Online Appendix to Çakıcı and Mills: *On the Role of Teletriage in Healthcare Demand Management.*

EC.1. Proofs of analytical results

Proof of Lemma 1 Let C_t be the event that the patient was in state C at epoch t and let R_t be the event that the patient recovered after epoch t. Then, a patient with belief $b = \Pr\{C_t\}$ who does not recover should update her belief to $\Pr\{C_{t+1}|\neg R_t\}$. First:

$$\Pr\{C_t|\neg R_t\} = \frac{\Pr\{C_t, \neg R_t\}}{\Pr\{\neg R_t\}} = \frac{\Pr\{C_t\}}{\Pr\{\neg R_t\}} = \frac{\Pr\{C_t\}}{\Pr\{\neg R_t|C_t\}\Pr\{C_t\} + \Pr\{\neg R_t|\neg C_t\}\Pr\{\neg C_t\}} = \frac{b}{b + (1-p_{iR})(1-b)}$$

Subsequently,

$$\begin{aligned} \Pr\{C_{t+1}|\neg R_t\} &= \Pr\{C_{t+1}|C_t, \neg R_t\}\Pr\{C_t|\neg R_t\} + \Pr\{C_{t+1}|\neg C_t, \neg R_t\}\Pr\{\neg C_t|\neg R_t\} \\ &= 1\frac{b}{b+(1-p_{iR})(1-b)} + \frac{p_{iW}}{1-p_{iR}}\left(1 - \frac{b}{b+(1-p_{iR})(1-b)}\right) = \frac{b + p_{iW}(1-b)}{b+(1-p_{iR})(1-b)} \end{aligned} \quad \text{(EC.1)}$$

Subtracting b from (EC.1) yields $\frac{p_{iW}(1-b)+p_{iR}(b-b^2)}{b+(1-p_{iR})(1-b)}$, which is strictly positive when $b < 1$ and zero when $b = 1$. Therefore, not recovering always increases the patient's belief about the probability she is critical (except in the trivial case when her belief is equal to one □

Proof of Proposition 1 Note that teletriage is informative if $\Pr(C|PC) > b$ and $\Pr(C|PS) < b$, uninformative if $\Pr(C|PC) = b$ or $\Pr(C|PS) = b$, and worse than guessing if $\Pr(C|PC) < b$ or $\Pr(C|PS) > b$. Below we analyze these cases.

First, $\Pr(C|PC) - b = \dfrac{(1-\alpha_i)b}{(1-\alpha_i)b + \beta_i(1-b)} - b = \dfrac{(1-\alpha_i-\beta_i)b(1-b)}{(1-\alpha_i)b+\beta_i(1-b)}$. $\Pr(C|PC) - b$ shows that calling teletriage and getting predicted critical is informative if $0 < b < 1$ and $\alpha_i + \beta_i < 1$, uninformative if $b = 0$ and $\beta_i \neq 0$ or $b = 1$ and $\alpha_i \neq 1$ or $\alpha_i + \beta_i = 1$ and $\alpha_i \neq 1$, and worse than guessing otherwise. Second, $\Pr(C|PS) - b = \dfrac{\alpha_i b}{\alpha_i b + (1-\beta_i)(1-b)} - b = \dfrac{b(1-b)(\alpha_i+\beta_i-1)}{\alpha_i b + (1-\beta_i)(1-b)}$.

$\Pr(C|PS) - b$ shows that calling teletriage and geting predicted sick is informative if $0 < b < 1$ and $\alpha_i + \beta_i < 1$, uninformative if $b = 0$ and $\beta_i \neq 1$ or $b = 1$ and $\alpha_i \neq 0$ or $\alpha_i + \beta_i = 1$ and $\alpha_i \neq 0$, and worse than guessing otherwise. □

Proof of Proposition 2 In the statement of the proposition, we defined $\underline{b}_0 = \frac{\beta b_0 + \frac{c_T}{c_P}(1-b_0)}{\beta b_0 + (1-\alpha)(1-b_0)}$ and $\bar{b}_0 = \frac{(1-\beta)b_0 - \frac{c_T}{c_P}(1-b_0)}{(1-\beta)b_0+\alpha(1-b_0)}$. Now further define $\underline{\underline{b}}_0 = \frac{\beta b_0}{\beta b_0 + (1-\alpha)(1-b_0)}$ and $\bar{\bar{b}}_0 = \frac{(1-\beta)b_0}{(1-\beta)b_0+\alpha(1-b_0)}$, and note that $\underline{\underline{b}}_0 \leq \underline{b}_0$ and $\bar{b}_0 \leq \bar{\bar{b}}_0$. We claim that when $\underline{b}_0 < \bar{b}_0$, the patients with beliefs between $\underline{b}_0$ and $\bar{b}_0$ call teletriage, while those lower than $\underline{b}_0$ go to the PCP and those greater than $\bar{b}_0$ go to the ED. We now prove this statement by considering three different ranges defined by these points.

- Beliefs at least $\bar{\bar{b}}_0$. In this case, starting with $b \geq \bar{\bar{b}}_0$ and substituting the expresion for $\bar{\bar{b}}_0$ yields $\frac{\alpha b}{\alpha b + (1-\beta)(1-b)} \geq b_0$. The left hand side of the this expression is b_{PS}. Moreover, we know that $b_{PC} \geq b \geq b_{PS}$ because we assumed teletriage was informative. Thus, both b_{PS} and b_{PC} are at least b_0, so a patient with belief b would go to the ED following a teletriage call regardless of whether she is predicted sick or critical. Hence, her cost for calling teletriage is $c_T + c_E$, which is at least as large as c_E (which is itself at most $c_P + bc_E$ because $b \geq b_0$). We conclude that a patient with beliefs in this range would go to the ED.

- For beliefs at most $\underline{\underline{b}}_0$, the steps are analogous (we omit them for space reasons).
- Beliefs larger than $\underline{\underline{b}}_0$ and smaller than $\bar{\bar{b}}_0$: in this range, we have $b_{PS} \le b_0 \le b_{PC}$. Hence, a patient calling teletriage with a belief in this range would go to the PCP when predicted sick and to the ED when predicted critical. Applying this to (11), we have $\tilde{V}_0(b) = \min\{c_E, \quad c_P + bc_E, \quad c_T + (\alpha b + (1-\beta)(1-b))(c_P + b_{PS}c_E) + ((1-\alpha)b + \beta(1-b))c_E\}$. From this expression, we solve to determine that the patient prefers teletriage to the ED if and only if $c_T + (\alpha b + (1-\beta)(1-b))(c_P + b_{PS}c_E) + ((1-\alpha)b + \beta(1-b))c_E < c_E$. Solving for b yields $b < \frac{(1-\beta)b_0 - \frac{c_T}{c_P}(1-b_0)}{(1-\beta)b_0 + \alpha(1-b_0)}$, the right hand side of which is $\bar{b}_0$. Similarly, the patient prefers teletriage to the PCP when $c_T + (\alpha b + (1-\beta)(1-b))(c_P + b_{PS}c_E) + ((1-\alpha)b + \beta(1-b))c_E < c_P + b_{PS}c_E$, which is true if and only if $b > \underline{b}_0$. Hence, the patient prefers teletriage to the other options if and only if her belief is greater than $\underline{b}_0$ and less than $\bar{b}_0$, which concludes the proof for the case where $\underline{b}_0 < \bar{b}_0$. For the remaining case where $\underline{b}_0 \ge \bar{b}_0$, no patient will call teletriage because at least one of the providers is preferred to teletriage at every belief.

Proof of Proposition 3. First, we prove (15). We have $\pi^{ED} - \tilde{\pi}^{ED} > 0$ if and only if $\int_l^{b_0} bf(b)db + \int_{b_0}^u f(b)db > \int_l^u (b + \beta(1-b))f(b)db$. Simplifying and solving this expression leads to $\frac{u - \frac{u^2}{2} - b_0 + \frac{b_0^2}{2}}{u - l - \left(\frac{u^2}{2} + \frac{l^2}{2}\right)} > \beta$, and rearranging the terms above yields (15). The proof of (16) is analogous starting from $\pi^{DD} - \tilde{\pi}^{DD} > 0$. □

Proof of Proposition 4. In the statement of the proposition, we defined $\underline{b}_1 = \frac{\beta b_1 + \frac{c_T}{h + c_P}(1-b_1)}{\beta b_1 + (1-\alpha)(1-b_1)}$ and $\bar{b}_1 = \frac{(1-\beta)b_1 - \frac{c_T}{h+c_P}(1-b_1)}{(1-\beta)b_1 + \alpha(1-b_1)}$. Now further define $\underline{\underline{b}}_1 = \frac{\beta b_1}{\beta b_1 + (1-\alpha)(1-b_1)}$ and $\bar{\bar{b}}_1 = \frac{(1-\beta)b_1}{(1-\beta)b_1 + \alpha(1-b_1)}$. and note that $\underline{\underline{b}}_1 \le \underline{b}_1$ and $\bar{b}_1 \le \bar{\bar{b}}_1$. We claim that when $\underline{b}_1 < \bar{b}_1$, the patients with beliefs between $\underline{b}_1$ and $\bar{b}_1$ call teletriage, while those lower than $\underline{b}_1$ go to the PCP and those greater than $\bar{b}_1$ go to the ED.

This proof follows the same steps as the proof of Proposition 2 by considering three different ranges defined by these points. Although we still define each case clearly, for the sake of brevity we skip a few of the algebraic steps that are the same as in the proof of Proposition 2.

- Beliefs at least $\bar{\bar{b}}_1$. In this case, algebraic simplification of the expression $b \ge \bar{\bar{b}}_1$ yields $b_{PS} \ge b_1$, and hence a patient with this belief would go to the ED following a teletriage call regardless of whether she is predicted sick or critical. Hence, her cost for calling teletriage is $c_T + c_E$, which is at least as large as c_E (which is itself at most $h + c_P + (b + (1-b)p_W)c_E$ because $b \ge b_1$). We conclude that a patient with beliefs in this range would go to the ED.
- Beliefs at most $\underline{\underline{b}}_1$. In this case, $b_{PC} \le b_1$ and hence using similar logic, a patient with beliefs in this range would go to the PCP.
- Beliefs larger than $\underline{\underline{b}}_1$ and smaller than $\bar{\bar{b}}_1$: in this range, we have $b_{PS} \le b_1 \le b_{PC}$. Hence, a patient calling teletriage with a belief in this range would go to the PCP when predicted sick and to the ED when predicted critical. Applying this to (11), we have

$$\tilde{V}_0(b) = \min\{c_E, \quad h + c_P + (b + (1-b)p_W)c_E,$$
$$c_T + (\alpha b + (1-\beta)(1-b))(h + c_P + (b_{PS} + (1-b_{PS})p_W)c_E) + ((1-\alpha)b + \beta(1-b))c_E\}.$$

From this expression, we solve to determine that the patient prefers teletriage to the ED if and only if

$$c_T + (\alpha b + (1-\beta)(1-b))(h + c_P + b_{PS}c_E + (1-b_{PS})p_W c_E) + ((1-\alpha)b + \beta(1-b))c_E < c_E$$
$$c_T + (\alpha b + (1-\beta)(1-b))(c_P + h) + \alpha b c_E + (1-\beta)(1-b)p_W c_E + ((1-\alpha)b + \beta(1-b))c_E < c_E$$

Solving for b yields $b < \frac{(1-\beta)(c_E(1-p_W)-h-c_P)-c_T}{(\alpha-(1-\beta))(h+c_P)+(1-\beta)(1-p_W)c_E}$, and dividing top and bottom by $c_E(1-p_W)$ and substituting the definition of b_1 yields $b < \frac{(1-\beta)b_1 - \frac{c_T}{h+c_P}(1-b_1)}{(1-\beta)b_1+\alpha(1-b_1)}$, the right-hand-side of which is $\bar{b}_1$. Similarly, the patient prefers teletriage to the PCP when $c_T + (\alpha b + (1-\beta)(1-b))(h+c_P+(b_{PS}+(1-b_{PS})p_W)c_E) + ((1-\alpha)b+\beta(1-b))c_E < h+c_P+(b+(1-b)p_W)c_E$, which after some simplification is true if and only if $b > \underline{b}_1$.

For the remaining case where $\underline{b}_0 \geq \bar{b}_0$, no patient will call teletriage because at least one of the providers is preferred to teletriage at every belief. □

Proof of Proposition 5. For the traditional-access case, we have the following:

$$\pi^{ED}(b) = \begin{cases} 1, & b \geq b_1 \\ b+(1-b)p_W, & b < b_1 \end{cases} \qquad \tilde{\pi}^{ED}(b) = \begin{cases} 1, & b \geq \bar{b}_1 \\ b+\beta(1-b)+(1-\beta)(1-b)p_W, & \underline{b}_1 \leq b < \bar{b}_1 \\ b+(1-b)p_W, & b < \underline{b}_1 \end{cases}$$

$$\pi^{PCP}(b) = \begin{cases} 0, & b \geq b_1 \\ b+(1-b)(1-p_R), & b < b_1 \end{cases} \quad \text{and} \quad \tilde{\pi}^{PCP}(b) = \begin{cases} 0, & b \geq \bar{b}_1 \\ \alpha b+(1-\beta)(1-b)(1-p_R), & \underline{b}_1 \leq b < \bar{b}_1 \\ b+(1-b)(1-p_R), & b < \underline{b}_1 \end{cases}$$

$$\pi^{DD}(b) = \begin{cases} 0, & b \geq b_1 \\ b+(1-b)p_W, & b < b_1 \end{cases} \qquad \tilde{\pi}^{DD}(b) = \begin{cases} 0, & b \geq \bar{b}_1 \\ \alpha b+(1-\beta)(1-b)p_W, & \underline{b}_1 \leq b < \bar{b}_1 \\ b+(1-b)p_W, & b < \underline{b}_1 \end{cases}$$

Compared to the open-access case, b_1 replaces b_0, while additional terms account for the fact that the patient may worsen before visiting the PCP or recover and skip the PCP appointment, whether they use teletriage or not. Once making these changes, the definition of redundancy remains similar:

$$\tilde{\pi}^{R}(b) = \begin{cases} 0, & b \geq \bar{b}_1 \\ \tilde{\pi}^{ED}(b), & b_1 \leq b < \bar{b}_1 \\ \tilde{\pi}^{PCP}(b), & \underline{b}_1 \leq b < b_1 \\ 0, & b < \underline{b}_1. \end{cases}$$

First, we prove (18). We have $\pi^{ED} - \tilde{\pi}^{ED} > 0$ if and only if $\int_l^{b_1}(b+(1-b)p_W)f(b)db + \int_{b_1}^u f(b)db > \int_l^u (b+\beta(1-b)+(1-\beta)(1-b)p_W)f(b)db$. Solving these integrals and simplifying yields $(1-p_W)\left(\frac{b_1^2}{2}-\frac{u^2}{2}\right) + (1-p_W)(u-b_1) > \beta(1-p_W)\left(u-\frac{u_1^2}{2}-\left(l-\frac{l^2}{2}\right)\right)$. Simplifying the above inequality for β yields (18).

The proof of (19) is analogous starting from $\pi^{DD} - \tilde{\pi}^{DD} > 0$. □

Proof of Proposition 6. We have $b_0 - b_1 = 1 - \frac{c_P}{c_E} - \left(1 - \frac{h+c_P}{c_E(1-p_W)}\right) = \frac{h+c_P p_W}{c_E(1-p_W)} > 0$. □

Proof of Proposition 7. We have $\bar{b}_1 - \bar{b}_0 = -\frac{\frac{c_T p_W(1-\beta)}{c_E(1-p_W)} + \frac{(h+c_P p_W)\alpha(1-\beta)}{c_E(1-p_W)} + \frac{c_T h(1-\alpha-\beta)}{(c_E)^2(1-p_W)}}{(b_0(1-\beta)+\alpha(1-b_0))(b_1(1-\beta)+\alpha(1-b_1)))} < 0$, since $\alpha+\beta<1$ when teletriage is informative, and

$$\begin{aligned}
\underline{b}_1 - \underline{b}_0 > 0 &\Leftrightarrow \frac{\beta b_1 + \frac{c_T}{h+c_P}(1-b_1)}{\beta b_1+(1-\alpha)(1-b_1)} - \frac{\beta b_1 + \frac{c_T}{c_P}(1-b_0)}{\beta b_0+(1-\alpha)(1-b_0)} > 0 \\
&= \frac{-\beta(1-\alpha)c_P(h+c_P)(b_0-b_1)+\beta c_T(c_P(b_0-b_1)-b_1 h(1-b_0))-(1-\alpha)(1-b_0)(1-b_1)c_T h}{c_P(h+c_P)(\beta b_1+(1-\alpha)(1-b_1))(\beta b_0+(1-\alpha)(1-b_0))} > 0 \\
&\Leftrightarrow \beta(b_0-b_1)c_P(c_T-(1-\alpha)(h+c_P)) - (1-b_0)c_T h((1-\alpha)-(1-\alpha-\beta)b_1) > 0 \\
&\Leftrightarrow \beta\frac{h+c_P p_W}{c_E(1-p_W)}c_P(c_T-(1-\alpha)(h+c_P)) - \frac{c_P c_T h}{c_E}\left((1-\alpha)-(1-\alpha-\beta)\left(1-\frac{h+c_P}{c_E(1-p_W)}\right)\right) > 0 \\
&\Leftrightarrow h c_P(h+c_P)(c_T(1-\alpha-\beta)-(1-\alpha)\beta c_E) > p_W(\beta c_P c_E(h+c_P)(c_T-(1-\alpha)c_P)) \\
&\Leftrightarrow p_W(c_T-(1-\alpha)c_P)) > \frac{h}{\beta c_E}(c_T(1-\alpha-\beta)+(1-\alpha)\beta c_E)) \qquad \text{(EC.2)}
\end{aligned}$$

Since $p_W \geq 0$, in equation (EC.2) $\alpha > 1 - \frac{c_T}{c_P}$ must hold. Then $p_W > \frac{h}{\beta c_E} \frac{c_T(1-\alpha-\beta)+\beta(1-\alpha)c_E}{c_T-(1-\alpha)c_P}$. $\square$

Proof of Corollary 1 Note that since $c_P > 0$, $b_0 + b_1 < 2$ holds. Then,

$$\beta^1 - \beta^0 = \frac{u - \frac{u^2}{2} - \left(b_1 - \frac{b_1^2}{2}\right)}{u - \frac{u^2}{2} - \left(l - \frac{l^2}{2}\right)} - \frac{u - \frac{u^2}{2} - \left(b_0 - \frac{b_0^2}{2}\right)}{u - \frac{u^2}{2} - \left(l - \frac{l^2}{2}\right)} = \frac{b_0 - \frac{b_0^2}{2} - \left(b_1 - \frac{b_1^2}{2}\right)}{u - \frac{u^2}{2} - \left(l - \frac{l^2}{2}\right)} = \frac{\frac{(b_0-b_1)(2-b_0-b_1)}{2}}{u - \frac{u^2}{2} - \left(l - \frac{l^2}{2}\right)} > 0.$$

$\square$

Proof of Corollary 2 We have

$$\begin{aligned}
\alpha^1 - \alpha^0 > 0 &\Leftrightarrow \frac{b_1^2 - l^2}{u^2 - l^2} - 2p_W \frac{u - \frac{u^2}{2} - \left(b_1 - \frac{b_1^2}{2}\right)}{u^2 - l^2} + 2\beta p_W \frac{u - \frac{u^2}{2} - \left(l - \frac{l^2}{2}\right)}{u^2 - l^2} - \frac{b_0^2 - l^2}{u^2 - l^2} > 0 \\
&\Leftrightarrow \frac{b_1^2 - b_0^2}{u^2 - l^2} - 2p_W \frac{u - \frac{u^2}{2} - \left(b_1 - \frac{b_1^2}{2}\right)}{u^2 - l^2} + 2\beta p_W \frac{u - \frac{u^2}{2} - \left(l - \frac{l^2}{2}\right)}{u^2 - l^2} > 0 \\
&\Leftrightarrow 2p_W \left(\beta \left(u - \frac{u^2}{2} - \left(l - \frac{l^2}{2}\right)\right) - \left(u - \frac{u^2}{2} - \left(b_1 - \frac{b_1^2}{2}\right)\right)\right) > b_0^2 - b_1^2 \\
&\Leftrightarrow 2p_W(\beta - \beta^1) > \frac{b_0^2 - b_1^2}{u - \frac{u^2}{2} - \left(l - \frac{l^2}{2}\right)}. \qquad \text{(EC.3)}
\end{aligned}$$

Note that (EC.3) can only hold when $p_W > 0$ and $\beta > \beta^1$. In this case, we have $p_W > \frac{b_0^2 - b_1^2}{2(\beta-\beta^1)\left(u - \frac{u^2}{2} - \left(l - \frac{l^2}{2}\right)\right)}$.
$\square$

Proof of Proposition 8. We will do the proof for the traditional model and the steps are the same for the open-access model. The proof is by induction. Let $V_n(b)$ be the value function when the patient can wait at most n times before making a decision. Then $V_0(b)$ is given by (2), which is the minimum of a constant and an increasing linear function of b; therefore $V_0(b)$ is non-decreasing and concave.

The inductive step is as follows. For $n \geq 1$, we have $V_n(b) = \min\{c_E, h + c_P + (b + (1-b)p_W)c_E, h + (1 - (1 - b)p_R)V_{n-1}(b^+)\}$. Now, suppose that V_{n-1} is non-decreasing and concave. V_n is the minimum of three functions. The first is constant, and the second is linear increasing. Therefore, it is sufficient to show that the third is non-decreasing concave, since the minimum of nondecreasing concave functions is also nondecreasing concave. Thus, the remainder of the induction hinges on showing that $h + (1 - (1 - b)p_R)V_{n-1}(b^+)$ is non-decreasing concave. Both $(1 - (1 - b)p_R)$ and $V_{n-1}(b^+)$ are increasing functions of b, so their product is also increasing. By substituting the definition of b^+, this function can be written as $h + (1 - (1 - b)p_R)V_{n-1}\left(\frac{b+p_W(1-b)}{b+(1-p_R)(1-b)}\right)$. To show concavity, we apply the following Lemma:

LEMMA EC.1. *Linear-fractional transformations in the form $g(x) = (cx + d)f((ax + b)/(cx + d))$ preserve concavity, i.e., if $f(x)$ is concave then so is $g(x)$.*

The lemma follows from Boyd and Vandenberghe (2004, p.90), who show that linear-fractional transformations preserve convexity, i.e., if $f(x)$ is convex then so is $g(x)$. Multiplying by -1 on both sides, we similarly conclude that if $-f(x)$ is convex (i.e., $f(x)$ is concave), $-g(x)$ will also be convex (i.e., $g(x)$ is concave).

When teletriage is available the proof is very similar with the addition of the third term. Again, we will do the proof for traditional-access model and steps are the same for open-access model. Let $\tilde{V}_n(b)$ be the disutility function when the patient can wait at most n times before making a decision. Then, $\tilde{V}_0(b)$ is given by (12) where $V_0(b_{PS}) = h + c_P + \left(p_W + \frac{\alpha b}{\alpha b+(1-\beta)(1-b)}(1 - p_W)\right)c_E$ and $V_0(b_{PC}) = c_E$. Thus, $\tilde{V}_0(b) =$

$\min\{c_E, h+c_P+(b+(1-b)p_W)c_E, c_T+(\alpha b+(1-\beta)(1-b))\left(h+c_P+\left(p_W+\frac{\alpha b}{\alpha b+(1-\beta)(1-b)}(1-p_W)\right)c_E\right)+((1-\alpha)b+(1-\beta)(1-b))c_E\}$. So $\tilde{V}_0(b)$ equals to the minimum of the first two terms in $V_0(b)$ and the constant plus linear and increasing function of b; therefore $\tilde{V}_0(b)$ is non-decreasing and concave. Now, for $n\geq 1$, we have $\tilde{V}_n(b)=\min\{c_E, h+c_P+(b+(1-b)p_W)c_E, c_T+(\alpha b+(1-\beta)(1-b))V_n(b_{PS})+((1-\alpha)b+(1-\beta)(1-b))V_n(b_{PC}), h+(1-(1-b)p_R)\tilde{V}_{n-1}(b^+)\}=\min\{c_E, h+c_P+(b+(1-b)p_W)c_E, c_T+(\alpha b+(1-\beta)(1-b))\left(h+c_P+\left(p_W+\frac{\alpha b}{\alpha b+(1-\beta)(1-b)}(1-p_W)\right)c_E\right)+((1-\alpha)b+(1-\beta)(1-b))c_E, h+(1-(1-b)p_R)\tilde{V}_{n-1}(b^+)\}$. Assume that $\tilde{V}_{n-1}(b^+)$ is non-decreasing and concave. $\tilde{V}_n$ is the minimum of four functions where the first, second and third terms are the same as in $\tilde{V}_0(b)$. Hence, it is sufficient to show that $h+(1-(1-b)p_R)\tilde{V}_{n-1}(b^+)$ is non-decreasing and concave. This is surely true following the same arguments used in the proof of the case without teletriage. The proof that $\tilde{V}(b)\leq V(b)$ is trivial as in $\tilde{V}(b)$ the patient has one additional option over which to minimize. □

Proof of Corollary 3 $V(b)$ is a non-decreasing concave function, ED disutility is a constant, and PCP disutility is a linear increasing function. Since $V(b)$ is the minimum of these plus waiting, it is clear that for large enough b, the ED disutility should be the minimum, and that the PCP disutility can be the minimum only over one interval (since a linear increasing function can intersect a non-decreasing concave function at most twice). Therefore, at most the following five cases exist: (1) Wait — ED, (2) Wait — PCP — Wait — ED, (3) PCP — Wait — ED, (4) PCP — ED, (5) Wait — PCP — ED. Figure 3 shows examples of cases 1-4. To prove the Corollary, it only remains to show that case 5 cannot happen. Observe that the PCP and ED functions intersect at $b=1-c_E/c_P$. If waiting is not optimal at this belief (which would be implied by the structure of case 5), then the value of waiting at that point in time must be larger or equal to c_E. Solving this inequality yields $p_R\leq h/c_P$. On the other hand, for waiting to be optimal for $b=0$, the value of waiting must be *lower* than the value of going to the PCP with a belief of zero. Solving this inequality yields $p_R\geq\frac{h+p_Wc_E}{c_P+p_Wc_E}$. These two inequalities on p_R cannot be simultaneously true unless $p_W=0$, in which case they both hold with equality, and the patient is indifferent between a solution with the structure of case 5 and a solution with the structure of case 1. Hence, case 5 never occurs as the structure of the optimal solution (at least, not uniquely). □

Proof of Corollary 4 Suppose that teletriage is optimal for beliefs u and w, with $u<w$. Then we will show that it is also optimal for all beliefs $b\in(u,w)$. Two distinct non-decreasing concave functions can intersect at most twice. It is trivial to show that calling teletriage is larger than or equal to c_E when $b=1$, and hence the fourth part of (13) (which is non-decreasing and concave) must intersect the minimum of the other three (which is also non-decreasing and concave) at some point greater than w but at most one. Call this point z. Therefore, there are only two possibilities. The first is that the value of teletriage does not intersect the minimum of the other three anywhere else in $[0,1]$, and hence teletriage is optimal for all beliefs between u and w. The second is that the value of teletriage intersects the minimum of the other three at some other point $y\in[0,1]$. If this is the case, then surely $(u,w)\subseteq(y,z)$ because the two functions can intersect at most twice, and hence teletriage is optimal for all beliefs between u and w. □

Proof of Proposition 9 To show that Proposition 8, Corollary 3, and Corollary 4 generalize to the case where holding cost is any non-decreasing concave function of b, we simply need to generalize Proposition

8 as the Corollaries follow directly. In the Proof of Proposition 8, the structure of both the initial step and the inductive step involves showing that each element in the minimum was non-decreasing concave; it follows that the function is also non-decreasing concave because taking the pointwise minimum preserves the non-decreasing concave property. In each step of the proof, we implicitly used the fact that adding a constant h to a non-decreasing concave function preserves the non-decreasing concave property. Changing h to a non-decreasing concave function $h(b)$ preserves the non-decreasing concave property because the sum of two non-decreasing concave functions is also non-decreasing concave. □

References

Boyd S, Vandenberghe L (2004) *Convex optimization* (Cambridge university press).

EC.2. Additional numerical analysis

In this section, we present tables for the top 20 and bottom 20 of illnesses by ED treatment cost. We omit the results for $h=1.5$ and $h=2.5$ for space reasons; these are available from the corresponding author.

Table EC.1 Costs with and without TT with free TT and open-access PCP (20 highest-cost patients).

Parameters				Actions without TT				Actions with TT							% Change		Cost without TT			Cost with TT			Percent Change		
c_E	c_P	c_T	h	π^{ED}	π^{PCP}	π^{DD}	π^{Wait}	$\tilde{\pi}^{TT}$	$\tilde{\pi}^{R}$	$\frac{\tilde{\pi}^{R}}{\tilde{\pi}^{TT}}$	$\tilde{\pi}^{ED}$	$\tilde{\pi}^{PCP}$	$\tilde{\pi}^{DD}$	$\tilde{\pi}^{Wait}$	ED	DD	Payer	Patient	Total	Payer	Patient	Total	Payer	Patient	Total
100	25	0.0	1.0	0.21	0.94	0.14	0.00	0.16	0.10	0.64	0.21	0.89	0.10	0.00	1.8	-30	787.93	44.07	832.00	796.64	43.28	839.92	1.1	-1.8	1.0
100	25	0.0	2.0	0.21	0.94	0.14	0.00	0.16	0.10	0.63	0.21	0.89	0.10	0.00	1.8	-30	787.93	44.07	832.00	796.64	43.28	839.92	1.1	-1.8	1.0
150	25	0.0	1.0	0.21	0.94	0.14	0.01	0.16	0.10	0.61	0.21	0.89	0.10	0.00	1.8	-30	787.87	44.07	831.94	796.67	43.28	839.95	1.1	-1.8	1.0
150	25	0.0	2.0	0.20	0.95	0.16	0.00	0.12	0.07	0.60	0.21	0.91	0.12	0.00	1.0	-23	770.52	54.28	824.80	773.98	53.63	827.61	0.4	-1.2	0.3
200	25	0.0	1.0	0.20	0.96	0.16	0.00	0.09	0.06	0.60	0.20	0.93	0.13	0.00	0.7	-20	758.43	64.40	822.83	759.70	63.83	823.53	0.2	-0.9	0.1
200	25	0.0	2.0	0.20	0.95	0.16	0.00	0.12	0.07	0.59	0.21	0.91	0.12	0.00	1.0	-24	770.49	54.28	824.77	773.98	53.62	827.60	0.5	-1.2	0.3
200	50	0.0	1.0	0.21	0.94	0.14	0.01	0.16	0.10	0.61	0.21	0.89	0.10	0.00	1.8	-30	743.81	88.14	831.95	753.44	86.55	839.99	1.3	-1.8	1.0
200	50	0.0	2.0	0.21	0.94	0.14	0.01	0.16	0.10	0.59	0.21	0.89	0.10	0.00	1.8	-30	743.80	88.13	831.93	753.50	86.54	840.04	1.3	-1.8	1.0
300	50	0.0	1.0	0.20	0.96	0.16	0.00	0.10	0.06	0.58	0.20	0.93	0.13	0.00	0.7	-20	694.01	128.80	822.81	695.87	127.66	823.53	0.3	-0.9	0.1
300	50	0.0	2.0	0.20	0.95	0.16	0.01	0.12	0.07	0.57	0.21	0.91	0.12	0.00	1.0	-24	716.19	108.55	824.74	720.39	107.24	827.63	0.6	-1.2	0.4
400	50	0.0	1.0	0.21	0.94	0.14	0.02	0.17	0.10	0.56	0.21	0.89	0.10	0.00	1.8	-30	743.81	88.11	831.92	753.63	86.51	840.14	1.3	-1.8	1.0
400	50	0.0	2.0	0.20	0.95	0.16	0.01	0.12	0.07	0.58	0.21	0.91	0.12	0.00	1.0	-24	661.93	162.83	824.76	666.78	160.86	827.64	0.7	-1.2	0.3
300	75	0.0	1.0	0.20	0.95	0.16	0.01	0.12	0.07	0.54	0.21	0.91	0.12	0.00	1.0	-24	716.15	108.54	824.69	720.43	107.22	827.65	0.6	-1.2	0.4
300	75	0.0	2.0	0.20	0.96	0.16	0.00	0.10	0.06	0.56	0.20	0.93	0.13	0.00	0.7	-20	629.59	193.19	822.78	632.06	191.48	823.54	0.4	-0.9	0.1
450	75	0.0	1.0	0.20	0.95	0.15	0.02	0.14	0.08	0.55	0.20	0.91	0.11	0.00	1.0	-27	603.84	161.36	765.20	607.48	159.13	766.61	0.6	-1.4	0.2
450	75	0.0	2.0	0.20	0.96	0.16	0.01	0.10	0.05	0.53	0.20	0.92	0.13	0.00	0.7	-20	693.92	128.79	822.71	695.89	127.63	823.52	0.3	-0.9	0.1
600	75	0.0	1.0	0.20	0.96	0.16	0.01	0.12	0.06	0.54	0.20	0.92	0.12	0.00	0.7	-23	572.10	191.29	763.39	574.26	189.31	763.57	0.4	-1.0	0.0
600	75	0.0	2.0	0.21	0.93	0.14	0.02	0.18	0.09	0.54	0.21	0.89	0.10	0.00	1.8	-31	699.85	132.13	831.98	710.63	129.71	840.34	1.5	-1.8	1.0

Table EC.2 Costs with and without TT with optimal TT copay and open-access PCP (20% highest-cost patients).

Parameters				Actions without TT				Actions with TT							% Change		Cost without TT			Cost with TT			Percent Change		
c_E	c_P	c_T	h	π^{ED}	π^{PCP}	π^{DD}	π^{Wait}	$\tilde{\pi}^{TT}$	$\tilde{\pi}^{R}$	$\frac{\tilde{\pi}^{R}}{\tilde{\pi}^{TT}}$	$\tilde{\pi}^{ED}$	$\tilde{\pi}^{PCP}$	$\tilde{\pi}^{DD}$	$\tilde{\pi}^{Wait}$	ED	DD	Payer	Patient	Total	Payer	Patient	Total	Payer	Patient	Total
100	25	5.9	1.0	0.21	0.94	0.14	0.00	0.06	0.03	0.55	0.21	0.92	0.12	0.00	-0.1	-15	787.93	44.07	832.00	785.40	43.86	829.26	-0.3	-0.5	-0.3
100	25	5.7	2.0	0.21	0.94	0.14	0.00	0.06	0.03	0.55	0.21	0.92	0.12	0.00	-0.1	-14	787.93	44.07	832.00	785.33	43.87	829.20	-0.3	-0.5	-0.3
150	25	4.7	1.0	0.21	0.94	0.14	0.01	0.06	0.03	0.49	0.21	0.92	0.12	0.00	-0.2	-14	787.87	44.07	831.94	785.24	43.88	829.12	-0.3	-0.4	-0.3
150	25	4.9	2.0	0.20	0.95	0.16	0.00	0.07	0.04	0.53	0.20	0.93	0.13	0.00	0.3	-16	770.52	54.28	824.80	769.68	53.98	823.66	-0.1	-0.6	-0.1
200	25	3.7	1.0	0.20	0.96	0.16	0.00	0.07	0.04	0.56	0.20	0.93	0.13	0.00	0.4	-17	758.43	64.40	822.83	758.21	63.99	822.20	0.0	-0.6	-0.1
200	25	1.9	2.0	0.20	0.95	0.16	0.00	0.06	0.03	0.48	0.20	0.93	0.13	0.00	0.2	-14	770.49	54.28	824.77	769.24	54.03	823.27	-0.2	-0.5	-0.2
200	50	12.0	1.0	0.21	0.94	0.14	0.01	0.05	0.03	0.48	0.21	0.92	0.13	0.00	-0.2	-13	743.81	88.14	831.95	741.25	87.78	829.03	-0.3	-0.4	-0.4
200	50	12.3	2.0	0.21	0.94	0.14	0.01	0.05	0.02	0.45	0.21	0.92	0.13	0.00	-0.2	-13	743.80	88.13	831.93	741.24	87.78	829.02	-0.3	-0.4	-0.3
300	50	12.0	1.0	0.20	0.96	0.16	0.00	0.06	0.03	0.50	0.20	0.94	0.14	0.00	0.2	-14	694.01	128.80	822.81	693.15	128.25	821.40	-0.1	-0.4	-0.2
300	50	11.6	2.0	0.20	0.95	0.16	0.01	0.05	0.02	0.44	0.20	0.93	0.14	0.00	0.1	-13	716.19	108.55	824.74	714.82	108.16	822.98	-0.2	-0.4	-0.2
400	50	10.1	1.0	0.21	0.94	0.14	0.02	0.06	0.02	0.42	0.21	0.92	0.12	0.01	-0.2	-13	743.81	88.11	831.92	741.29	87.75	829.04	-0.3	-0.4	-0.3
400	50	8.0	2.0	0.20	0.95	0.16	0.01	0.04	0.02	0.43	0.20	0.93	0.14	0.00	0.0	-11	661.93	162.83	824.76	660.54	162.33	822.87	-0.2	-0.3	-0.2
300	75	18.2	1.0	0.20	0.95	0.16	0.01	0.05	0.02	0.40	0.20	0.93	0.14	0.01	0.0	-12	716.15	108.54	824.69	714.70	108.17	822.87	-0.2	-0.3	-0.2
300	75	19.1	2.0	0.20	0.96	0.16	0.00	0.04	0.02	0.43	0.20	0.94	0.14	0.00	0.1	-12	629.59	193.19	822.78	628.54	192.59	821.13	-0.2	-0.3	-0.2
450	75	18.6	1.0	0.20	0.95	0.15	0.02	0.04	0.02	0.40	0.20	0.93	0.13	0.01	-0.1	-11	603.84	161.36	765.20	601.81	160.94	762.75	-0.3	-0.3	-0.3
450	75	19.3	2.0	0.20	0.96	0.16	0.01	0.05	0.02	0.40	0.20	0.94	0.14	0.00	0.1	-12	693.92	128.79	822.71	692.76	128.35	821.11	-0.2	-0.3	-0.2
600	75	17.6	1.0	0.20	0.96	0.16	0.01	0.03	0.01	0.37	0.20	0.94	0.14	0.01	0.0	-10	572.10	191.29	763.39	570.46	190.91	761.37	-0.3	-0.2	-0.3
600	75	17.1	2.0	0.21	0.93	0.14	0.02	0.05	0.02	0.40	0.21	0.92	0.12	0.01	-0.2	-13	699.85	132.13	831.98	697.41	131.62	829.03	-0.3	-0.4	-0.4

Table EC.3 Costs with and without TT with free TT and open-access PCP (20% lowest-cost patients).

Parameters				Actions without TT				Actions with TT							% Change		Cost without TT			Cost with TT			Percent Change		
c_E	c_P	c_T	h	π^{ED}	π^{PCP}	π^{DD}	π^{Wait}	$\tilde{\pi}^{TT}$	$\tilde{\pi}^{R}$	$\frac{\tilde{\pi}^R}{\tilde{\pi}^{TT}}$	$\tilde{\pi}^{ED}$	$\tilde{\pi}^{PCP}$	$\tilde{\pi}^{DD}$	$\tilde{\pi}^{Wait}$	ED	DD	Payer	Patient	Total	Payer	Patient	Total	Payer	Patient	Total
100	25	0.0	1.0	0.25	0.45	0.05	0.53	0.18	0.07	0.41	0.25	0.41	0.03	0.47	0.5	-42	153.72	39.99	193.71	154.35	39.06	193.41	0.4	-2.3	-0.2
100	25	0.0	2.0	0.22	0.70	0.10	0.29	0.19	0.09	0.46	0.23	0.62	0.06	0.27	2.5	-41	186.04	42.62	228.66	180.11	41.61	221.72	-3.2	-2.4	-3.0
150	25	0.0	1.0	0.22	0.63	0.09	0.36	0.18	0.08	0.45	0.22	0.58	0.05	0.31	0.8	-38	163.38	51.56	214.94	161.86	50.71	212.57	-0.9	-1.6	-1.1
150	25	0.0	2.0	0.21	0.80	0.13	0.19	0.16	0.08	0.46	0.21	0.73	0.09	0.17	1.7	-34	190.33	53.30	243.63	183.34	52.49	235.83	-3.7	-1.5	-3.2
200	25	0.0	1.0	0.21	0.72	0.11	0.27	0.17	0.08	0.45	0.21	0.67	0.07	0.23	0.8	-34	166.32	62.33	228.65	163.64	61.57	225.21	-1.6	-1.2	-1.5
200	25	0.0	2.0	0.20	0.85	0.15	0.14	0.14	0.06	0.45	0.21	0.79	0.10	0.12	1.0	-29	188.23	63.61	251.84	182.37	62.92	245.29	-3.1	-1.1	-2.6
200	50	0.0	1.0	0.27	0.27	0.02	0.70	0.15	0.06	0.36	0.27	0.27	0.01	0.64	-0.7	-42	102.83	74.75	177.58	105.88	73.41	179.29	3.0	-1.8	1.0
200	50	0.0	2.0	0.25	0.45	0.05	0.53	0.18	0.07	0.41	0.25	0.41	0.03	0.47	0.6	-42	118.91	79.97	198.88	120.22	78.11	198.33	1.1	-2.3	-0.3
300	50	0.0	1.0	0.23	0.51	0.06	0.48	0.20	0.08	0.42	0.23	0.48	0.04	0.41	-0.1	-40	103.59	99.44	203.03	106.45	97.97	204.42	2.8	-1.5	0.7
300	50	0.0	2.0	0.22	0.63	0.09	0.36	0.18	0.08	0.45	0.22	0.58	0.05	0.31	0.8	-38	119.12	103.11	222.23	118.47	101.42	219.89	-0.5	-1.6	-1.1
400	50	0.0	1.0	0.22	0.62	0.08	0.37	0.19	0.08	0.43	0.22	0.59	0.05	0.31	0.3	-37	103.78	121.81	225.59	105.15	120.37	225.52	1.3	-1.2	0.0
400	50	0.0	2.0	0.21	0.72	0.11	0.27	0.17	0.08	0.45	0.21	0.67	0.07	0.23	0.8	-34	117.21	124.65	241.86	115.49	123.14	238.63	-1.5	-1.2	-1.3
300	75	0.0	1.0	0.28	0.22	0.02	0.77	0.14	0.05	0.35	0.28	0.22	0.01	0.70	-1.4	-41	67.95	108.51	176.46	71.66	106.91	178.57	5.5	-1.5	1.2
300	75	0.0	2.0	0.27	0.33	0.03	0.65	0.17	0.06	0.38	0.26	0.32	0.02	0.58	-0.6	-42	76.78	115.17	191.95	80.17	112.82	192.99	4.4	-2.0	0.5
450	75	0.0	1.0	0.23	0.49	0.06	0.50	0.20	0.08	0.40	0.23	0.47	0.04	0.43	-0.2	-39	70.49	145.93	216.42	74.55	144.01	218.56	5.8	-1.3	1.0
450	75	0.0	2.0	0.23	0.55	0.07	0.43	0.19	0.08	0.43	0.23	0.52	0.04	0.38	0.4	-40	74.66	151.33	225.99	76.79	148.96	225.75	2.9	-1.6	-0.1
600	75	0.0	1.0	0.22	0.60	0.09	0.39	0.19	0.08	0.42	0.22	0.58	0.06	0.32	0.2	-34	72.56	179.41	251.97	75.25	177.52	252.77	3.7	-1.1	0.3
600	75	0.0	2.0	0.22	0.65	0.09	0.33	0.18	0.08	0.44	0.22	0.62	0.06	0.28	0.5	-35	76.81	184.41	261.22	78.10	182.18	260.28	1.7	-1.2	-0.4

Table EC.4 Costs with and without TT with optimal TT copay and open-access PCP (20% lowest-cost patients).

Parameters				Actions without TT				Actions with TT							% Change		Cost without TT			Cost with TT			Percent Change		
c_E	c_P	c_T	h	π^{ED}	π^{PCP}	π^{DD}	π^{Wait}	$\tilde{\pi}^{TT}$	$\tilde{\pi}^{R}$	$\frac{\tilde{\pi}^R}{\tilde{\pi}^{TT}}$	$\tilde{\pi}^{ED}$	$\tilde{\pi}^{PCP}$	$\tilde{\pi}^{DD}$	$\tilde{\pi}^{Wait}$	ED	DD	Payer	Patient	Total	Payer	Patient	Total	Payer	Patient	Total
100	25	5.9	1.0	0.25	0.45	0.05	0.53	0.01	0.00	0.25	0.25	0.44	0.05	0.53	-0.3	-7	153.72	39.99	193.71	153.15	39.92	193.07	-0.4	-0.2	-0.3
100	25	5.7	2.0	0.22	0.70	0.10	0.29	0.04	0.01	0.32	0.22	0.68	0.09	0.28	-0.3	-11	186.04	42.62	228.66	184.21	42.44	226.65	-1.0	-0.4	-0.9
150	25	4.7	1.0	0.22	0.63	0.09	0.36	0.04	0.01	0.30	0.22	0.62	0.08	0.35	-0.1	-11	163.38	51.56	214.94	162.40	51.40	213.80	-0.6	-0.3	-0.5
150	25	4.9	2.0	0.21	0.80	0.13	0.19	0.05	0.02	0.34	0.21	0.78	0.12	0.18	0.2	-13	190.33	53.30	243.63	187.64	53.06	240.70	-1.4	-0.5	-1.2
200	25	3.7	1.0	0.21	0.72	0.11	0.27	0.05	0.02	0.31	0.21	0.70	0.09	0.26	0.0	-14	166.32	62.33	228.65	164.97	62.09	227.06	-0.8	-0.4	-0.7
200	25	1.9	2.0	0.20	0.85	0.15	0.14	0.08	0.03	0.40	0.21	0.82	0.12	0.13	0.6	-20	188.23	63.61	251.84	184.50	63.17	247.67	-2.0	-0.7	-1.7
200	50	12.0	1.0	0.27	0.27	0.02	0.70	0.00	0.00	0.30	0.27	0.27	0.02	0.70	-0.1	-4	102.83	74.75	177.58	102.72	74.72	177.44	-0.1	0.0	-0.1
200	50	12.3	2.0	0.25	0.45	0.05	0.53	0.01	0.00	0.25	0.25	0.44	0.05	0.53	-0.3	-6	118.91	79.97	198.88	118.49	79.86	198.35	-0.4	-0.1	-0.3
300	50	12.0	1.0	0.23	0.51	0.06	0.48	0.01	0.00	0.29	0.23	0.50	0.06	0.47	-0.2	-5	103.59	99.44	203.03	103.53	99.37	202.90	-0.1	-0.1	-0.1
300	50	11.6	2.0	0.22	0.63	0.09	0.36	0.03	0.01	0.29	0.22	0.62	0.08	0.35	-0.2	-8	119.12	103.11	222.23	118.49	102.91	221.40	-0.5	-0.2	-0.4
400	50	10.1	1.0	0.22	0.62	0.08	0.37	0.03	0.01	0.32	0.22	0.61	0.07	0.35	-0.2	-10	103.78	121.81	225.59	103.47	121.64	225.11	-0.3	-0.1	-0.2
400	50	8.0	2.0	0.21	0.72	0.11	0.27	0.05	0.02	0.31	0.21	0.70	0.09	0.26	0.0	-13	117.21	124.65	241.86	116.08	124.23	240.31	-1.0	-0.3	-0.6
300	75	18.2	1.0	0.28	0.22	0.02	0.77	0.00	0.00	0.28	0.28	0.22	0.02	0.76	-0.1	-4	67.95	108.51	176.46	67.89	108.49	176.38	-0.1	0.0	0.0
300	75	19.1	2.0	0.27	0.33	0.03	0.65	0.01	0.00	0.29	0.27	0.33	0.03	0.65	-0.1	-4	76.78	115.17	191.95	76.68	115.10	191.78	-0.1	-0.1	-0.1
450	75	18.6	1.0	0.23	0.49	0.06	0.50	0.01	0.00	0.32	0.23	0.49	0.06	0.50	-0.1	-2	70.49	145.93	216.42	70.43	145.91	216.34	-0.1	0.0	0.0
450	75	19.3	2.0	0.23	0.55	0.07	0.43	0.01	0.00	0.27	0.23	0.55	0.07	0.43	-0.2	-5	74.66	151.33	225.99	74.44	151.19	225.63	-0.3	-0.1	-0.2
600	75	17.6	1.0	0.22	0.60	0.09	0.39	0.01	0.00	0.30	0.22	0.60	0.08	0.38	-0.1	-3	72.56	179.41	251.97	72.42	179.38	251.80	-0.2	0.0	-0.1
600	75	17.1	2.0	0.22	0.65	0.09	0.33	0.03	0.01	0.30	0.22	0.65	0.08	0.32	-0.1	-8	76.81	184.41	261.22	76.38	184.17	260.55	-0.6	-0.1	-0.3

Table EC.5 Costs with and without TT with free TT and traditional-access PCP (20% highest-cost patients).

Parameters				Actions without TT				Actions with TT							% Change		Cost without TT			Cost with TT			Percent Change		
c_E	c_P	c_T	h	π^{ED}	π^{PCP}	π^{DD}	π^{Wait}	$\tilde{\pi}^{TT}$	$\tilde{\pi}^{R}$	$\frac{\tilde{\pi}^R}{\tilde{\pi}^{TT}}$	$\tilde{\pi}^{ED}$	$\tilde{\pi}^{PCP}$	$\tilde{\pi}^{DD}$	$\tilde{\pi}^{Wait}$	ED	DD	Payer	Patient	Total	Payer	Patient	Total	Payer	Patient	Total
100	25	0.0	1.0	0.34	0.90	0.27	0.00	0.07	0.04	0.55	0.34	0.88	0.25	0.00	-0.2	-8	1195.10	56.73	1251.83	1191.90	56.51	1248.41	-0.3	-0.4	-0.3
100	25	0.0	2.0	0.34	0.90	0.27	0.00	0.18	0.11	0.62	0.35	0.85	0.23	0.00	1.1	-17	1195.10	56.73	1251.83	1204.80	55.88	1260.68	0.8	-1.5	0.7
150	25	0.0	1.0	0.34	0.92	0.29	0.00	0.07	0.03	0.51	0.34	0.89	0.26	0.00	0.1	-9	1169.10	73.73	1242.83	1167.70	73.46	1241.16	-0.1	-0.4	-0.1
150	25	0.0	2.0	0.34	0.90	0.27	0.01	0.14	0.08	0.58	0.34	0.86	0.23	0.00	0.5	-14	1195.10	56.73	1251.83	1198.20	56.14	1254.34	0.3	-1.0	0.2
200	25	0.0	1.0	0.21	0.94	0.14	0.01	0.19	0.11	0.61	0.21	0.88	0.10	0.00	0.5	-31	787.87	44.07	831.94	786.66	43.44	830.10	-0.2	-1.4	-0.2
200	25	0.0	2.0	0.21	0.94	0.14	0.00	0.16	0.09	0.59	0.21	0.88	0.10	0.00	0.4	-30	787.93	44.07	832.00	786.19	43.50	829.69	-0.2	-1.3	-0.3
200	50	0.0	1.0	0.20	0.95	0.16	0.00	0.09	0.05	0.52	0.20	0.92	0.13	0.00	0.0	-20	770.54	54.28	824.82	767.21	53.94	821.15	-0.4	-0.6	-0.4
200	50	0.0	2.0	0.21	0.94	0.14	0.00	0.18	0.11	0.62	0.21	0.88	0.10	0.00	0.5	-31	787.91	44.07	831.98	786.65	43.45	830.10	-0.2	-1.4	-0.2
300	50	0.0	1.0	0.20	0.96	0.16	0.00	0.05	0.02	0.49	0.20	0.94	0.14	0.00	-0.1	-12	758.44	64.40	822.84	755.71	64.20	819.91	-0.4	-0.3	-0.4
300	50	0.0	2.0	0.20	0.95	0.16	0.00	0.09	0.05	0.52	0.20	0.92	0.13	0.00	0.0	-20	770.54	54.28	824.82	767.22	53.94	821.16	-0.4	-0.6	-0.4
400	50	0.0	1.0	0.20	0.96	0.16	0.00	0.05	0.02	0.49	0.20	0.94	0.14	0.00	-0.1	-12	758.43	64.40	822.83	755.71	64.20	819.91	-0.4	-0.3	-0.4
400	50	0.0	2.0	0.34	0.93	0.29	0.00	0.11	0.06	0.58	0.34	0.89	0.26	0.00	0.4	-12	1149.80	90.63	1240.43	1151.40	90.00	1241.40	0.1	-0.7	0.1
300	75	0.0	1.0	0.21	0.94	0.14	0.00	0.13	0.07	0.54	0.21	0.89	0.11	0.00	0.4	-26	743.83	88.14	831.97	742.99	87.24	830.23	-0.1	-1.0	-0.2
300	75	0.0	2.0	0.20	0.95	0.16	0.00	0.05	0.02	0.48	0.20	0.93	0.14	0.00	0.0	-13	770.52	54.28	824.80	768.36	54.09	822.45	-0.3	-0.3	-0.3
450	75	0.0	1.0	0.20	0.96	0.16	0.00	0.13	0.07	0.55	0.20	0.91	0.12	0.00	0.1	-25	758.42	64.40	822.82	754.02	63.84	817.86	-0.6	-0.9	-0.6
450	75	0.0	2.0	0.34	0.90	0.27	0.01	0.03	0.02	0.47	0.34	0.89	0.26	0.01	-0.2	-4	1138.30	113.46	1251.76	1135.10	113.29	1248.39	-0.3	-0.1	-0.3
600	75	0.0	1.0	0.33	0.93	0.29	0.01	0.12	0.06	0.52	0.33	0.89	0.25	0.00	0.5	-13	1026.00	268.83	1294.83	1030.00	266.95	1296.95	0.4	-0.7	0.2
600	75	0.0	2.0	0.20	0.95	0.16	0.00	0.09	0.04	0.49	0.20	0.91	0.13	0.00	0.0	-20	770.49	54.28	824.77	767.19	53.94	821.13	-0.4	-0.6	-0.4

Table EC.6 Costs with and without TT with optimal TT copay and traditional-access PCP (20% highest-cost patients).

Parameters				Actions without TT				Actions with TT							% Change		Cost without TT			Cost with TT			Percent Change		
c_E	c_P	c_T	h	π^{ED}	π^{PCP}	π^{DD}	π^{Wait}	$\tilde{\pi}^{TT}$	$\tilde{\pi}^{R}$	$\frac{\tilde{\pi}^{R}}{\tilde{\pi}^{TT}}$	$\tilde{\pi}^{ED}$	$\tilde{\pi}^{PCP}$	$\tilde{\pi}^{DD}$	$\tilde{\pi}^{Wait}$	ED	DD	Payer	Patient	Total	Payer	Patient	Total	Payer	Patient	Total
100	25	5.4	1.0	0.34	0.90	0.27	0.01	0.19	0.11	0.61	0.35	0.85	0.22	0.00	1.1	-17	1195.10	56.73	1251.83	1204.80	55.87	1260.67	0.8	-1.5	0.7
100	25	5.3	2.0	0.34	0.90	0.27	0.00	0.14	0.08	0.60	0.34	0.86	0.23	0.00	0.5	-14	1195.10	56.73	1251.83	1198.20	56.14	1254.34	0.3	-1.0	0.2
150	25	4.9	1.0	0.21	0.94	0.14	0.00	0.18	0.11	0.62	0.21	0.88	0.10	0.00	0.5	-31	787.93	44.07	832.00	786.67	43.45	830.12	-0.2	-1.4	-0.2
150	25	4.2	2.0	0.34	0.90	0.27	0.01	0.10	0.06	0.55	0.34	0.87	0.24	0.00	0.1	-11	1195.10	56.73	1251.83	1194.00	56.35	1250.35	-0.1	-0.7	-0.1
200	25	3.9	1.0	0.21	0.94	0.14	0.01	0.11	0.06	0.52	0.21	0.89	0.11	0.00	0.3	-24	787.87	44.07	831.94	786.15	43.68	829.83	-0.2	-0.9	-0.3
200	25	3.3	2.0	0.34	0.90	0.27	0.00	0.18	0.12	0.63	0.35	0.85	0.23	0.00	1.1	-17	1195.10	56.74	1251.84	1204.80	55.88	1260.68	0.8	-1.5	0.7
200	50	10.6	1.0	0.20	0.95	0.16	0.00	0.05	0.02	0.49	0.20	0.93	0.14	0.00	0.0	-13	770.54	54.28	824.82	768.37	54.09	822.46	-0.3	-0.3	-0.3
200	50	11.1	2.0	0.21	0.94	0.14	0.00	0.11	0.06	0.53	0.21	0.89	0.11	0.00	0.3	-24	787.91	44.07	831.98	786.15	43.68	829.83	-0.2	-0.9	-0.3
300	50	11.8	1.0	0.20	0.96	0.16	0.00	0.03	0.01	0.46	0.20	0.95	0.15	0.00	-0.1	-8	758.44	64.40	822.84	756.42	64.29	820.71	-0.3	-0.2	-0.3
300	50	11.1	2.0	0.20	0.95	0.16	0.00	0.05	0.02	0.49	0.20	0.93	0.14	0.00	0.0	-13	770.54	54.28	824.82	768.37	54.09	822.46	-0.3	-0.3	-0.3
400	50	9.8	1.0	0.20	0.96	0.16	0.00	0.03	0.01	0.46	0.20	0.95	0.15	0.00	-0.1	-8	758.43	64.40	822.83	756.41	64.29	820.70	-0.3	-0.2	-0.3
400	50	9.4	2.0	0.34	0.93	0.29	0.00	0.08	0.04	0.53	0.34	0.90	0.26	0.00	0.2	-10	1149.80	90.63	1240.43	1149.40	90.21	1239.61	0.0	-0.5	-0.1
300	75	15.9	1.0	0.34	0.93	0.29	0.01	0.11	0.06	0.55	0.34	0.89	0.26	0.00	0.4	-12	1149.70	90.62	1240.32	1151.40	90.00	1241.40	0.1	-0.7	0.1
300	75	17.1	2.0	0.20	0.95	0.16	0.00	0.03	0.01	0.44	0.20	0.94	0.14	0.00	0.0	-8	770.52	54.28	824.80	768.76	54.18	822.94	-0.2	-0.2	-0.2
450	75	18.7	1.0	0.34	0.92	0.29	0.01	0.14	0.08	0.58	0.34	0.88	0.25	0.00	0.7	-14	1095.40	147.46	1242.86	1100.10	146.03	1246.13	0.4	-1.0	0.3
450	75	17.7	2.0	0.34	0.90	0.27	0.01	0.06	0.03	0.50	0.34	0.88	0.25	0.00	-0.2	-7	1138.30	113.46	1251.76	1135.10	113.09	1248.19	-0.3	-0.3	-0.3
600	75	17.8	1.0	0.33	0.93	0.29	0.01	0.04	0.02	0.36	0.33	0.91	0.27	0.01	0.0	-6	1026.00	268.83	1294.83	1024.70	268.34	1293.04	-0.1	-0.2	-0.1
600	75	16.8	2.0	0.20	0.95	0.16	0.00	0.05	0.02	0.45	0.20	0.93	0.14	0.00	0.0	-13	770.49	54.28	824.77	768.35	54.09	822.44	-0.3	-0.3	-0.3

Table EC.7 Costs with and without TT with free TT and traditional-access PCP (20% lowest-cost patients).

Parameters				Actions without TT				Actions with TT							% Change		Cost without TT			Cost with TT			Percent Change		
c_E	c_P	c_T	h	π^{ED}	π^{PCP}	π^{DD}	π^{Wait}	$\tilde{\pi}^{TT}$	$\tilde{\pi}^{R}$	$\frac{\tilde{\pi}^{R}}{\tilde{\pi}^{TT}}$	$\tilde{\pi}^{ED}$	$\tilde{\pi}^{PCP}$	$\tilde{\pi}^{DD}$	$\tilde{\pi}^{Wait}$	ED	DD	Payer	Patient	Total	Payer	Patient	Total	Payer	Patient	Total
100	25	0.0	1.0	0.24	0.65	0.14	0.23	0.04	0.01	0.30	0.24	0.63	0.12	0.23	-0.2	-10	188.82	42.72	231.54	186.80	42.53	229.33	-1.1	-0.5	-1.0
100	25	0.0	2.0	0.24	0.65	0.14	0.23	0.21	0.09	0.41	0.25	0.58	0.09	0.21	1.9	-34	188.82	42.72	231.54	183.82	41.77	225.59	-2.6	-2.2	-2.6
150	25	0.0	1.0	0.24	0.65	0.14	0.24	0.05	0.01	0.27	0.24	0.63	0.13	0.23	0.1	-11	176.06	54.02	230.08	174.18	53.80	227.98	-1.1	-0.4	-0.9
150	25	0.0	2.0	0.25	0.54	0.10	0.36	0.11	0.03	0.31	0.25	0.50	0.08	0.34	0.5	-21	172.57	41.90	214.47	170.38	41.32	211.70	-1.3	-1.4	-1.3
200	25	0.0	1.0	0.25	0.45	0.05	0.53	0.20	0.10	0.52	0.25	0.39	0.03	0.50	1.4	-45	153.72	39.99	193.71	151.24	39.00	190.24	-1.6	-2.5	-1.8
200	25	0.0	2.0	0.21	0.78	0.12	0.21	0.17	0.08	0.47	0.22	0.69	0.08	0.20	1.4	-37	198.07	43.22	241.29	189.34	42.47	231.81	-4.4	-1.8	-3.9
200	50	0.0	1.0	0.21	0.80	0.13	0.19	0.08	0.03	0.42	0.21	0.75	0.10	0.20	0.6	-25	190.33	53.30	243.63	183.40	52.85	236.25	-3.6	-0.9	-3.0
200	50	0.0	2.0	0.23	0.58	0.08	0.40	0.21	0.11	0.51	0.24	0.50	0.05	0.38	1.3	-42	169.91	41.61	211.52	165.20	40.63	205.83	-2.8	-2.4	-2.7
300	50	0.0	1.0	0.20	0.89	0.16	0.10	0.04	0.02	0.38	0.20	0.86	0.13	0.10	0.1	-14	194.25	63.88	258.13	190.23	63.66	253.89	-2.1	-0.3	-1.6
300	50	0.0	2.0	0.21	0.86	0.15	0.13	0.08	0.03	0.44	0.21	0.81	0.11	0.14	0.4	-24	199.03	53.67	252.70	192.45	53.26	245.71	-3.3	-0.8	-2.8
400	50	0.0	1.0	0.20	0.85	0.15	0.14	0.04	0.01	0.35	0.21	0.82	0.13	0.14	0.1	-14	188.23	63.61	251.84	184.28	63.37	247.65	-2.1	-0.4	-1.7
400	50	0.0	2.0	0.23	0.71	0.16	0.17	0.16	0.06	0.39	0.23	0.65	0.12	0.14	0.8	-27	173.70	65.75	239.45	169.13	65.03	234.16	-2.6	-1.1	-2.2
300	75	0.0	1.0	0.24	0.52	0.07	0.46	0.09	0.04	0.42	0.24	0.47	0.05	0.46	0.7	-32	126.78	81.78	208.56	123.58	80.44	204.02	-2.5	-1.6	-2.2
300	75	0.0	2.0	0.21	0.73	0.11	0.26	0.03	0.01	0.32	0.21	0.70	0.10	0.26	0.1	-13	178.11	52.65	230.76	175.23	52.43	227.66	-1.6	-0.4	-1.3
450	75	0.0	1.0	0.21	0.80	0.13	0.20	0.15	0.07	0.48	0.21	0.71	0.09	0.20	1.0	-35	179.05	63.15	242.20	170.03	62.35	232.38	-5.0	-1.3	-4.1
450	75	0.0	2.0	0.26	0.47	0.09	0.44	0.01	0.00	0.25	0.26	0.47	0.08	0.44	-0.2	-3	127.32	82.50	209.82	126.92	82.44	209.36	-0.3	-0.1	-0.2
600	75	0.0	1.0	0.25	0.48	0.09	0.43	0.22	0.08	0.34	0.25	0.46	0.06	0.34	-0.1	-29	58.77	189.17	247.94	62.80	187.13	249.93	6.9	-1.1	0.8
600	75	0.0	2.0	0.22	0.63	0.09	0.36	0.07	0.02	0.38	0.22	0.59	0.07	0.35	0.5	-23	163.38	51.56	214.94	159.52	51.10	210.62	-2.4	-0.9	-2.0

Table EC.8 Costs with and without TT with optimal TT copay and traditional-access PCP (20% lowest-cost patients).

Parameters				Actions without TT				Actions with TT							% Change		Cost without TT			Cost with TT			Percent Change		
c_E	c_P	c_T	h	π^{ED}	π^{PCP}	π^{DD}	π^{Wait}	$\tilde{\pi}^{TT}$	$\tilde{\pi}^{R}$	$\frac{\tilde{\pi}^{R}}{\tilde{\pi}^{TT}}$	$\tilde{\pi}^{ED}$	$\tilde{\pi}^{PCP}$	$\tilde{\pi}^{DD}$	$\tilde{\pi}^{Wait}$	ED	DD	Payer	Patient	Total	Payer	Patient	Total	Payer	Patient	Total
100	25	5.4	1.0	0.25	0.54	0.10	0.36	0.21	0.08	0.38	0.26	0.48	0.07	0.32	1.4	-33	172.57	41.90	214.47	169.99	40.91	210.90	-1.5	-2.4	-1.7
100	25	5.3	2.0	0.24	0.65	0.14	0.23	0.12	0.04	0.35	0.24	0.61	0.11	0.22	0.9	-22	188.82	42.72	231.54	185.33	42.12	227.45	-1.8	-1.4	-1.8
150	25	4.9	1.0	0.22	0.70	0.10	0.29	0.22	0.11	0.51	0.23	0.61	0.06	0.27	1.5	-41	186.04	42.62	228.66	178.88	41.71	220.59	-3.8	-2.2	-3.5
150	25	4.2	2.0	0.25	0.54	0.10	0.36	0.06	0.02	0.27	0.25	0.52	0.09	0.35	-0.1	-13	172.57	41.90	214.47	170.76	41.58	212.34	-1.0	-0.8	-1.0
200	25	3.9	1.0	0.25	0.45	0.05	0.53	0.06	0.02	0.35	0.25	0.41	0.04	0.53	0.4	-26	153.72	39.99	193.71	150.77	39.47	190.24	-1.9	-1.3	-1.8
200	25	3.3	2.0	0.24	0.73	0.16	0.14	0.21	0.09	0.43	0.24	0.65	0.11	0.12	2.0	-33	200.00	43.13	243.13	194.25	42.24	236.49	-2.9	-2.1	-2.7
200	50	10.6	1.0	0.21	0.80	0.13	0.19	0.04	0.01	0.35	0.21	0.77	0.11	0.19	0.2	-14	190.33	53.30	243.63	186.40	53.07	239.47	-2.1	-0.4	-1.7
200	50	11.1	2.0	0.23	0.58	0.08	0.40	0.08	0.03	0.39	0.23	0.53	0.06	0.40	0.4	-27	169.91	41.61	211.52	165.50	41.05	206.55	-2.6	-1.3	-2.3
300	50	11.8	1.0	0.20	0.89	0.16	0.10	0.03	0.01	0.33	0.20	0.87	0.14	0.10	0.0	-9	194.25	63.88	258.13	191.84	63.76	255.60	-1.2	-0.2	-1.0
300	50	11.1	2.0	0.21	0.86	0.15	0.13	0.04	0.02	0.37	0.21	0.83	0.12	0.13	0.2	-15	199.03	53.67	252.70	194.89	53.45	248.34	-2.1	-0.4	-1.7
400	50	9.8	1.0	0.20	0.85	0.15	0.14	0.02	0.01	0.31	0.20	0.84	0.13	0.14	0.0	-8	188.23	63.61	251.84	186.13	63.49	249.62	-1.1	-0.2	-0.9
400	50	9.4	2.0	0.23	0.71	0.16	0.17	0.08	0.03	0.31	0.23	0.68	0.13	0.15	0.3	-16	173.70	65.75	239.45	171.02	65.35	236.37	-1.5	-0.6	-1.3
300	75	15.9	1.0	0.24	0.62	0.13	0.26	0.18	0.07	0.38	0.24	0.58	0.09	0.22	0.6	-28	160.11	65.01	225.12	158.10	64.24	222.34	-1.3	-1.2	-1.2
300	75	17.1	2.0	0.21	0.73	0.11	0.26	0.02	0.00	0.28	0.21	0.71	0.10	0.26	0.0	-7	178.11	52.65	230.76	176.68	52.56	229.24	-0.8	-0.2	-0.7
450	75	18.7	1.0	0.24	0.60	0.13	0.29	0.19	0.08	0.39	0.24	0.55	0.09	0.24	0.9	-31	122.05	107.20	229.25	120.51	105.50	226.01	-1.3	-1.6	-1.4
450	75	17.7	2.0	0.26	0.47	0.09	0.44	0.02	0.00	0.24	0.26	0.46	0.08	0.44	-0.4	-6	127.32	82.50	209.82	126.64	82.31	208.95	-0.5	-0.2	-0.4
600	75	17.8	1.0	0.25	0.48	0.09	0.43	0.01	0.00	0.24	0.25	0.48	0.09	0.42	-0.1	-3	58.77	189.17	247.94	58.78	189.10	247.88	0.0	0.0	0.0
600	75	16.8	2.0	0.22	0.63	0.09	0.36	0.03	0.01	0.30	0.22	0.61	0.08	0.35	-0.1	-11	163.38	51.56	214.94	161.85	51.39	213.24	-0.9	-0.3	-0.8

Table EC.9 Linear regression model: optimal teletriage copayment. R-square $= 0.98$ and F-test $P < 0.001$.

	Coefficient	Std Err	T	P
Intercept	0.69	0.50	1.39	0.17
c_E/c_P	-0.51	0.07	-7.66	< 0.001
c_P	0.27	0.01	49.84	< 0.001