0, c) = d_2$ iff $\delta \geq \frac{c-1}{c-p_1}$ (boundary between red and yellow areas), and $d(s_1, c, 0) = d_1$ iff $\delta \geq \frac{c-1}{c-p_2}$ (boundary between yellow and green areas).*

   Proof. We prove the part with $d(s_2, 0, c) = d_2$, the part with $d(s_1, c, 0) = d_1$ is obtained by replacing p_1 with p_2. By OSDP, $d(s_2, 0, c) = d_2$ iff
   $$\begin{aligned}(1 - c) + \frac{\delta}{1 - \delta} &\geq \frac{(1 - c)\delta p_2}{1 - \delta p_1} + \left(\frac{\delta}{1 - \delta} - \frac{\delta p_2}{1 - \delta p_1}\right), \\ \delta &\geq \frac{c - 1}{c - p_1}.\end{aligned}$$

   ■

3. Consider cases with $(Var(\theta_1|h_t), Var(\theta_2|h_t)) = (c, c)$. There are 3 possible continuation subcases depending on whether $\delta < \frac{c-1}{c-p_1}$, $\frac{c-1}{c-p_1} \leq \delta < \frac{c-1}{c-p_2}$, or $\delta \geq \frac{c-1}{c-p_2}$. We consider each of these subcases in turn.

(a) Consider subcase $\delta < \frac{c-1}{c-p_1}$ (red area).

Lemma 4 $d(s_2, c, c) = d_2$.

Proof. By OSDP, $d(s_2, c, c) = d_2$ iff

$$(1-c) + \frac{\delta p_2}{1-\delta} \geq -c + \frac{\delta p_1}{1-\delta},$$

which is trivially satisfied. ■

Lemma 5 $d(s_1, c, c) = 1$ *iff* $\delta \leq \frac{1}{2p_2}$ *(boundary between light and dark red areas).* $d(s_1, c, c) = d_1$ *is satisfied for all* δ *and* p_2 *iff* $c \leq 2$.

Proof. By OSDP, $d(s_1, c, c) = d_1$ iff

$$\begin{aligned}(1-c) + \frac{\delta p_1}{1-\delta} &\geq -c + \frac{\delta p_2}{1-\delta}, \\ \delta &\leq \frac{1}{2p_2}.\end{aligned}$$

Moreover, $d(s_1, c, c) = 1$ is satisfied for all δ and p_2 iff subcase $\delta < \frac{c-1}{c-p_1}$ implies $\delta \leq \frac{1}{2p_2}$, which is equivalent to

$$\frac{1}{2p_2} - \frac{c-1}{c-(1-p_2)} \geq 0$$

for all $p_2 \geq \frac{1}{2}$. By simplifying the inequality, we obtain $c \leq \frac{3p_2-1}{2p_2-1}$ for all $p_2 \geq \frac{1}{2}$, which is equivalent to $c \leq 2$. ■

(b) Consider subcase $\frac{c-1}{c-p_1} \leq \delta < \frac{c-1}{c-p_2}$ (yellow area).

Lemma 6 $d(s_2, c, c) = d_2$.

Proof. By OSDP, $d(s_2, c, c) = d_2$ iff

$$(1-c) + \frac{\delta p_2}{1-\delta} \geq -c + \left(\frac{\delta}{1-\delta} - \frac{\delta p_2}{1-\delta p_1}\right) + \frac{(1-c)\,\delta p_2}{1-\delta p_1}.$$

In the subcase $\frac{c-1}{c-p_1} \leq \delta < \frac{c-1}{c-p_2}$, $d(1, c, 0) = 2$. Therefore, conditional on $d(s_2, c, c) = d_2$, the physician is better off by prescribing $d(s_1, c, 0) = d_2$ in the future:

$$(1-c) + \frac{\delta p_2}{1-\delta} \geq (1-c) + \left(\frac{\delta}{1-\delta} - \frac{\delta p_1}{1-\delta p_2}\right) + \frac{(1-c)\,\delta p_1}{1-\delta p_2}.$$

Therefore, the initial inequality is satisfied because $\frac{\delta p_2}{1-\delta p_1} > \frac{\delta p_1}{1-\delta p_2}$ for $p_2 > \frac{1}{2}$. ■

Lemma 7 $d(s_1, c, c) = d_1$ *iff* $\frac{1-\delta p_2}{1-\delta} \geq \frac{c\delta p_2}{1-\delta p_1}$ *(boundary between light and dark yellow areas).*

Proof. By OSDP, $d(s_1, c, c) = d_1$ iff

$$\begin{aligned}1 - c + \frac{(1-c)\,\delta p_2}{1-\delta p_1} + \left(\frac{\delta}{1-\delta} - \frac{\delta p_2}{1-\delta p_1}\right) &\geq -c + \frac{\delta p_2}{1-\delta}, \\ \frac{1-\delta p_2}{1-\delta} &\geq \frac{c\delta p_2}{1-\delta p_1}.\end{aligned}$$

■

(c) Consider subcase $\delta \geq \frac{c-1}{c-p_2}$ (green area).

Lemma 8 $d(s_2, c, c) = d_2$.

Proof. By OSDP, $d(s_2, c, c) = d_2$ iff

$$\begin{aligned}(1-c) + \frac{(1-c)\,\delta p_1}{1-\delta p_2} + \left(\frac{\delta}{1-\delta} - \frac{\delta p_1}{1-\delta p_2}\right) &\geq -c + \frac{(1-c)\,\delta p_2}{1-\delta p_1} + \left(\frac{\delta}{1-\delta} - \frac{\delta p_2}{1-\delta p_1}\right), \\ 1 &\geq -c\left(\frac{\delta p_2}{1-\delta p_1} - \frac{\delta p_1}{1-\delta p_2}\right),\end{aligned}$$

which is satisfied because $\frac{\delta p_2}{1-\delta p_1} > \frac{\delta p_1}{1-\delta p_2}$ for $p_2 > \frac{1}{2}$. ■

Lemma 9 $d(s_1, c, c) = d_1$ *(no dark green area).*

Proof. By OSDP, $d(s_1, c, c) = d_1$ iff

$$\begin{aligned}1 - c + \frac{(1-c)\,\delta p_2}{1-\delta p_1} + \left(\frac{\delta}{1-\delta} - \frac{\delta p_2}{1-\delta p_1}\right) &\geq -c + \frac{(1-c)\,\delta p_1}{1-\delta p_1} + \left(\frac{\delta}{1-\delta} - \frac{\delta p_1}{1-\delta p_2}\right), \\ 1 &\geq c\left[\frac{\delta p_1}{1-\delta p_2} - \frac{\delta p_2}{1-\delta p_1}\right],\end{aligned}$$

which is satisfied because $\frac{\delta p_2}{1-\delta p_1} > \frac{\delta p_1}{1-\delta p_2}$ for $p_2 > \frac{1}{2}$. ■

Proof of Corollary 1

We compute expected concentration for each area in turn.

In light red, dark red, and dark yellow areas, expected concentration is:

$$C_r = 1.$$

In light yellow area, expected concentration is:

$$C_y = p_1\left(p_1^2 + p_2^2\right) + p_2.$$

In light green area, expected concentration is:

$$C_g = p_1^2 + p_2^2.$$

Noting that $C_r > C_y > C_g$, the left panel of Figure A.1 immediately implies that expected concentration decreases with δ.

Proof of Corollary 2

We compute expected deviation for each area in turn under fixed market shares m_d of each drug d. We use equalities $p_1 + p_2 = 1$ and $m_1 + m_2 = 1$ to express all results in terms of p_2 and m_2 only.

In light red area, expected deviation is:

$$\begin{aligned}D_{lr} &= p_1\left[(1-m_1)^2 + (0-m_2)^2\right] + p_2\left[(0-m_1)^2 + (1-m_2)^2\right] \\ &= 2\left[(1-p_2)\,m_2^2 + p_2\,(1-m_2)^2\right].\end{aligned}$$

In dark red and dark yellow areas, expected deviation is:

$$\begin{aligned}D_{dry} &= (0-m_1)^2 + (1-m_2)^2 \\ &= 2\,(1-m_2)^2.\end{aligned}$$

In light yellow area, expected deviation is:

$$\begin{aligned} D_{ly} &= p_1\left[(p_1-m_1)^2+(p_2-m_2)^2\right]+p_2\left[(0-m_1)^2+(1-m_2)^2\right] \\ &= 2(1-p_2)(p_2-m_2)^2+2p_2(1-m_2)^2. \end{aligned}$$

In light green area, expected deviation is:

$$\begin{aligned} D_g &= (p_1-m_1)^2+(p_2-m_2)^2 \\ &= 2(p_2-m_2)^2. \end{aligned}$$

It is easy to verify that $D_{lr} > D_{dry}$ if $m_2 \geq p_2$ and $D_{dry} \geq D_{ly} \geq D_g$ iff $m_2 \leq \frac{1+p_2}{2}$. Combining these observations, the left panel of Figure A.1 immediately implies that expected deviation decreases with δ if $m_2 \in \left[p_2, \frac{1+p_2}{2}\right]$. Finally we note that if the market share m_2 of drug 2 is generated by physicians who may have different δ but otherwise are identical, then $m_2 \geq p_2$ always holds and $m_2 \leq \frac{1+p_2}{2}$ holds if the share of physicians in the dark areas is less than a half.