Supplementary Material for Chapter 5

Tables

	Perfect Test	90% Sensitive & 90% Specific RDT						
Rank	All Noise	1x Poisson Noise	7x Poisson Noise	1x Dynamical Noise	7x Dynamical Noise			
1	Variance (0.62)	Variance (0.61)	Variance (0.6)	Variance (0.66)	Index of dispersion (0.47)			
2	Index of dispersion (0.58)	Index of dispersion (0.59)	Index of dispersion (0.6)	Autocovariance (0.63)	Autocorrelation (0.45)			
3	Autocovariance (0.58)	Autocovariance (0.55) Coefficient of variation (0.59)		Index of dispersion (0.57)	Coefficient of variation (0.45)			
4	Autocorrelation (0.38)	Coefficient of variation (0.51)	Autocovariance (0.51)	Mean (0.48)	Autocovariance (0.39)			
5	Mean (0.38)	Autocorrelation (0.41)	Mean (0.37)	Autocorrelation (0.42)	Variance (0.38)			
6	Coefficient of variation (0.15)	Mean (0.35)	Autocorrelation (0.36)	Coefficient of variation (0.12)	Skewness (0.11)			
7	Skewness (0.06)	Skewness (0.14)	Skewness (0.1)	Skewness (-0.05)	Kurtosis (-0.19)			
8	Kurtosis (-0.02) Kurtosis (0.0		Kurtosis (0.02) Kurtosis (-0.11)		Mean (-0.21)			

Table 1: The ranking and mean value of Kendall's Tau computed on the subset of the emergent time series after the burn-in period, for a perfect test and an RDT with 90% sensitivity and 90% specificity, under high and low Poisson and dynamical noise systems

	Perfect Test	90% Sensitive & 90% Specific RDT						
Rank	All Noise	1x Poisson Noise	7x Poisson Noise	1x Dynamical Noise	7x Dynamical Noise			
1	Autocovariance (0.7)	Autocovariance (0.73)	Autocovariance (0.72)	Autocovariance (0.66)	Mean (0.55)			
2	Variance (0.7)	Variance (0.71)	Mean (0.7)	Variance (0.64)	Variance (0.54)			
3	Mean (0.68)	Mean (0.7)	Variance (0.68)	Mean (0.63)	Autocovariance (0.53)			
4	Index of dispersion (0.63)	Index of dispersion (0.67)	Index of dispersion (0.68)	Index of dispersion (0.59)	Skewness (0.51)			
5	Autocorrelation (0.62)	Autocorrelation (0.67)	Coefficient of variation (0.67)	Autocorrelation (0.57)	Kurtosis (0.51)			
6	Skewness (0.6)	Coefficient of variation (0.6)	Autocorrelation (0.66)	Skewness (0.56)	Index of dispersion (0.5)			
7	Kurtosis (0.53)	Skewness (0.58)	Skewness (0.6)	Kurtosis (0.51)	Autocorrelation (0.49)			
8	Coefficient of variation (0.39)			Coefficient of variation (0.45)	Coefficient of variation (0.48)			

Table 2: The ranking of AUC computed on the subset of the emergent time series after the burn-in period, for a perfect test and an RDT with 90% sensitivity and 90% specificity, under high and low Poisson and dynamical noise systems

	Perfec	ct Test	90% Sensitive & 90% Specific RDT						
Rank	All Noise -	All Noise -	1x Poisson	7x Poisson	1x	7x			
Kank	AUC-0.5	Accuracy	Noise	Noise	Dynamical	Dynamical			
					Noise	Noise			
1	1 Autocovariance Mean (0.72)		Mean (0.73)	Variance	Variance	Mean (0.6)			
	(0.2)			(0.73)	(0.68)				
2	Variance Variance Varia		Variance	Coefficient Mean (0.66)		Skewness			
	(0.2)	(0.72)	(0.7)	of variation		(0.57)			
			(0.72)						
3	3 Mean (0.18) Autocovariance		Autocovariance	Mean (0.72)	Autocovariance	Kurtosis			
		(0.7)	(0.7)		(0.65)	(0.55)			
4	4 Index of Index of		Index of	Index of	Skewness	Autocorrelation			
	dispersion dispersion		dispersion	dispersion	(0.6)	(0.54)			
	(0.13) (0.63) (0.69)		(0.69)	(0.72)					
5	5 AutocorrelationAutocorrelation		Autocorrelation	Autocovariance	Index of	Autocovariance			
	(0.12)	(0.62)	(0.67)	(0.71)	dispersion	(0.52)			
					(0.6)				
6	Coefficient	Skewness	Coefficient	Autocorrelation	Kurtosis	Coefficient			
	of variation	(0.6)	of variation	(0.66)	(0.57)	of variation			
	(0.11)		(0.66)			(0.52)			
7	Skewness	Kurtosis	Skewness	Skewness	Autocorrelation	Variance			
	(0.1)	(0.58)	(0.62)	(0.66)	(0.55)	(0.52)			
8	Kurtosis Coefficient Ku		Kurtosis	Kurtosis Coefficient		Index of			
	(0.03) of variation		(0.56)	(0.57)	of variation	dispersion			
	(0.5)				(0.51)	(0.51)			

Table 3: The ranking and $|{\rm AUC}-0.5|$ for each metric computed on the emergent time series with a perfect test, and the alert accuracy with an RDT. The values are computed on the full time series, and the subset from after the completion of the burn-in period, with a perfect test

Plots AUC Magnitude Heatmaps After 5yr Burn in



Figure 1: Poisson noise, 1x

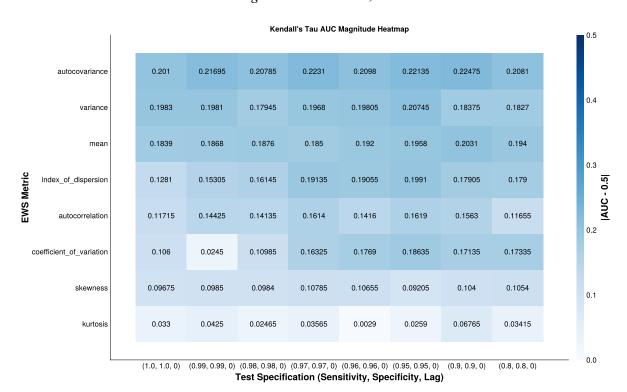


Figure 2: Poisson noise, 7x

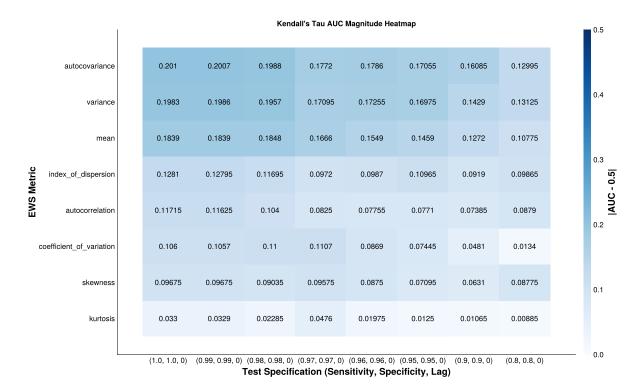


Figure 3: Dynamical noise, 1x

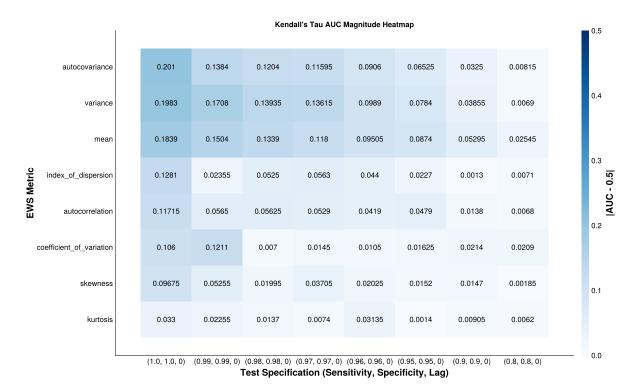


Figure 4: Dynamical noise, 7x

AUC Heatmaps

After 5yr Burn in



Figure 5: Poisson noise, 1x



Figure 6: Poisson noise, 7x



Figure 7: Dynamical noise, 1x



Figure 8: Dynamical noise, 7x

Optimal Threshold Accuracies

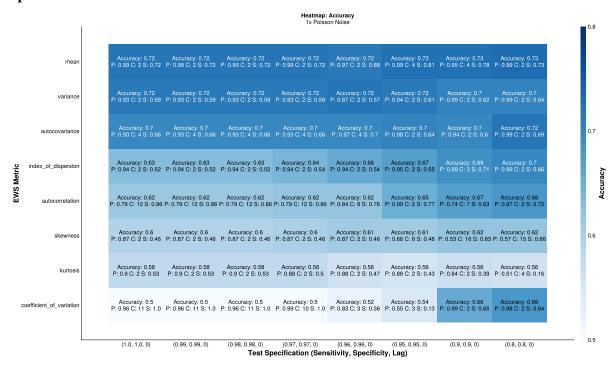


Figure 9: The maximal alert accuracy under 1x Poisson noise. P) refers to the long-running percentile threshold to return a flag, and C) the number of consecutive flags to trigger and alert, that in combination produce the maximal accuracy. S) refers to the specificity of the alert system

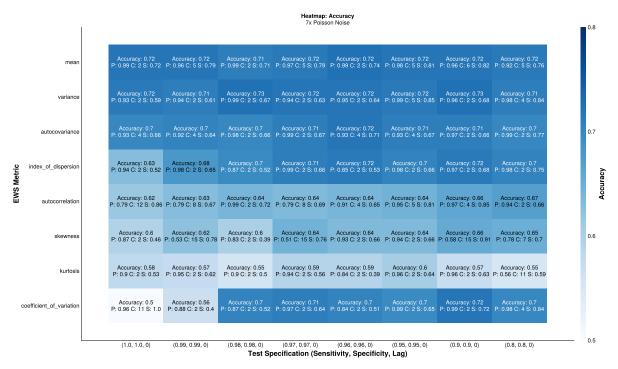


Figure 10: The maximal alert accuracy under 7x Poisson noise. P) refers to the long-running percentile threshold to return a flag, and C) the number of consecutive flags to trigger and alert, that in combination produce the maximal accuracy. S) refers to the specificity of the alert system

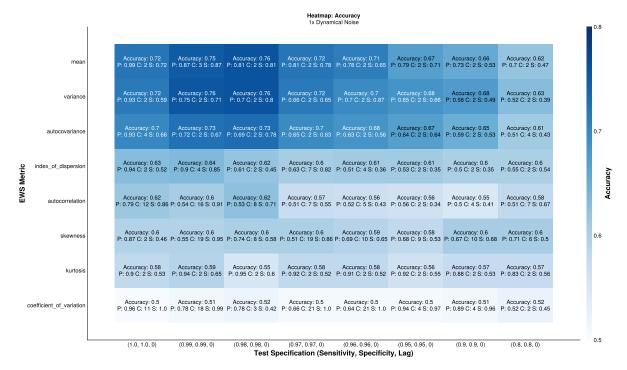


Figure 11: The maximal alert accuracy under 1x Dynamical noise. P) refers to the long-running percentile threshold to return a flag, and C) the number of consecutive flags to trigger and alert, that in combination produce the maximal accuracy. S) refers to the specificity of the alert system

							Accuracy nical Noise			
	mean		ccuracy: 0.72 .99 C: 2 S: 0.72	Accuracy: 0.7 P: 0.85 C: 2 S: 0.75	Accuracy: 0.7 P: 0.84 C: 2 S: 0.88	Accuracy: 0.68 P: 0.8 C: 2 S: 0.87	Accuracy: 0.66 P: 0.73 C: 2 S: 0.64	Accuracy: 0.66 P: 0.72 C: 2 S: 0.62	Accuracy: 0.6 P: 0.73 C: 2 S: 0.69	Accuracy: 0.54 P: 0.64 C: 10 S: 0.85
EWS Metri	variance		ccuracy: 0.72 .93 C: 2 S: 0.59	Accuracy: 0.64 P: 0.65 C: 5 S: 0.68	Accuracy: 0.61 P: 0.65 C: 4 S: 0.96	Accuracy: 0.58 P: 0.53 C: 2 S: 0.81	Accuracy: 0.56 P: 0.51 C: 3 S: 0.81	Accuracy: 0.54 P: 0.59 C: 3 S: 0.92	Accuracy: 0.52 P: 0.61 C: 2 S: 0.93	Accuracy: 0.52 P: 0.56 C: 9 S: 0.96
	autocovariance		Accuracy: 0.7 .93 C: 4 S: 0.66	Accuracy: 0.64 P: 0.69 C: 2 S: 0.6	Accuracy: 0.6 P: 0.64 C: 4 S: 0.96	Accuracy: 0.58 P: 0.51 C: 5 S: 0.88	Accuracy: 0.55 P: 0.5 C: 5 S: 0.87	Accuracy: 0.54 P: 0.5 C: 4 S: 0.82	Accuracy: 0.52 P: 0.54 C: 9 S: 0.96	Accuracy: 0.52 P: 0.56 C: 4 S: 0.9
	index_of_dispersion		ccuracy: 0.63 .94 C: 2 S: 0.52	Accuracy: 0.54 P: 0.52 C: 12 S: 0.73	Accuracy: 0.54 P: 0.56 C: 7 S: 0.9	Accuracy: 0.52 P: 0.5 C: 5 S: 0.88	Accuracy: 0.52 P: 0.51 C: 2 S: 0.82	Accuracy: 0.51 P: 0.5 C: 4 S: 0.91	Accuracy: 0.51 P: 0.64 C: 3 S: 0.92	Accuracy: 0.52 P: 0.59 C: 2 S: 0.85
	autocorrelation		ccuracy: 0.62 79 C: 12 S: 0.86	Accuracy: 0.54 P: 0.78 C: 8 S: 0.95	Accuracy: 0.53 P: 0.64 C: 17 S: 0.99	Accuracy: 0.55 P: 0.6 C: 8 S: 0.82	Accuracy: 0.53 P: 0.53 C: 13 S: 0.87	Accuracy: 0.52 P: 0.6 C: 13 S: 0.94	Accuracy: 0.54 P: 0.6 C: 13 S: 0.91	Accuracy: 0.54 P: 0.58 C: 10 S: 0.65
	skewness	P: 0	Accuracy: 0.6 .87 C: 2 S: 0.46	Accuracy: 0.59 P: 0.51 C: 11 S: 0.78	Accuracy: 0.6 P: 0.51 C: 11 S: 0.74	Accuracy: 0.59 P: 0.55 C: 11 S: 0.95	Accuracy: 0.58 P: 0.51 C: 11 S: 0.96	Accuracy: 0.57 P: 0.53 C: 10 S: 0.9	Accuracy: 0.57 P: 0.57 C: 9 S: 0.82	Accuracy: 0.54 P: 0.52 C: 10 S: 0.76
	kurtosis		ccuracy: 0.58 0.9 C: 2 S: 0.53	Accuracy: 0.54 P: 0.55 C: 4 S: 0.26	Accuracy: 0.55 P: 0.84 C: 2 S: 0.87	Accuracy: 0.55 P: 0.73 C: 2 S: 0.63	Accuracy: 0.57 P: 0.7 C: 3 S: 0.81	Accuracy: 0.54 P: 0.5 C: 4 S: 0.51	Accuracy: 0.55 P: 0.68 C: 2 S: 0.68	Accuracy: 0.52 P: 0.67 C: 2 S: 0.68
	oefficient_of_variation		Accuracy: 0.5 .96 C: 11 S: 1.0	Accuracy: 0.51 P: 0.89 C: 9 S: 0.98	Accuracy: 0.51 P: 0.5 C: 8 S: 0.69	Accuracy: 0.52 P: 0.5 C: 8 S: 0.85	Accuracy: 0.52 P: 0.63 C: 6 S: 0.89	Accuracy: 0.53 P: 0.52 C: 2 S: 0.59	Accuracy: 0.52 P: 0.63 C: 7 S: 0.89	Accuracy: 0.52 P: 0.61 C: 7 S: 0.89
			(1.0, 1.0, 0)	(0.99, 0.99, 0)	(0.98, 0.98, 0) Test Sr	(0.97, 0.97, 0)	(0.96, 0.96, 0) sitivity. Specifici	(0.95, 0.95, 0)	(0.9, 0.9, 0)	(0.8, 0.8, 0)

Figure 12: The maximal alert accuracy under 7x Dynamical noise. P) refers to the long-running percentile threshold to return a flag, and C) the number of consecutive flags to trigger and alert, that in combination produce the maximal accuracy. S) refers to the specificity of the alert system

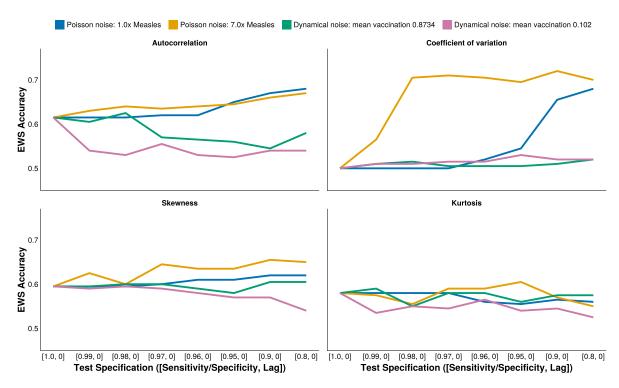


Figure 13: The change in alert accuracy for less correlated EWS metrics under increasing diagnostic uncertainty, and low and high levels of Poisson or dynamical noise

Survival Analysis

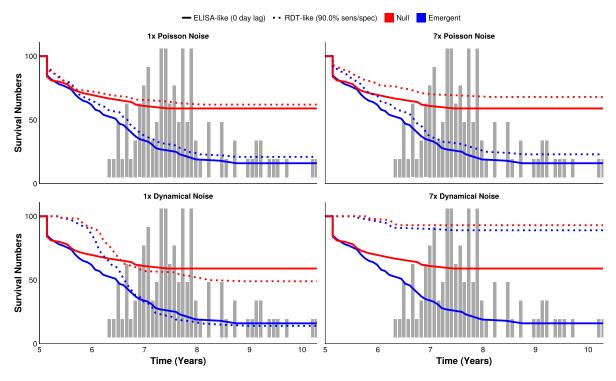


Figure 14: Survival curves for the variance EWS metric computed on emergent and null simulations, with a perfect test and an RDT equivalent with 90% sensitivity and specificity. The histogram depicts the times when the tipping point is reached ($R_E=1$) under the emergent simulation, right-truncating the curves

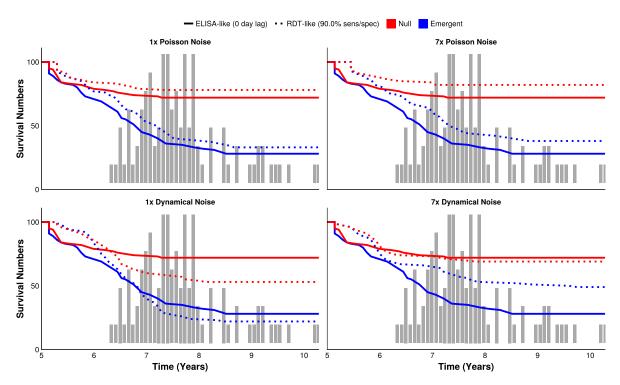


Figure 15: Survival curves for the mean EWS metric computed on emergent and null simulations, with a perfect test and an RDT equivalent with 90% sensitivity and specificity. The histogram depicts the times when the tipping point is reached ($R_{\rm E}=1$) under the emergent simulation, right-truncating the curves.

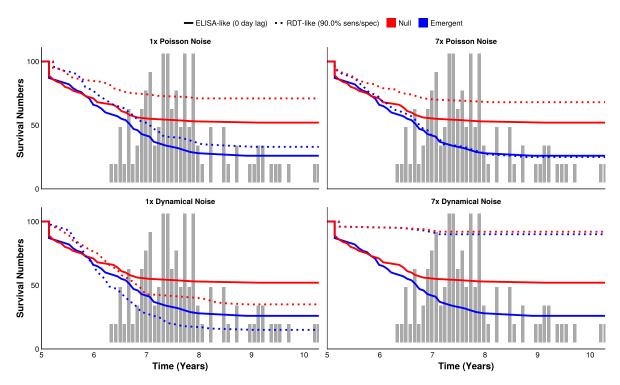


Figure 16: Survival curves for the index of dispersion EWS metric computed on emergent and null simulations, with a perfect test and an RDT equivalent with 90% sensitivity and specificity. The histogram depicts the times when the tipping point is reached ($R_E=1$) under the emergent simulation, right-truncating the curves.

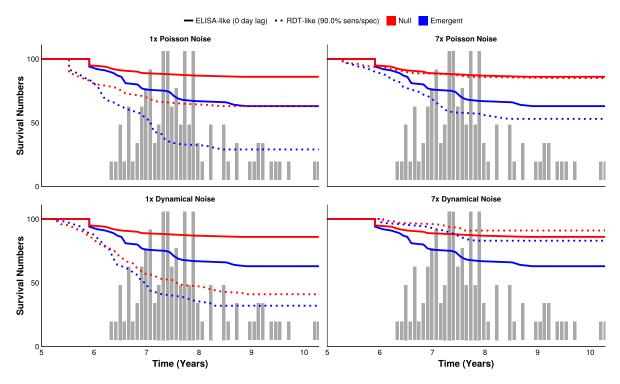


Figure 17: Survival curves for the autocorrelation EWS metric computed on emergent and null simulations, with a perfect test and an RDT equivalent with 90% sensitivity and specificity. The histogram depicts the times when the tipping point is reached ($R_{\rm E}=1$) under the emergent simulation, right-truncating the curves.

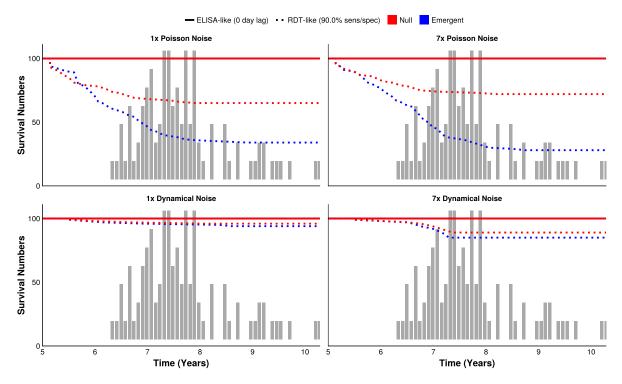


Figure 18: Survival curves for the coefficient of variation EWS metric computed on emergent and null simulations, with a perfect test and an RDT equivalent with 90% sensitivity and specificity. The histogram depicts the times when the tipping point is reached ($R_E=1$) under the emergent simulation, right-truncating the curves.

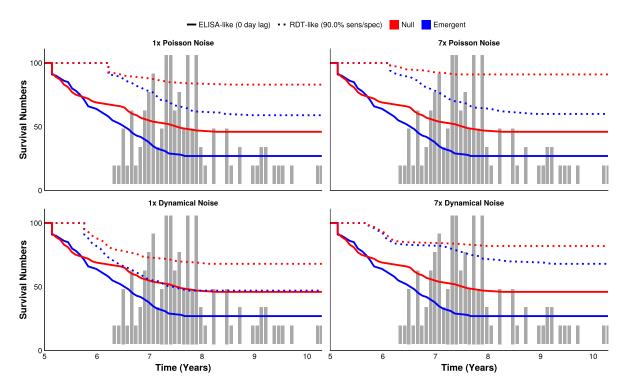


Figure 19: Survival curves for the skewness EWS metric computed on emergent and null simulations, with a perfect test and an RDT equivalent with 90% sensitivity and specificity. The histogram depicts the times when the tipping point is reached ($R_E=1$) under the emergent simulation, right-truncating the curves.

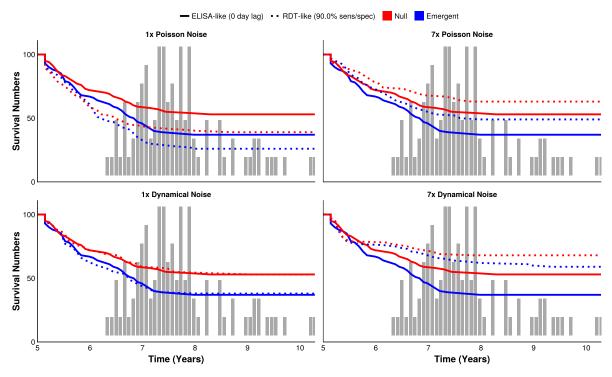


Figure 20: Survival curves for the kurtosis EWS metric computed on emergent and null simulations, with a perfect test and an RDT equivalent with 90% sensitivity and specificity. The histogram depicts the times when the tipping point is reached ($R_E=1$) under the emergent simulation, right-truncating the curves.