The MET Project: Distinguishing Multisystem Inflammatory Syndrome in Children from Typhus Using Artificial Intelligence

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BACKGROUND

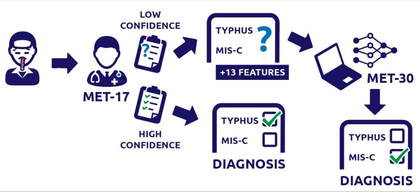
- Murine typhus, a rickettsial disease endemic in Texas, is a known clinical and laboratory mimic of Multi-system Inflammatory Syndrome in Children (MIS-C)
- As the therapeutic approaches differ greatly, and serologic confirmation takes time, it is essential to develop tools to rapidly distinguish between these entities

OBJECTIVE

- **Develop a decision support system to timely differentiate typhus from MIS-C**

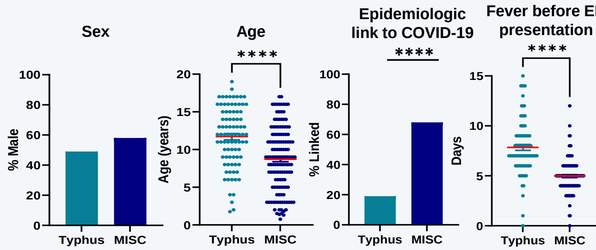
METHODS

- Retrospective chart review of 133 MIS-C and 87 typhus patients admitted to TCH
- 43 demographic, clinical, and laboratory features available within 6 hours of presentation
- Patients divided evenly into training and test cohorts
- Features narrowed to 30 by an iterative process of importance using an Attention LSTM
- MET-17 is a score calculated using 17 features, selected based on importance obtained from the Attention module, which delivers a confidence index (CI) for the diagnosis
- MET-30 is an Attention LSTM used to categorize cases that do not meet the CI cutoff with MET-17

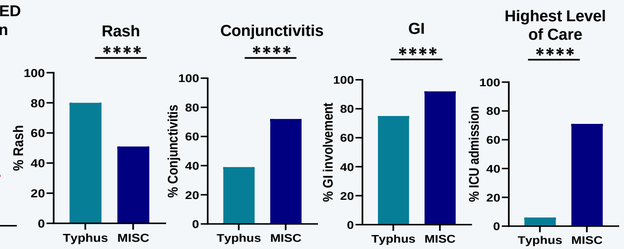


RESULTS**** = $p<0.0001$

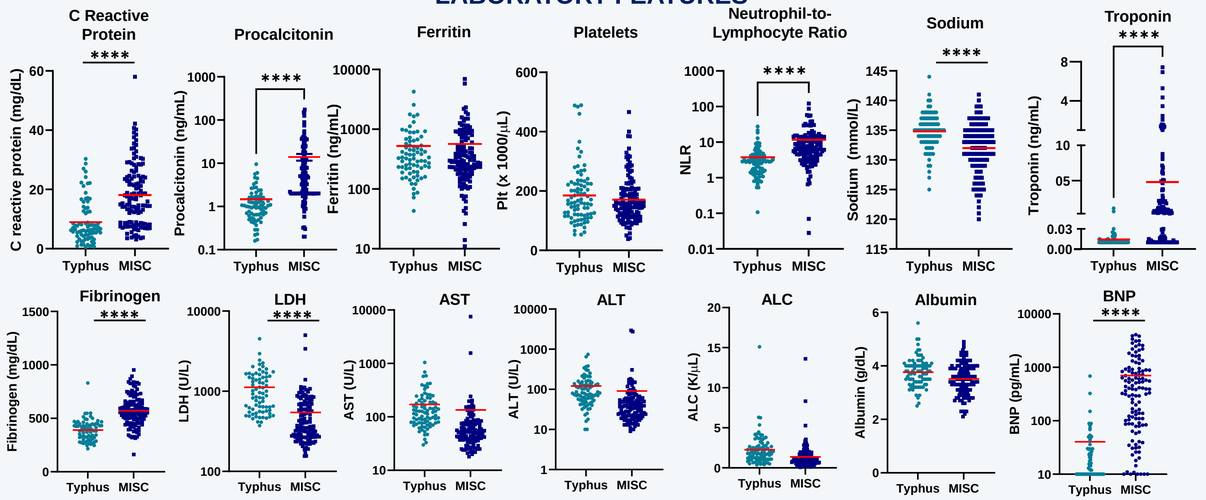
DEMOGRAPHIC FEATURES



CLINICAL FEATURES



LABORATORY FEATURES



Vitals	Threshold	Under	Above
Fever before hospital (days)	7 days	-8	8
Highest heart rate in ED	124 bpm	4	-4
Fever Tmax	103ºF	6	-6

MET-17

Demographics	>= 11	< 11
Age (years)	4	-4

AST	Female						Male					
	0-4	4-7	7-10	10-12	12-16	16-25	0-4	4-7	7-10	10-12	12-16	16-25
Min	20	15	15	10	10	5	20	15	15	10	15	10
Max	60	50	40	40	30	30	60	50	40	60	40	45

If AST is WITHIN the normal range the patient will get -11 points // If AST is ABOVE the normal range will get 11 points

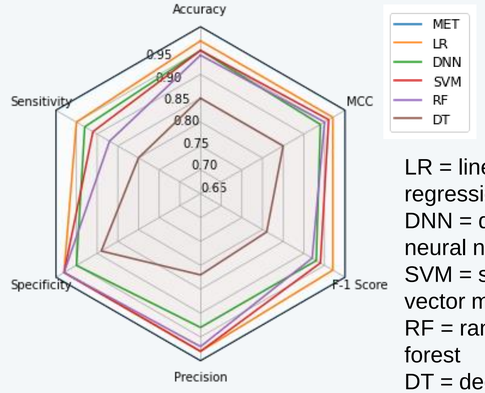
Labs	Normal Range	If Low	If Normal	If High
BNP	Below 200	-	10	-10
Fibrinogen	220-440	4	16	-16
Troponin	Below 0.03	-	9	-9
Sodium	Above 135	-2	2	-
ANC/ALC ratio	Below 3.67	-	4	-4

Clinicals	If Yes	If No
Antecedent illness	-2	2
Epidemiologic link to SARS-CoV-2	-5	5
Conjunctivitis	-4	4
Rash	3	-3

ALT	Female			Male		
	0-4	4-14	14-25	0-4	4-14	14-25
Min	14	11	10	12	10	11
Max	45	28	35	45	41	26

If ALT is ABOVE the normal range the patient will get 8 points // If it is not, will get -8 points

AI MODEL PERFORMANCE



LR = linear regression
DNN = deep neural networks
SVM = support-vector machine
RF = random forest
DT = decision trees

- The MET score outperforms all other models in all performance metrics computed

CONCLUSIONS

- **Artificial Intelligence can be successfully employed to distinguish MIS-C from typhus**
- MET Score (MET-17 and MET-30) with a CI of 0.85 achieves a perfect performance in both cohorts

NEXT STEPS

- Ongoing interinstitutional results validation using MIS-C and typhus patients from other hospitals
- **Deploy our tool on MDCalc,** accessible to all clinicians, to maximize clinical applicability and to collect multi-center data to continuously validate our algorithm

ACKNOWLEDGMENTS

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Turning Discovery Into Health

RAPID ACCELERATION OF DIAGNOSTICS (RADX)

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