**Supplementary Data File 2: Alternative staging approaches**

**A. Conventional King’s staging (stages 4a and 4b are collapsed into a single stage 4).** Q matrix estimates closed paralleled those of the full model presented in the main text. Model comparison using the *DRAIC*method (1) favored the full model (4a and 4b considered separate stages) over the less informative or “coarse” conventional model (stages 4a and 4b collapsed into a single stage 4). Except for dilution of the specific effect of bulbar onset on transitions to stage 4a, covariate effects were similar for the the conventional and full models.

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| Transition (Q) matrix King's stages with collapsed stage 4 (CI in parentheses) |
|  | **1**  | **2**  | **3**  | **4**  | **death**  |
| 1  | -0.227  | 0.211  | 0  | 0.016  | 0  |
| CI  | (-0.243, -0.213)  | (0.197, 0.227)  |  | (0.012, 0.022)  |  |
| 2  | 0.069  | -0.285  | 0.189  | 0.026  | 0.002  |
| CI  | (0.062, 0.076)  | (-0.299, -0.272)  | (0.179, 0.201)  | (0.021, 0.031)  | (0.001, 0.004)  |
| 3  | 0  | 0.076  | -0.172  | 0.077  | 0.018  |
| CI  |  | (0.07, 0.083)  | (-0.181, -0.163)  | (0.071, 0.083)  | (0.015, 0.021)  |
| 4  | 0  | 0  | 0.019  | -0.049  | 0.03  |
| CI  |  |  | (0.017, 0.022)  | (-0.052, -0.045)  | (0.027, 0.033)  |
| death  | 0  | 0  | 0  | 0  | 0  |

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| King’s (collapsed stage 4) univariate hazard ratios by transition (CI in parentheses) |
| **Transitions** | **Bulbar onset**  | **Steep preslope****≤ -0.733 points/mo** | **Less steep preslope****> -0.393 points/mo**  | **Age (per decade)**  | **Female sex**  |
| 1-2  | 0.83  | 1.39  | 0.64  | 0.97  | 1.09  |
|   | (0.69, 1)  | (1.09, 1.78)  | (0.54, 0.75)  | (0.9, 1.03)  | (0.95, 1.27)  |
| 1-4  | 7.85  | 0.61  | 0.37  | 1.79  | 1.27  |
|   | (3.44, 17.88)  | (0.17, 2.15)  | (0.21, 0.67)  | (1.31, 2.44)  | (0.7, 2.3)  |
| 2-3  | 1.44  | 1.36  | 0.66  | 1.06  | 1.12  |
|   | (1.24, 1.69)  | (1.17, 1.57)  | (0.58, 0.76)  | (1.01, 1.12)  | (0.99, 1.26)  |
| 2-4  | 4.15  | 0.91  | 0.52  | 1.23  | 1.35  |
|   | (2.74, 6.31)  | (0.56, 1.49)  | (0.34, 0.8)  | (1.02, 1.47)  | (0.91, 1.99)  |
| 2-death  | 0.69  | 4.04  | 0.48  | 1.62  | 0.93  |
|   | (0.07, 6.5)  | (0.31, 52.56)  | (0.01, 18.61)  | (0.59, 4.42)  | (0.11, 7.84)  |
| 3-4  | 1.57  | 1.67  | 0.85  | 1.31  | 1.14  |
|   | (1.3, 1.9)  | (1.4, 2)  | (0.66, 1.09)  | (1.22, 1.4)  | (0.97, 1.34)  |
| 3-death  | 0.69  | 1.27  | 0.94  | 1.6  | 0.88  |
|   | (0.42, 1.12)  | (0.86, 1.89)  | (0.58, 1.52)  | (1.32, 1.93)  | (0.62, 1.25)  |
| 4-death  | 1.09  | 1.58  | 0.65  | 1.36  | 1.08  |
|   | (0.88, 1.35)  | (1.29, 1.94)  | (0.48, 0.87)  | (1.21, 1.52)  | (0.9, 1.3)  |

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| Hazard ratio estimates from multivariable models that include age (by decade) and tertiles of pre-slope (steepest and least steep tertiles compared to middle tertile) |
| **King’s stage transitions** | **Steep preslope****≤ -0.733 points/mo** | **Less steep preslope****> -0.393 points/mo**  | **Age (per decade)**  |
| Sequential progression(1-2, 2-3, 3-4) | 1.45(1.30, 1.61) | 0.67(0.67, 0.71) | 1.07(1.03, 1.11) |
| Death (from stages 2 to 4) | 1.31(1.07, 1.72) | 0.77(0.58, 1.03) | 1.40(1.28, 1.53) |

1. Thom HHZ, Jackson CH, Commenges D, Sharples LD. State selection in Markov models for panel data with application to psoriatic arthritis. Stat Med. 2015 Jul 20;34(16):2456–75.

**B. “FT10” and “FT8” staging (using ALSFRS-R subscore thresholds of 10 and 8 respectively, instead of 9 used for FT9 staging):** Cumulative distribution plots at initial observation and for all observations, transition (Q) matrix estimates, and prevalence plots are presented. Note that FT8 and FT10 have higher and lower mortality by stage than in FT9, but lower and higher risk of sequential progression than FT9, respectively. Direct comparison of these multistate model fits is not possible using AIC or another criterion. Effects of prognostically important variables on transition intensities with FT10 and FT8 were qualitiatively similar to those observed with FT9 and are not presented.



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| Transition (Q) matrix FT10 staging (CI in parentheses). AIC = 45237 |
|  | **0**  | **1**  | **2**  | **3**  | **4**  | **death**  |
| 0  | -0.402  | 0.402  | 0  | 0  | 0  | 0  |
|   | (-0.48, -0.337)  | (0.337, 0.48)  |  |  |  |  |
| 1  | 0.021  | -0.279  | 0.257  | 0  | 0  | 0.001  |
|   | (0.016, 0.026)  | (-0.295, -0.263)  | (0.242, 0.273)  |  |  | (0, 0.002)  |
| 2  | 0  | 0.057  | -0.26  | 0.202  | 0  | 0.001  |
|   |  | (0.052, 0.062)  | (-0.271, -0.25)  | (0.194, 0.212)  |  | (0, 0.003)  |
| 3  | 0  | 0  | 0.093  | -0.309  | 0.209  | 0.006  |
|   |  |  | (0.087, 0.101)  | (-0.321, -0.297)  | (0.199, 0.219)  | (0.004, 0.01)  |
| 4  | 0  | 0  | 0  | 0.121  | -0.18  | 0.059  |
|   |  |  |  | (0.112, 0.13)  | (-0.19, -0.17)  | (0.054, 0.064)  |
| death  | 0  | 0  | 0  | 0  | 0  | 0  |

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| Transition (Q) matrix FT8 staging (CI in parentheses). AIC = 46635 |
|  | **0**  | **1**  | **2**  | **3**  | **4**  | **death**  |
| 0  | -0.296  | 0.296  | 0  | 0  | 0  | 0  |
|   | (-0.317, -0.278)  | (0.278, 0.317)  |  |  |  |  |
| 1  | 0.045  | -0.26  | 0.213  | 0  | 0  | 0.002  |
|   | (0.041, 0.051)  | (-0.272, -0.25)  | (0.203, 0.223)  |  |  | (0.001, 0.003)  |
| 2  | 0  | 0.063  | -0.237  | 0.17  | 0  | 0.004  |
|   |  | (0.058, 0.069)  | (-0.247, -0.228)  | (0.162, 0.178)  |  | (0.002, 0.006)  |
| 3  | 0  | 0  | 0.101  | -0.3  | 0.18  | 0.019  |
|   |  |  | (0.093, 0.111)  | (-0.315, -0.285)  | (0.168, 0.192)  | (0.014, 0.025)  |
| 4  | 0  | 0  | 0  | 0.134  | -0.244  | 0.11  |
|   |  |  |  | (0.119, 0.15)  | (-0.264, -0.225)  | (0.099, 0.122)  |
| death  | 0  | 0  | 0  | 0  | 0  | 0  |

