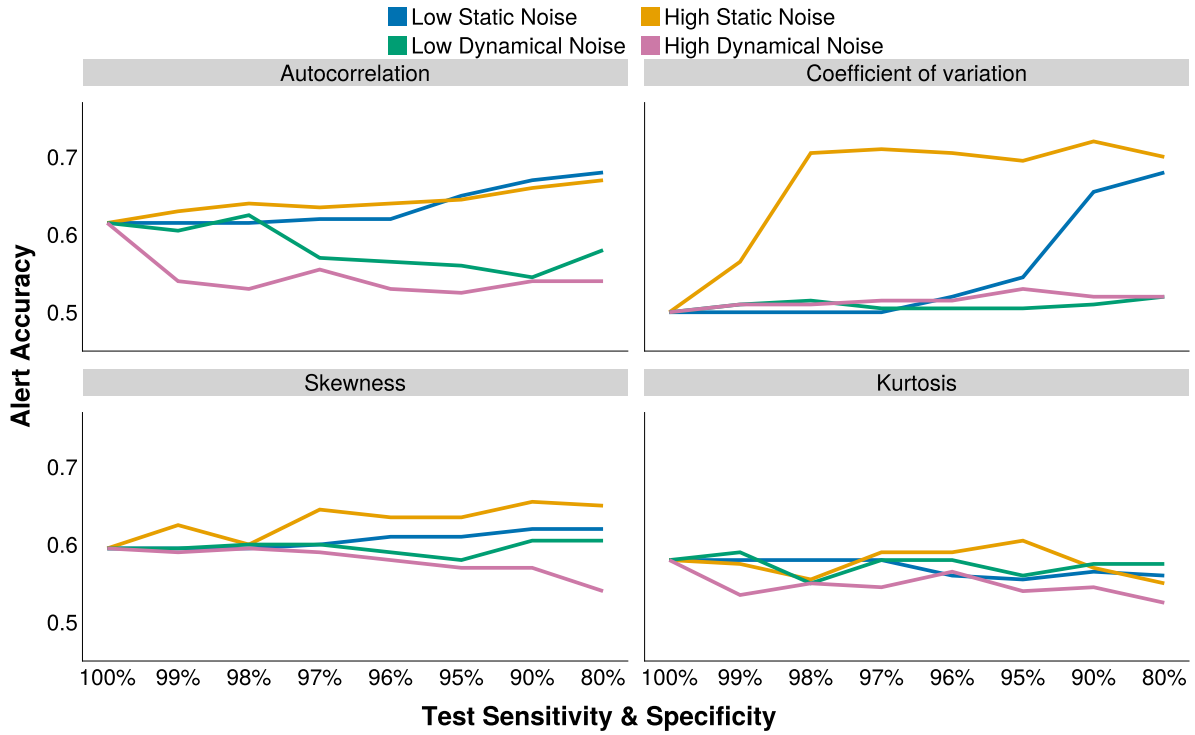
Supplementary Material for Chapter 5

Figures



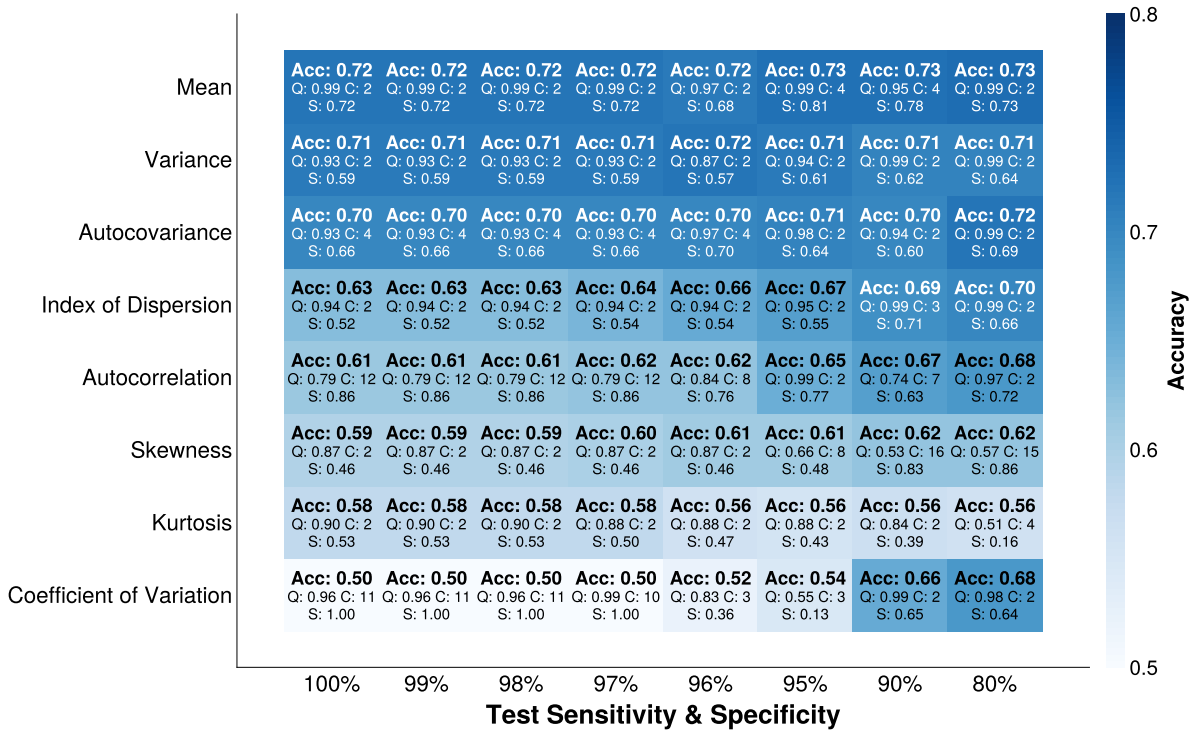
Supplemental Figure 1: The change in alert accuracy for the least correlated EWS metrics under increasing diagnostic uncertainty, and low and high levels of Poisson or dynamical noise. Low noise refers to simulations where the average incidence of noise is equal to the average incidence of measles. High noise refers to simulations where the average incidence of noise is equal to 7 times the average incidence of measles. The test sensitivity equals the test specificity for all diagnostic tests.

Supplemental Figure 2: The strength of the correlation ($|\text{AUC} - 0.5|$) for each EWS metric with emergence, at low levels of Poisson noise, for diagnostic tests of varying accuracy, and was computed after the completion of the burn-in period. The test sensitivity equals the test specificity for all diagnostic tests.

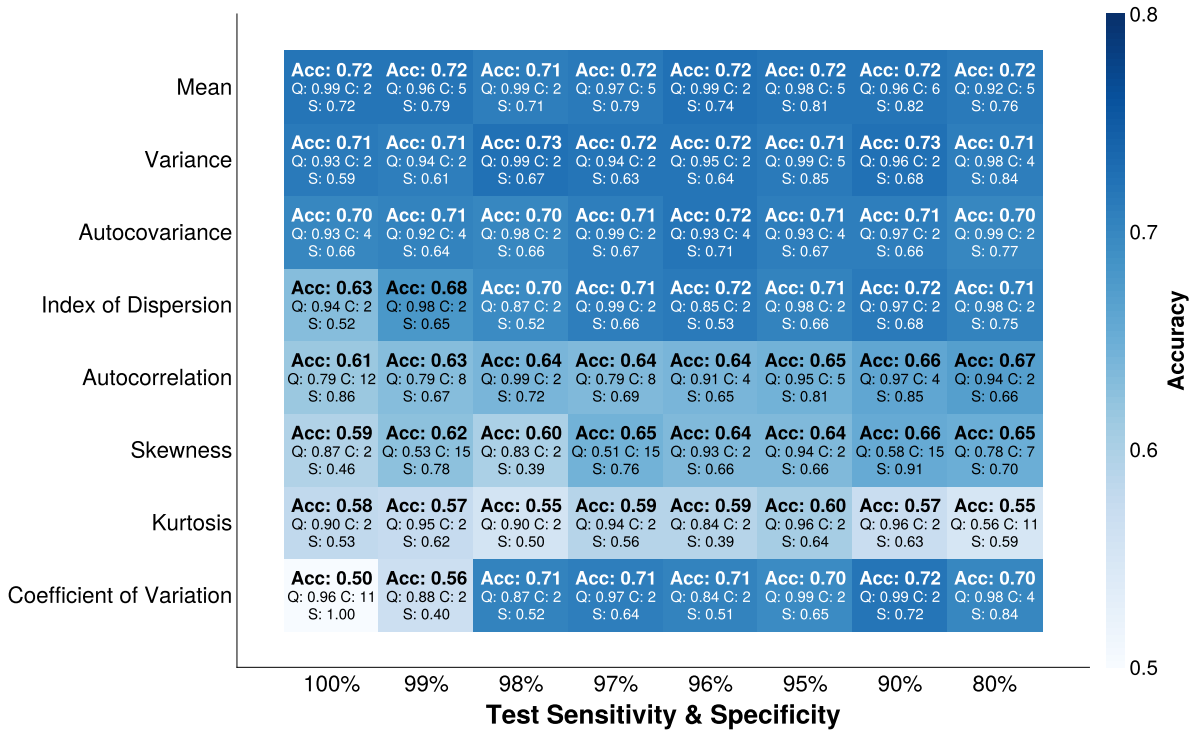
Supplemental Figure 3: The strength of the correlation ($|\text{AUC} - 0.5|$) for each EWS metric with emergence, at high levels of Poisson noise, for diagnostic tests of varying accuracy, and was computed after the completion of the burn-in period. The test sensitivity equals the test specificity for all diagnostic tests.

Supplemental Figure 4: The strength of the correlation ($|\text{AUC} - 0.5|$) for each EWS metric with emergence, at low levels of dynamical noise, for diagnostic tests of varying accuracy, and was computed after the completion of the burn-in period. The test sensitivity equals the test specificity for all diagnostic tests.

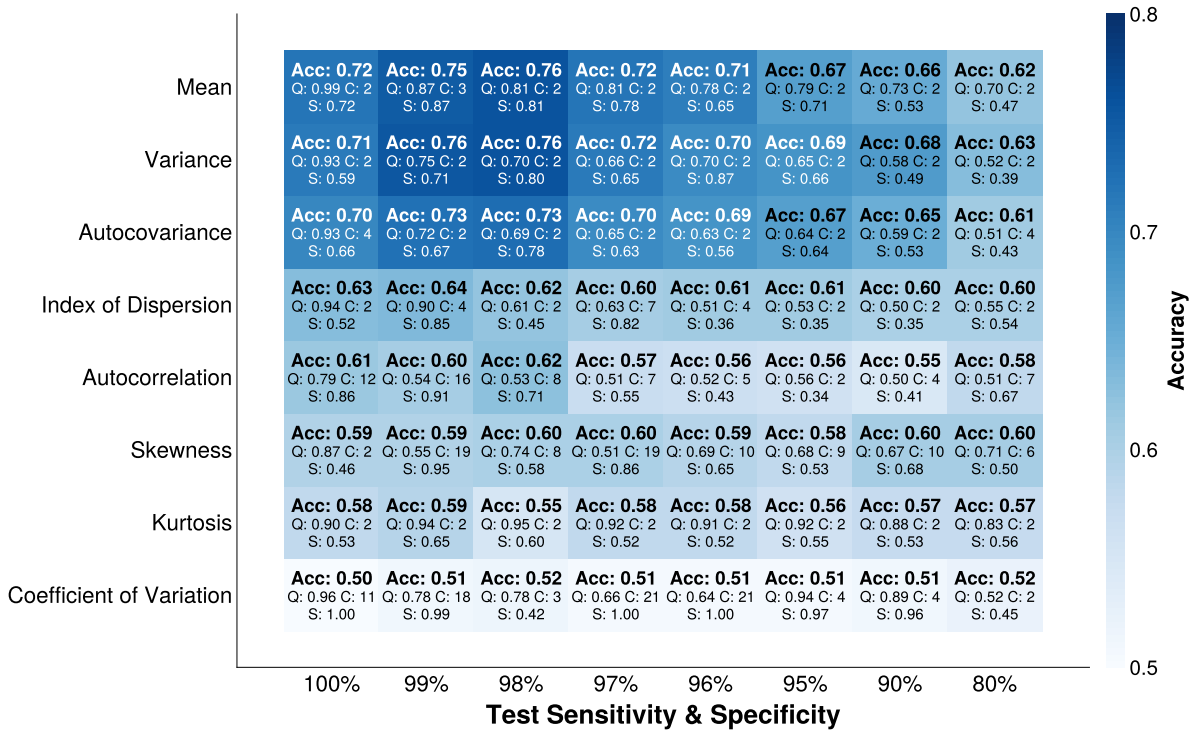
Supplemental Figure 5: The strength of the correlation ($|\text{AUC} - 0.5|$) for each EWS metric with emergence, at high levels of dynamical noise, for diagnostic tests of varying accuracy, and was computed after the completion of the burn-in period. The test sensitivity equals the test specificity for all diagnostic tests.



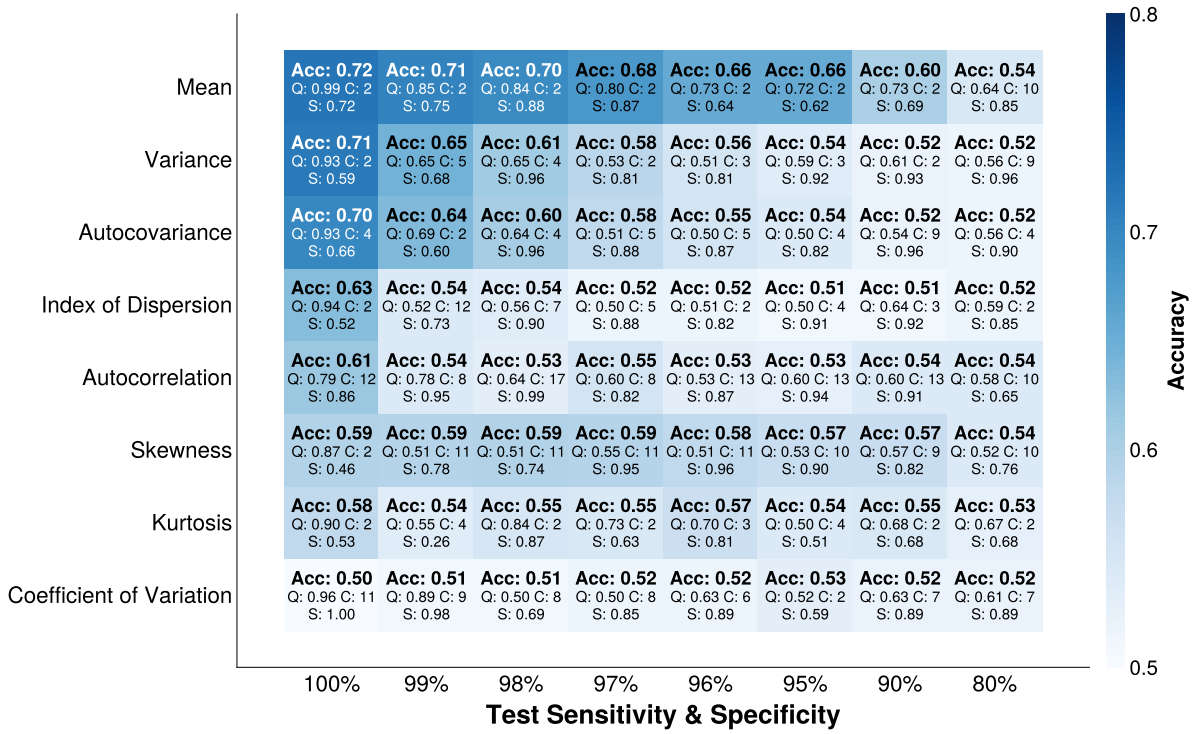
Supplemental Figure 6: The maximal alert accuracy achieved by each EWS metric under low levels of Poisson noise. Q) refers to the long-running quantile threshold to return a flag, and C) the number of consecutive flags to trigger an alert, that in combination produce the maximal accuracy. S) refers to the resulting specificity of the alert system. The test sensitivity equals the test specificity for all diagnostic tests.



Supplemental Figure 7: The maximal alert accuracy achieved by each EWS metric under high levels of Poisson noise. Q) refers to the long-running quantile threshold to return a flag, and C) the number of consecutive flags to trigger an alert, that in combination produce the maximal accuracy. S) refers to the resulting specificity of the alert system. The test sensitivity equals the test specificity for all diagnostic tests.



Supplemental Figure 8: The maximal alert accuracy achieved by each EWS metric under low levels of dynamical noise. Q) refers to the long-running quantile threshold to return a flag, and C) the number of consecutive flags to trigger an alert, that in combination produce the maximal accuracy. S) refers to the resulting specificity of the alert system. The test sensitivity equals the test specificity for all diagnostic tests.



Supplemental Figure 9: The maximal alert accuracy achieved by each EWS metric under high levels of dynamical noise. Q) refers to the long-running quantile threshold to return a flag, and C) the number of consecutive flags to trigger an alert, that in combination produce the maximal accuracy. S) refers to the resulting specificity of the alert system. The test sensitivity equals the test specificity for all diagnostic tests.

Tables

Rank	Perfect Test	90% Sensitive & Specific Imperfect Test			
	All Noise	Poisson Noise		Dynamical Noise	
		Low	High	Low	High
1	Variance (0.62)	Variance (0.61)	Variance (0.60)	Variance (0.66)	Index of dispersion (0.47)
2	Index of dispersion (0.58)	Index of dispersion (0.59)	Index of dispersion (0.60)	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 (0.10)	Skewness (-0.05)	Kurtosis (-0.19)
8	Kurtosis (-0.02)	Kurtosis (0.01)	Kurtosis (0.02)	Kurtosis (-0.11)	Mean (-0.21)

Supplemental 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 imperfect test with sensitivity and specificity equal to 90%, under high and low Poisson and dynamical noise systems

Rank	Perfect Test	90% Sensitive & Specific Imperfect Test			
	All Noise	Poisson Noise		Dynamical Noise	
		Low	High	Low	High
1	Mean (0.72)	Mean (0.73)	Variance (0.73)	Variance (0.68)	Mean (0.60)
2	Variance (0.71)	Variance (0.71)	Coefficient of variation (0.72)	Mean (0.66)	Skewness (0.57)
3	Autocovariance (0.70)	Autocovariance (0.70)	Mean (0.72)	Autocovariance (0.65)	Kurtosis (0.55)
4	Index of dispersion (0.63)	Index of dispersion (0.69)	Index of dispersion (0.72)	Skewness (0.60)	Autocorrelation (0.54)
5	Autocorrelation (0.61)	Autocorrelation (0.67)	Autocovariance (0.71)	Index of dispersion (0.60)	Autocovariance (0.52)
6	Skewness (0.59)	Coefficient of variation (0.66)	Autocorrelation (0.66)	Kurtosis (0.57)	Coefficient of variation (0.52)
7	Kurtosis (0.58)	Skewness (0.62)	Skewness (0.66)	Autocorrelation (0.55)	Variance (0.52)
8	Coefficient of variation (0.50)	Kurtosis (0.56)	Kurtosis (0.57)	Coefficient of variation (0.51)	Index of dispersion (0.51)

Supplemental Table 2: The ranking and alert accuracy of the EWS-based alert system computed on the subset of the emergent time series after the burn-in period, for a perfect test and an imperfect test with sensitivity and specificity equal to 90%, under high and low Poisson and dynamical noise systems