



Figure 1: Development and validation of the FAHR-Face foundation AI model, which was then used to train two independent facial health algorithms: FaceAge and FaceSurvival.

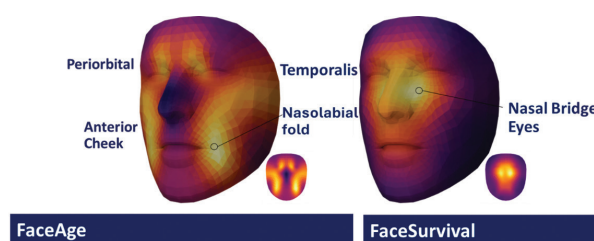


Figure 2: Saliency mapping identifies what portions of the face are most important for the predictions made by the FaceAge and FaceSurvival algorithms and illustrates the independence of the two algorithms.

Facial Health Recognition AI: A Vision for Health

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Facial appearance is an instantly accessible, non invasive signal of underlying physiology and health. Clinicians frequently use patient chronological age (age based on date of birth) for clinical decision-making, which is incorporated into many commonly used decision support tools across medicine, but also rely on subjective assessments of each patient's biological age and overall health to refine decision making.

Building on this insight, we have developed and clinically validated multiple artificial intelligence (AI) algorithms to automatically quantify health status from simple face photographs, including a foundation model trained on >40 million face photos, and two fine tuned downstream algorithms: FaceAge quantifies biological age, and FaceSurvival predicts an individual's mortality risk.

FaceAge underwent a two-stage, age-balanced fine-tuning on 749,935 public images, ensuring optimal performance across the full adult age-range, while FaceSurvival was fine-tuned on face photos of 34,389 cancer patients (Figure 1). Model robustness across different image conditions (e.g. cosmetic surgery) and independence (saliency mapping; Figure 2) were tested extensively.

For age estimation on healthy individuals, FaceAge had the lowest mean absolute error (MAE) of 5.1 years on public datasets, outperforming benchmark algorithms with accuracy across the full human age span. Both algorithms were clinically validated as independent prognostic factors even after adjusting for known clinical factors in large cancer patient cohorts from two independent cancer centers (MGB and Maastricht). In cancer patients, FaceAge outperformed a prior facial age estimation model in survival prognostication. FaceSurvival demonstrated robust prediction of mortality, and the highest-risk quartile had more than triple the mortality of the lowest. In a proof-of-principle clinical use case, FaceAge improved the ability of clinicians to prognosticate at the end-of-life.

AI can convert an everyday selfie into actionable clinical data, enabling access to novel, low-cost biomarkers to improve decision making in oncology and across medicine. By embedding FaceAge and FaceSurvival into EHRs and digital patient-facing applications, we can unlock novel objective "digital vital signs" at the point-of-care and at home to personalize care.