

Appendix A. Mathematical equations used by the model

Variables	Values or equations
Rate of injury	0.1
Population involved in the MCI	1,040
Proportion of the minor injured casualties	0.4
Judgment factor of medical demand of the minor injured casualties	0.03
Proportion of the moderate injured casualties	0.26
Proportion of the serious injured casualties	0.34
Judgment factor of the risk of death on the spot	0.04
Increased medical demand of the minor injured casualties	Judgment factor of medical demand of the minor injured casualties \times EXP (IF THEN ELSE (Time \leq On-site waiting time, Time, On-site waiting time) \times 0.013)
Medical demand of the minor injured casualties	Number of the minor injured casualties \times (1 - Judgment factor of medical demand of the minor injured casualties + Increased medical demand of the minor injured casualties)
Number of the minor injured casualties	Number of casualties \times Proportion of the minor injured casualties
Number of casualties	Population involved in the MCI \times Rate of injury
Number of the moderate injured casualties	Number of casualties \times Proportion of the moderate injured casualties
Medical demand of the serious injured casualties	Number of the serious injured casualties - Number of deaths on the spot
Number of the serious injured casualties	Number of casualties \times Proportion of the serious injured casualties
Number of deaths on the spot	Number of the serious injured casualties \times Mortality on the spot
Mortality on the spot	(1 - Effective rate of on-site first aid) \times (Judgment factor of the risk of death on the spot + Increased risks of death on the spot) \times Proportion of the serious injured casualties
Increased risks of death on the spot	Judgment factor of the risk of death on the spot \times EXP (IF THEN ELSE (Time \leq On-site waiting time, Time, On-site waiting time) \times 0.028)
Effective rate of on-site first aid	Initial value of rate of on-site first aid \times Rate of on-site first aid
Rate of on-site first aid	0.1
Initial value of rate of on-site first aid	0.2
Actual medical demand	Medical demand of the minor injured casualties + Number of the moderate injured casualties + Medical demand of the serious injured casualties

Emergency medical demand	Actual medical demand
Hospitalized medical demand	Actual medical demand × Rate of hospitalized medical demand
Rate of hospitalized medical demand	0.889
Ratio of emergency medical supply and demand	Emergency medical rescue capability / Emergency medical demand
Ratio of hospitalized medical supply and demand	Hospitalized medical rescue capability / Hospitalized medical demand
Factor of emergency medical rescue capability	3 / 0.08
Emergency medical rescue capability	Factor of emergency medical rescue capability × Number of available emergency medical staff ^ Factor of emergency manpower × Fixed assets of hospitals ^ (1 - Factor of emergency manpower) / 10000
Factor of emergency manpower	0.7
Total population of Shanghai	24,260,000
Morbidity rate of the population	0.321 × 26
Rate of medical-seeking choice	0.154 × 26
Average medical expenses	(289 + 14862.2) / 2
Annual number of patients	Total population of Shanghai × Morbidity rate of the population
Number of patients seeking medical treatment	Annual number of patients × Rate of medical-seeking choice
Market profits of hospitals	Number of patients seeking medical treatment × Average medical expenses
Fixed assets of hospitals	136,874,000
Proportion of emergency incomes	0.311
Emergency incomes	Market profits of hospitals × Proportion of emergency incomes
Number of medical staff	35,584
Number of available medical staff of hospitals	11,120
Smooth cycle of manpower distribution	12
Proportion of hospitalized incomes	0.689
Hospitalized incomes	Market profits of hospitals × Proportion of hospitalized incomes
Average personal output	Market profits of hospitals / Number of medical staff
Distribution rate of emergency medical staff	SMOOTH (Average personal output of emergency medical staff / Average personal output / Ratio of emergency medical supply and demand, TIME STEP × Smooth cycle of manpower distribution)
Allocation condition of emergency medical staff	Distribution rate of emergency medical staff / (Distribution rate of emergency medical staff + Distribution rate of hospitalized medical staff)

Average personal output of emergency medical staff	Emergency incomes / Number of available emergency medical staff
Number of available emergency medical staff	Number of available medical staff of hospitals × DELAY1I (Allocation condition of emergency medical staff, TIME STEP, 0.1)
Average personal output of hospitalized medical staff	Hospitalized incomes / Number of available hospitalized medical staff
Number of available hospitalized medical staff	Number of available medical staff of hospitals × DELAY1I (Allocation condition of hospitalized medical staff, TIME STEP, 0.3)
Allocation condition of hospitalized medical staff	Distribution rate of hospitalized medical staff / (Distribution rate of emergency medical staff + Distribution rate of hospitalized medical staff)
Hospitalized medical rescue capability	Factor of hospitalized medical rescue capability × Number of available hospitalized medical staff ^ Factor of hospitalized manpower × Fixed assets of hospitals ^ (1 - Factor of hospitalized manpower) / 10000
Factor of hospitalized manpower	25 / 620
Distribution rate of hospitalized medical staff	SMOOTH (Average personal output of hospitalized medical staff / Average personal output / Ratio of hospitalized medical supply and demand, TIME STEP × Smooth cycle of manpower distribution)
Assessment of hospitalized medical rescue capability	IF THEN ELSE (Ratio of hospitalized medical supply and demand ≥ 1, 1, 2)
Assessment of emergency medical rescue capability	IF THEN ELSE(Ratio of emergency medical supply and demand>=1, 1, 2)
Assessment of medical rescue capability	IF THEN ELSE (Assessment of emergency medical rescue capability × Assessment of hospitalized medical rescue capability = 1, 1, IF THEN ELSE (Assessment of emergency medical rescue capability < Assessment of hospitalized medical rescue capability, 2, IF THEN ELSE (Assessment of emergency medical rescue capability > Assessment of hospitalized medical rescue capability, 3, 4)))
Average organization condition	0.65
Average decision condition	0.65
Average planning condition	0.65
Average judgment condition	0.65
Efficiency of the information system	0.7
Situation of implementing decisions	IF THEN ELSE (1 > DELAY3I (Medical evacuation decisions, Time + 0.01, 0), DELAY3I (Medical evacuation decisions, Time + 0.01, 0), 1)
Rate of completing plans	IF THEN ELSE (DELAY3I (Medical evacuation plans, Time + 0.01, 0) < 1, DELAY3I (Medical evacuation plans, Time + 0.01, 0), 1)

Rate of processing information	IF THEN ELSE (DELAY3I (Demand judgments, Time + 0.01, 0) < 1, DELAY3I (Demand judgments, Time + 0.01, 0), 1)
Rate of receiving information	IF THEN ELSE (Demand judgments < 1, DELAY3 (Efficiency of the information system, Time + 0.01), 0)
Organization and command situation	INTEG (IF THEN ELSE (Difference of organization situation > Situation of implementing decisions, + Situation of implementing decisions, + Difference of organization situation), 0.4)
Medical evacuation decisions	INTEG (IF THEN ELSE (Difference of decision situation > Rate of completing plans, + Rate of completing plans, + Difference of decision situation), 0.4)
Medical evacuation plans	INTEG (IF THEN ELSE (Difference of planning situation > Rate of processing information, + Rate of processing information, + Difference of planning situation), 0.4)
Demand judgments	INTEG (IF THEN ELSE (Difference of demand judgments > Rate of receiving information, + Rate of receiving information, + Difference of demand judgments), 0.4)
Implementation rate of organization and command	SMOOTH (Organization and command situation, Time + 0.01)
Difference of decision situation	Average decision condition - Medical evacuation decisions
Difference of planning situation	Average planning condition - Medical evacuation plans
Difference of demand judgments	Average judgment condition - Demand judgments
Difference of demand judgments	Average judgment condition - Demand judgments
Average on-site waiting time	12
Average triage and on-site first aid time	5
Number of emergency medical staff of emergency centers	153.44
Average medical evacuation time	10
Initial number of available ambulances	47.65
Transfer rate of ambulances	0.5
Number of available ambulances	Initial number of available ambulances × Transfer rate of ambulances
Actual number of ambulances involved in the MCI	Number of available ambulances × Implementation rate of organization and command
On-site waiting time	Average on-site waiting time / Implementation rate of organization and command
Pre-hospital time	On-site waiting time + Triage and on-site first aid time + Medical evacuation time
Average mortality of the minor injured casualties	0.02

Medical evacuation time	IF THEN ELSE (Actual number of ambulances involved in the MCI / Actual medical demand \geq 1, Average medical evacuation time, IF THEN ELSE ((Actual medical demand / Actual number of ambulances involved in the MCI - 1) \leq 1, Average medical evacuation time + 10.7, (Actual medical demand / Actual number of ambulances involved in the MCI - 1) \times 10.7 + Average medical evacuation time))
Actual number of emergency medical staff of emergency centers involved in the MCI	Number of emergency medical staff of emergency centers \times Implementation rate of organization and command
Triage and on-site first aid time	IF THEN ELSE (Actual number of emergency medical staff of emergency centers involved in the MCI / Actual medical demand \geq 1/3, Average of triage and on-site first aid time, Average of triage and on-site first aid time + 4 \times (Actual medical demand / Actual number of emergency medical staff of emergency centers involved in the MCI - 3))
Rank of the timeliness of pre-hospital time	IF THEN ELSE (Pre-hospital time \leq 30, 1, IF THEN ELSE (Pre-hospital time \leq 60, 2, IF THEN ELSE (Pre-hospital time \leq 120, 3, IF THEN ELSE (Pre-hospital time \leq 180, 4, 5)))))
Mortality	IF THEN ELSE (Time < 0.167, DELAY1 (Mortality on the spot, Time + 0.01), Mortality of the minor injured casualties + Mortality of the moderate injured casualties + Mortality of the serious injured casualties + Mortality on the spot)
Mortality of the minor injured casualties	Assessment of mortality of the minor injured casualties \times Proportion of the minor injured casualties + Increased risks of complication \times Incidence rate of complication of the minor injured casualties
Mortality of the moderate injured casualties	Assessment of mortality of the moderate injured casualties \times Proportion of the moderate injured casualties + Increased risks of complication \times Incidence rate of complication of the moderate injured casualties
Mortality of the serious injured casualties	Assessment of mortality of the serious injured casualties \times Proportion of the serious injured casualties + Increased risks of complication \times Incidence rate of complication of the serious injured casualties
Incidence rate of complication of the minor injured casualties	0.055
Increased risks of complication	0.123
Incidence rate of complication of the moderate injured casualties	0.359

Average mortality of the moderate injured casualties	0.05
Incidence rate of complication of the serious injured casualties	0.598
Average mortality of the serious injured casualties	0.15
Increased risks of medical rescue capability	IF THEN ELSE (Assessment of medical rescue capability = 1, 0, IF THEN ELSE (Assessment of medical rescue capability = 2, $0.015 \times \text{EXP}(\text{Time} \times 0.025)$, IF THEN ELSE (Assessment of medical rescue capability = 3, $0.03 \times \text{EXP}(\text{Time} \times 0.025)$, $0.06 \times \text{EXP}(\text{Time} \times 0.025)$)))
Increased risks of timeliness of pre-hospital time	IF THEN ELSE (Rank of the timeliness of pre-hospital time = 1, 0, IF THEN ELSE (Rank of the timeliness of pre-hospital time = 2, $0.005 \times \text{EXP}(\text{Time} \times 0.03)$, IF THEN ELSE (Rank of the timeliness of pre-hospital time = 3, $0.01 \times \text{EXP}(\text{Time} \times 0.03)$, IF THEN ELSE (Rank of the timeliness of pre-hospital time = 4, $0.015 \times \text{EXP}(\text{Time} \times 0.03)$, $0.025 \times \text{EXP}(\text{Time} \times 0.03)$))))
Assessment of mortality of the minor injured casualties	Average mortality of the minor injured casualties + Increased risks of medical rescue capability + Increased risks of timeliness of pre-hospital time
Assessment of mortality of the moderate injured casualties	Average mortality of the moderate injured casualties + Increased risks of medical rescue capability + Increased risks of timeliness of pre-hospital time
Assessment of mortality of the serious injured casualties	Average mortality of the serious injured casualties + Increased risks of medical rescue capability + Increased risks of timeliness of pre-hospital time
