tional hazards model with longitudinal covariates measured with error. *Biometrika* **88**, 447–458.

Wang, Y. and Taylor, J. M. G. (2001). Jointly modelling longitudinal and event time data with application to AIDS studies. *Journal of the American Statistical Association* **96**, 895–905.

Wulfsohn, M. S. and Tsiatis, A. A. (1997). A joint model for survival and longitudinal data measured with error. *Biometrics* **53**, 330–339.

Xu, J. and Zeger, S. L. (2001). The evaluation of multiple surrogate endpoints. *Biometrics* **57**, 81–87.

A. Sampling from the Posterior

We use Gibbs sampling to sample from the joint posterior distribution of the parameters: β, α, γ, λ, b_o, and V_0. The joint posterior does not have a closed form; however, given that the conditional posteriors either have a closed form or are log-concave, implementation of the Gibbs sampler is straight-forward. Let D denote the data and $rest$ denote the remaining parameters. Then at each iteration of the Gibbs sampler, we proceed as follows:

1. Let $\beta_{il} = (\beta_{il0}, \ldots, \beta_{ilp})', \;\; i = 1, \ldots, N, \;\; l = 1, \ldots, q$. Then use ARS to sample $[\beta_{il}|rest, D]$ from

$$
\begin{aligned}
p(\beta_{il}|rest, D) \;\; \propto \;\; & \exp\left\{-\frac{1}{2}\left[\beta_{il}'\left(\sum_{j=1}^{m_i} B_l(t_{ij})^2\Sigma^{-1} + V_{0l}^{-1}\right)\beta_{il}\right.\right. \\
& \left.\left. - 2\beta_{il}'\left(\Sigma^{-1}A_{il} + V_0^{-1}(b_{0l} + x_i'\alpha)\right)\right]\right\} \\
& \times \exp\left\{\nu_i(\gamma'\psi_\beta(s_i) + z_i{}'\zeta) - e^{z_i{}'\zeta}\sum_{j=1}^{J} H_{ij}(\beta, \gamma, \lambda)\right\},
\end{aligned}
$$

where

$$A_{il} = \sum_{j=1}^{m_i} \begin{pmatrix} Y_{ij1} - \sum_{\substack{k=1 \\ k \neq l}}^{q} \beta_{ik1} B_k(t_{ij}) \\ \vdots \\ Y_{ijp} - \sum_{\substack{k=1 \\ k \neq l}}^{q} \beta_{ikp} B_k(t_{ij}) \end{pmatrix}.$$

2. Sample

$$[V_{0l}^{-1} | rest, D] \sim Wishart \left(\left(S_{v_{0l}}^{-1} + \sum_{i=1}^{N} (\beta_{il} - b_{0l} - x_i'\alpha)(\beta_{il} - b_{0l} - x_i'\alpha)' \right)^{-1}, N + \nu_{v_{0l}} \right).$$

3. Sample

$$[\Sigma^{-1} | rest, D] \sim Wishart \left(\left(S^{-1} + \sum_{i=1}^{N} \sum_{j=1}^{m_i} (Y_{ij} - \psi_\beta(t_{ij}))(Y_{ij} - \psi_\beta(t_{ij}))' \right)^{-1}, \sum m_i + \nu_\epsilon \right).$$

4. Let $b_{0l} = (b_{0l0}, \ldots, b_{0lp})'$, $\; i = 1, \ldots, N$, $\; l = 1, \ldots, q$. Then sample

$$\begin{aligned} [b_{0l} | rest, D] &\sim N_2 \left(\mu_{b_{0l}}, \Sigma_{b_{0l}} \right), \text{ where} \\ \mu_{b_{0l}} &= \Sigma_{b_{0l}} (V_{0l}^{-1} \sum_{i=1}^{N} (\beta_{il} - x_i'\alpha) + A_1^{-1} A_0) \text{ and} \\ \Sigma_{b_{0l}} &= (N V_{0l}^{-1} + A_1^{-1})^{-1}. \end{aligned}$$

5. Use ARS to sample $[\gamma | rest, D]$ from

$$\begin{aligned} p(\gamma | rest, D) \;\; \propto \;\; & \exp \left\{ \sum_{i=1}^{N} \left(\nu_i (\gamma' \psi_\beta(s_i) + {z_i}'\zeta) - e^{{z_i}'\zeta} \sum_{j=1}^{J} H_{ij}(\beta, \gamma, \lambda) \right) \right\} \times \\ & \exp \left\{ -\frac{1}{2} (\gamma - g_0)' g_1^{-1} (\gamma - g_0) \right\}. \end{aligned}$$

6. Sample $[\lambda_j|rest, D] = gamma(d_{0j} + n_j, \sum_{i=1}^{N} e^{z_i'\zeta} H_{ij}(\beta, \gamma, 1) + d_{1j})$, where n_j is the number of events in the jth interval and $H_{ij}(\beta, \gamma, 1)$ is $H_{ij}(\beta, \gamma, \lambda)$ evaluated with $\lambda_j = 1$.

7. Sample

$$
\begin{aligned}
[\alpha|rest, D] &\sim N_p\left(\mu_\alpha, \Sigma_\alpha\right), \text{ where} \\
\mu_\alpha &= \Sigma_\alpha \left(\sum_{i=1}^{N} x_i \sum_{l=1}^{q} V_{0l}^{-1}(\beta_{il} - b_{0l}) + C_1^{-1} C_0 \right) \text{ and} \\
\Sigma_\alpha &= \left(q \sum_{i=1}^{N} x_i V_{0l}^{-1} x_i' + C_1^{-1} \right)^{-1}.
\end{aligned}
$$

B. Estimating the predicted survival curve

Given the G MCMC samples, $b_0^{(g)}$, $\alpha^{(g)}$, $\lambda^{(g)}$, $\gamma^{(g)}$ and $V_0^{(g)}$, $g = 1, \ldots, G$, we can estimate the predicted survival curve at a set of time points, $u = u_1, \ldots, J$, as follows.

Repeat the following steps for $g = 1, \ldots, G$.

1. Sample $\beta_{l,1}^*$ $N_2(b_{0l}^{(g)} + \alpha^{(g)}, V_{0l}^{(g)})$ and $\beta_{l,2}^*$ $N_2(b_{0l}^{(g)}, V_{0l}^{(g)})$.

2. Calculate $S_k^{(g)}(u_j) = \exp\{-\int_0^{u_j} \lambda^{(g)}(t) e^{\gamma'(g)'\psi_\beta(t) + \zeta*(2-k)} dt\},\ k = 1, 2.$

The predicted survival curve at time u_j is then, $S_k(u_j) = median(S_k^{(g)}(u_j), g = 1, \ldots, G),\ k = 1, 2$, where $k = 1$ indicates the treatment group and $k = 2$ is the non-treatment group.