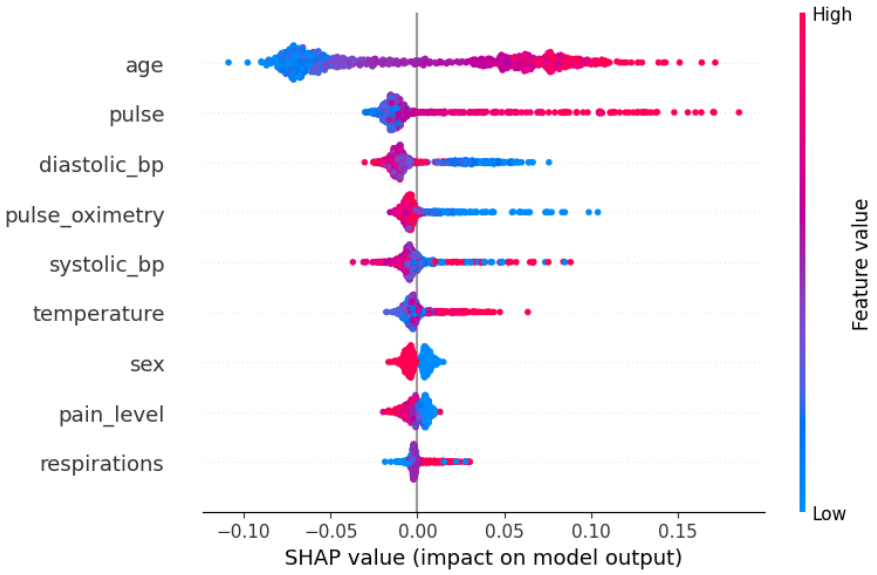
Supplementary Figures



Supplementary Figure 1. Beeswarm plot of tabular feature importance. We determine the contribution of each tabular feature using Shapley values. These values quantify contribution by taking the average marginal contribution of each feature over all possible subsets. We report the average estimated Shapley values over the validation set of all runs in our repeated k-fold cross validation. We illustrate a beeswarm plot to show the impact on model output of each tabular feature used. We observe that the model predicts a patient with a higher age, higher pulse rate, low pulse oximetry value and low diastolic blood pressure to be more likely to be admitted. From these features, age is overall the most predictive factor of predicted admission.

Supplementary Tables

	AUROC (95% CI)	AUPRC (95% CI)	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)
ESI	0.575 [0.575,0.576]	0.458 [0.457,0.459]	0.364 [0.317,0.433]	0.756 [0.679,0.809]	0.525 [0.512,0.535]	0.653 [0.631,0.685]
Video data only	0.693 [0.689,0.696]	0.608 [0.604,0.612]	0.632 [0.621,0.642]	0.658 [0.651,0.666]	0.563 [0.559,0.568]	0.721 [0.717,0.726]
Triage data only (RN)	0.678 [0.668,0.687]	0.603 [0.592,0.615]	0.658 [0.643,0.675]	0.587 [0.571,0.602]	0.529 [0.519,0.539]	0.716 [0.706,0.727]
Video + Triage data	0.714**** [0.709,0.719]	0.642 **** [0.636,0.649]	0.672*** [0.665,0.678]	0.626* [0.620,0.632]	0.558** [0.554,0.561]	0.734 **** [0.731,0.738]

Supplementary Table 1. ED disposition prediction using our Video + Triage Data late fusion model on the orientation video segment. These are the full results of Figures 3 and 4. (* $p < 0.01$ compared to triage only; ** $p < 0.01$ compared to triage only and ESI baseline; *** $p < 0.01$ compared to video only and ESI baseline & $p < 0.05$ compared to triage only; **** $p < 0.01$ compared to all other models)

Task	Task specifics
1. Baseline Observation	Ask the patient to remain silent while recording for 15 seconds.
2. Orientation	Ask the patients to answer three questions: What is your name? Where are you now? What is today's date?
3a. Respiration – Deep breath	Ask the patient to take a deep breath in and out
3a. Respiration – Functional breath (Counting)	Ask the patient to take a deep breath, then count from 1 to 100 as fast as possible, articulating each number, until they run out of breath
4a. Standardized movement - Coordination/cognition (Eye cover)	Ask the patient to cover their left eye with their right hand
4b. Standardized movement - Coordination/proprioception (Finger to Nose)	Ask the patient to touch their finger to their nose five times
5. Final observation (Post activity)	Ask the patient to remain silent again while recording for 15 seconds

Supplementary Table 2. Patient tasks during video recording.

	Classifier	AUROC (95% CI)	AUPRC (95% CI)	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)
1. Baseline	Random Forest	0.706 [0.700,0.713]	0.641 [0.632,0.650]	0.659 [0.642,0.679]	0.620 [0.604,0.635]	0.547 [0.541,0.554]	0.728 [0.721,0.737]
	XGBoost	0.691 [0.685,0.697]	0.617 [0.608,0.626]	0.644 [0.630,0.656]	0.627 [0.615,0.637]	0.545 [0.536,0.555]	0.720 [0.711,0.729]
	AdaBoost	0.689 [0.683,0.695]	0.622 [0.610,0.632]	0.622 [0.593,0.656]	0.642 [0.604,0.674]	0.549 [0.537,0.560]	0.714 [0.707,0.722]
2. Orientation	Random Forest	0.716 [0.710,0.721]	0.652 [0.643,0.660]	0.664 [0.650,0.678]	0.639 [0.629,0.651]	0.562 [0.556,0.567]	0.737 [0.730,0.743]
	XGBoost	0.710 [0.705,0.715]	0.631 [0.624,0.639]	0.657 [0.641,0.673]	0.643 [0.632,0.652]	0.561 [0.556,0.567]	0.732 [0.725,0.739]
	AdaBoost	0.706 [0.700,0.713]	0.637 [0.629,0.645]	0.637 [0.618,0.656]	0.643 [0.617,0.668]	0.558 [0.547,0.570]	0.723 [0.715,0.729]
3a. Deep Breath	Random Forest	0.707 [0.700,0.714]	0.641 [0.631,0.652]	0.658 [0.647,0.669]	0.623 [0.605,0.638]	0.550 [0.544,0.556]	0.728 [0.724,0.732]
	XGBoost	0.695 [0.687,0.702]	0.625 [0.613,0.636]	0.652 [0.639,0.667]	0.616 [0.606,0.628]	0.543 [0.534,0.552]	0.721 [0.712,0.731]
	AdaBoost	0.691 [0.682,0.700]	0.630 [0.618,0.641]	0.605 [0.580,0.630]	0.653 [0.624,0.682]	0.552 [0.540,0.563]	0.709 [0.702,0.715]
3b. Counting	Random Forest	0.708 [0.700,0.715]	0.645 [0.636,0.656]	0.659 [0.646,0.670]	0.631 [0.624,0.638]	0.554 [0.550,0.559]	0.731 [0.725,0.736]
	XGBoost	0.689 [0.680,0.696]	0.617 [0.607,0.629]	0.614 [0.589,0.638]	0.644 [0.620,0.667]	0.546 [0.535,0.557]	0.709 [0.701,0.718]
	AdaBoost	0.688 [0.681,0.697]	0.620 [0.610,0.631]	0.643 [0.615,0.667]	0.609 [0.575,0.644]	0.540 [0.525,0.555]	0.715 [0.706,0.724]
4a. Eye Cover	Random Forest	0.706 [0.700,0.713]	0.644 [0.633,0.655]	0.654 [0.644,0.664]	0.623 [0.613,0.631]	0.548 [0.542,0.554]	0.726 [0.720,0.733]
	XGBoost	0.703 [0.698,0.707]	0.640 [0.629,0.649]	0.647 [0.630,0.664]	0.635 [0.622,0.647]	0.552 [0.547,0.556]	0.725 [0.719,0.733]

	AdaBoost	0.704 [0.699,0.709]	0.642 [0.636,0.648]	0.640 [0.620,0.662]	0.649 [0.607,0.682]	0.565 [0.546,0.581]	0.728 [0.722,0.734]
4b. Finger to Nose	Random Forest	0.708 [0.702,0.714]	0.647 [0.638,0.656]	0.658 [0.645,0.669]	0.624 [0.608,0.637]	0.550 [0.543,0.558]	0.728 [0.723,0.733]
	XGBoost	0.700 [0.693,0.706]	0.621 [0.612,0.630]	0.650 [0.638,0.663]	0.625 [0.616,0.633]	0.546 [0.540,0.553]	0.724 [0.718,0.731]
	AdaBoost	0.695 [0.688,0.703]	0.621 [0.612,0.631]	0.620 [0.598,0.640]	0.660 [0.633,0.687]	0.562 [0.548,0.578]	0.717 [0.709,0.724]
5. Post Activity	Random Forest	0.705 [0.699,0.711]	0.640 [0.632,0.649]	0.658 [0.647,0.670]	0.624 [0.612,0.635]	0.550 [0.544,0.557]	0.728 [0.721,0.735]
	XGBoost	0.690 [0.683,0.696]	0.610 [0.599,0.621]	0.641 [0.622,0.659]	0.627 [0.615,0.640]	0.542 [0.538,0.547]	0.719 [0.711,0.726]
	AdaBoost	0.686 [0.679,0.692]	0.613 [0.602,0.622]	0.618 [0.595,0.640]	0.647 [0.627,0.670]	0.550 [0.543,0.558]	0.713 [0.706,0.720]

Supplementary Table 3. Video segment comparison with Video + Triage Data late fusion model. We illustrate results of our late fusion model with different classifiers on each of our video segments. For fair comparison, we train and evaluate our models on the same subset of n=627 patients that have video for all the different segments. We report the average and 95% confidence intervals of running 3-fold cross validation over 10 runs.

	Classifier	**AUROC (95% CI)**	**AUPRC (95% CI)**	**Sensitivity (95% CI)**	**Specificity (95% CI)**	**PPV (95% CI)**	**NPV (95% CI)**
1. Baseline	Random Forest	0.698 [0.692,0.704]	0.640 [0.633,0.646]	0.631 [0.622,0.639]	0.643 [0.634,0.653]	0.552 [0.544,0.559]	0.718 [0.712,0.723]
	XGBoost	0.691 [0.682,0.700]	0.624 [0.616,0.633]	0.619 [0.608,0.631]	0.643 [0.627,0.661]	0.546 [0.535,0.557]	0.711 [0.703,0.720]
	AdaBoost	0.672 [0.664,0.679]	0.602 [0.589,0.612]	0.766 [0.732,0.800]	0.432 [0.375,0.486]	0.495 [0.481,0.508]	0.750 [0.735,0.767]
2. Orientation	Random Forest	0.710 [0.705,0.715]	0.653 [0.647,0.659]	0.651 [0.642,0.660]	0.659 [0.654,0.664]	0.569 [0.565,0.574]	0.734 [0.729,0.740]
	XGBoost	0.710 [0.704,0.715]	0.646 [0.638,0.652]	0.644 [0.633,0.658]	0.665 [0.653,0.676]	0.572 [0.564,0.579]	0.731 [0.725,0.738]
	AdaBoost	0.702 [0.691,0.711]	0.635 [0.620,0.648]	0.737 [0.704,0.774]	0.507 [0.443,0.559]	0.520 [0.507,0.532]	0.753 [0.732,0.781]

3a. Deep Breath	Random Forest	0.694 [0.686,0.702]	0.633 [0.622,0.643]	0.637 [0.620,0.651]	0.641 [0.633,0.649]	0.552 [0.543,0.560]	0.720 [0.711,0.728]
	XGBoost	0.683 [0.672,0.695]	0.623 [0.606,0.640]	0.619 [0.603,0.634]	0.634 [0.618,0.649]	0.540 [0.531,0.549]	0.708 [0.700,0.715]
	AdaBoost	0.674 [0.665,0.684]	0.610 [0.595,0.625]	0.743 [0.698,0.789]	0.431 [0.365,0.492]	0.485 [0.470,0.500]	0.741 [0.717,0.764]
3b. Counting	Random Forest	0.701 [0.692,0.710]	0.641 [0.631,0.650]	0.642 [0.630,0.654]	0.651 [0.639,0.661]	0.562 [0.552,0.571]	0.727 [0.720,0.734]
	XGBoost	0.688 [0.677,0.698]	0.621 [0.610,0.633]	0.597 [0.576,0.615]	0.673 [0.658,0.686]	0.558 [0.546,0.571]	0.709 [0.698,0.719]
	AdaBoost	0.672 [0.668,0.677]	0.604 [0.595,0.613]	0.719 [0.676,0.761]	0.466 [0.418,0.515]	0.490 [0.483,0.498]	0.717 [0.705,0.730]
4a. Eye Cover	Random Forest	0.700 [0.694,0.706]	0.641 [0.634,0.649]	0.629 [0.622,0.634]	0.642 [0.630,0.653]	0.551 [0.544,0.558]	0.717 [0.714,0.720]
	XGBoost	0.698 [0.690,0.706]	0.629 [0.614,0.643]	0.651 [0.617,0.697]	0.634 [0.577,0.670]	0.558 [0.546,0.568]	0.702 [0.656,0.730]
	AdaBoost	0.692 [0.684,0.699]	0.626 [0.616,0.636]	0.731 [0.707,0.756]	0.501 [0.445,0.553]	0.512 [0.497,0.529]	0.742 [0.724,0.762]
4b. Finger to Nose	Random Forest	0.696 [0.686,0.706]	0.639 [0.630,0.649]	0.617 [0.609,0.626]	0.653 [0.635,0.670]	0.555 [0.543,0.565]	0.714 [0.708,0.720]
	XGBoost	0.683 [0.674,0.691]	0.608 [0.596,0.619]	0.612 [0.595,0.631]	0.632 [0.611,0.651]	0.536 [0.528,0.544]	0.704 [0.698,0.710]
	AdaBoost	0.681 [0.667,0.694]	0.604 [0.589,0.620]	0.709 [0.679,0.741]	0.512 [0.433,0.576]	0.512 [0.491,0.531]	0.711 [0.698,0.724]
5. Post Activity	Random Forest	0.697 [0.690,0.705]	0.636 [0.629,0.643]	0.630 [0.616,0.647]	0.646 [0.634,0.659]	0.552 [0.543,0.562]	0.719 [0.711,0.727]
	XGBoost	0.685 [0.677,0.694]	0.613 [0.599,0.629]	0.618 [0.606,0.629]	0.639 [0.628,0.650]	0.542 [0.534,0.551]	0.709 [0.703,0.714]
	AdaBoost	0.680 [0.669,0.690]	0.611 [0.602,0.621]	0.736 [0.697,0.775]	0.473 [0.419,0.523]	0.500 [0.489,0.511]	0.741 [0.719,0.769]

Supplementary Table 4. Video segment comparison with Video + Triage Data early fusion model. We illustrate results of our early fusion model with different classifiers on each of our video segments. For fair comparison, we

train and evaluate our models on the same subset of n=627 patients that have video for all the different segments. We report the average and 95% confidence intervals of running 3-fold cross validation over 10 runs.

	Classifier	AUROC (95% CI)	AUPRC (95% CI)	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)
1. Baseline	Random Forest	0.671 [0.663,0.679]	0.589 [0.580,0.598]	0.622 [0.602,0.642]	0.625 [0.613,0.637]	0.536 [0.524,0.547]	0.707 [0.696,0.718]
	XGBoost	0.650 [0.642,0.658]	0.562 [0.549,0.576]	0.609 [0.591,0.627]	0.608 [0.596,0.622]	0.518 [0.509,0.526]	0.694 [0.686,0.702]
	AdaBoost	0.649 [0.641,0.657]	0.562 [0.552,0.572]	0.630 [0.600,0.660]	0.582 [0.542,0.621]	0.514 [0.501,0.527]	0.698 [0.693,0.704]
2. Orientation	Random Forest	0.685 [0.677,0.692]	0.608 [0.600,0.615]	0.619 [0.606,0.631]	0.645 [0.633,0.659]	0.548 [0.538,0.558]	0.712 [0.704,0.719]
	XGBoost	0.672 [0.664,0.681]	0.588 [0.578,0.598]	0.607 [0.590,0.626]	0.646 [0.628,0.661]	0.543 [0.529,0.553]	0.706 [0.696,0.714]
	AdaBoost	0.673 [0.660,0.685]	0.587 [0.572,0.603]	0.656 [0.636,0.679]	0.575 [0.537,0.609]	0.523 [0.509,0.537]	0.715 [0.705,0.724]
3a. Deep Breath	Random Forest	0.670 [0.663,0.676]	0.600 [0.592,0.607]	0.615 [0.604,0.627]	0.618 [0.604,0.631]	0.530 [0.524,0.537]	0.701 [0.696,0.705]
	XGBoost	0.647 [0.636,0.657]	0.568 [0.550,0.584]	0.591 [0.574,0.607]	0.614 [0.589,0.637]	0.519 [0.506,0.534]	0.686 [0.678,0.694]
	AdaBoost	0.653 [0.643,0.663]	0.575 [0.565,0.587]	0.604 [0.569,0.641]	0.590 [0.535,0.642]	0.516 [0.500,0.537]	0.682 [0.667,0.693]
3b. Counting	Random Forest	0.674 [0.664,0.682]	0.600 [0.593,0.606]	0.617 [0.607,0.627]	0.629 [0.618,0.642]	0.537 [0.529,0.546]	0.706 [0.699,0.712]
	XGBoost	0.649 [0.638,0.659]	0.571 [0.558,0.583]	0.574 [0.555,0.591]	0.644 [0.619,0.668]	0.529 [0.516,0.542]	0.688 [0.682,0.694]
	AdaBoost	0.641 [0.631,0.652]	0.559 [0.551,0.570]	0.681 [0.636,0.724]	0.489 [0.422,0.558]	0.492 [0.476,0.509	0.692 [0.655,0.721]
4a. Eye Cover	Random Forest	0.668 [0.661,0.675]	0.595 [0.587,0.604]	0.619 [0.607,0.630]	0.612 [0.597,0.626]	0.527 [0.519,0.535]	0.701 [0.694,0.708]

	XGBoost	0.668 [0.663,0.674]	0.590 [0.580,0.601]	0.610 [0.586,0.634]	0.636 [0.615,0.656]	0.541 [0.536,0.546]	0.706 [0.697,0.715]
	AdaBoost	0.670 [0.665,0.675]	0.582 [0.572,0.592]	0.648 [0.621,0.679]	0.575 [0.511,0.629]	0.526 [0.504,0.546]	0.718 [0.711,0.727]
4b. Finger to Nose	Random Forest	0.672 [0.667,0.677]	0.605 [0.598,0.611]	0.617 [0.602,0.632]	0.614 [0.602,0.626]	0.528 [0.523,0.533]	0.700 [0.693,0.707]
	XGBoost	0.664 [0.656,0.672]	0.583 [0.574,0.593]	0.606 [0.594,0.617]	0.616 [0.605,0.625]	0.523 [0.514,0.532]	0.695 [0.688,0.703]
	AdaBoost	0.663 [0.654,0.672]	0.574 [0.565,0.582]	0.596 [0.577,0.621]	0.626 [0.590,0.655]	0.530 [0.518,0.543]	0.695 [0.687,0.702]
5. Post Activity	Random Forest	0.670 [0.663,0.676]	0.590 [0.584,0.596]	0.622 [0.612,0.631]	0.611 [0.597,0.626]	0.527 [0.517,0.537]	0.702 [0.695,0.709]
	XGBoost	0.648 [0.641,0.655]	0.557 [0.547,0.568]	0.611 [0.591,0.630]	0.605 [0.583,0.625]	0.518 [0.509,0.526]	0.693 [0.686,0.700]
	AdaBoost	0.649 [0.642,0.657]	0.559 [0.547,0.572]	0.623 [0.596,0.656]	0.573 [0.533,0.603]	0.507 [0.500,0.515]	0.678 [0.657,0.692]

Supplementary Table 5. Video segment comparison with Video-only model. We illustrate results of our video-only model with different classifiers on each of our video segments. For fair comparison, we train and evaluate our models on the same subset of n=627 patients that have video for all the different segments. We report the average and 95% confidence intervals of running 3-fold cross validation over 10 runs.