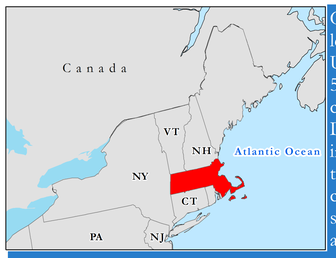
Surviving Sepsis: Utilization of a Vulnerability Model to Identify Towns at Highest Risk of Poor Hospital Outcomes due to Severe Infection

Sepsis Intro



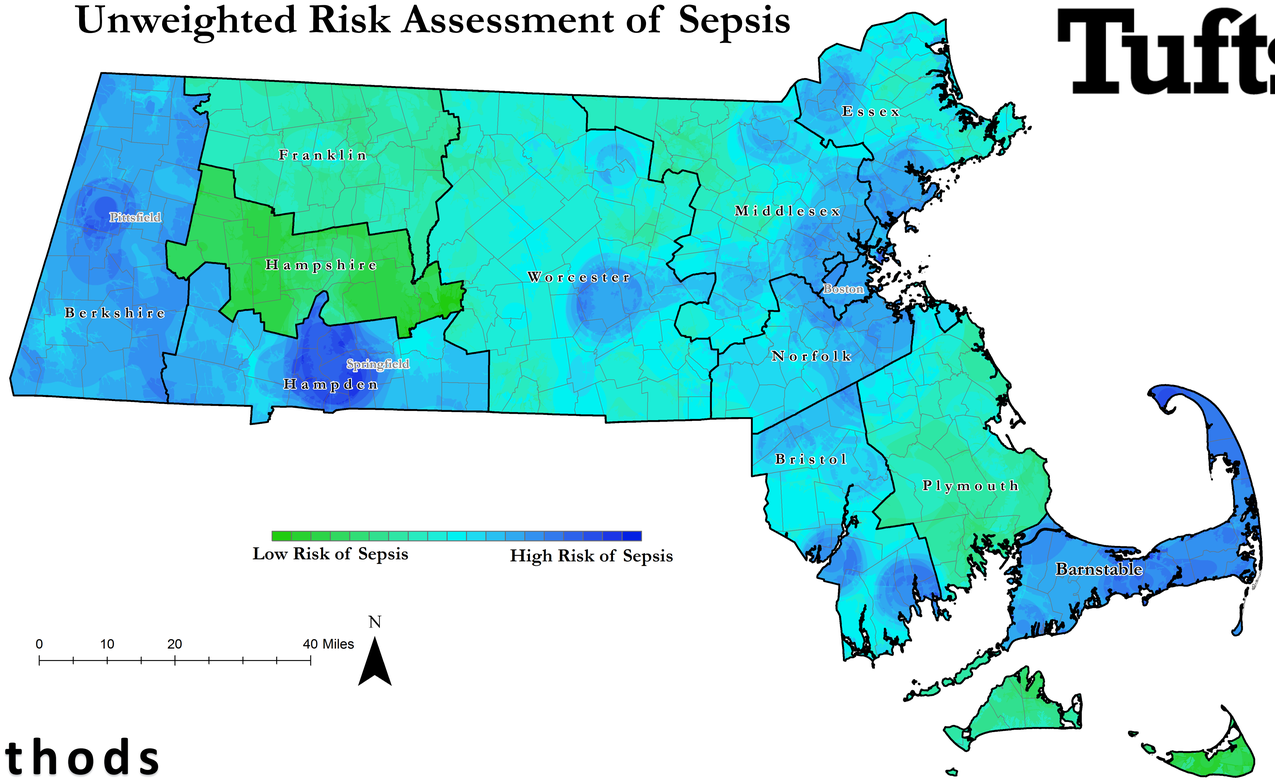
Currently, sepsis is the leading cause of death in U.S. hospitals, with up to 50 percent of sepsis cases resulting in death. Defined as a whole body inflammatory response to an infection, sepsis is considered a widespread systemic overreaction and can quickly progress to septic shock if not identified and treated early.

Characterizing sepsis has been a challenge for our healthcare system, as hospital sepsis presentations are often vague and misleading. As the utilization of new algorithms and therapeutic interventions to treat sepsis in the clinical setting continues to improve, more should be done from a public health standpoint to assist in the identification of sepsis and ensure that quality of patient care is optimized. To assist hospital clinicians with screening for sepsis, public health officials should utilize geospatial analyst tools to measure the areas with greatest risk of poor hospital outcomes due to sepsis.

By utilizing the current hospital protocols for sepsis screening and diagnosis, an unweighted risk factor calculation for sepsis has been generated and includes various illnesses commonly seen in sepsis patients.

With the hope of presenting this geospatial sepsis risk model to public health and healthcare leaders in the state of Massachusetts, perhaps a policy measure can be implemented to create new interventions for enhanced sepsis screening and preparedness on the community level. Additionally, by factoring in Emergency Medical Services (EMS) Region and Zone administrative boundary data, information on the medical response teams transporting high risk patients can be identified. By doing so, policies addressing the EMS and hospital component in sepsis identification and treatment can provide information on what areas in Massachusetts would benefit most from a sepsis health policy change.

Unweighted Risk Assessment of Sepsis



Tufts

Table 1: Ten Highest Unweighted Sepsis Scores (Mean + SD) by Town in the state of Massachusetts

TOWN	MIN	MAX	RANGE	MEAN	STD
SPRINGFIELD	24	27	3	25.57766	0.730039
PROVINCETOWN	25	26	1	25.49669	0.499989
WEST SPRINGFIELD	24	27	3	25.46622	0.564554
CHICOPEE	14	27	13	25.34196	0.708725
LONGMEADOW	22	27	5	25.26323	1.011944
AGAWAM	21	27	6	24.78476	1.370413
EAST LONGMEADOW	22	27	5	24.75424	1.401887
HOLYOKE	13	27	14	24.64802	1.007499
PITTSFIELD	21	26	5	24.15612	0.860884
TRURO	23	25	2	24.06262	0.248638

Conclusions

Sepsis is a public health crisis worthy of a policy response in Massachusetts. To increase the likelihood of survival for critically ill patients presenting to hospitals with sepsis, early recognition through a community-based public health approach is critical.

In 2012, the US Health & Human Services' Agency for Healthcare Research & Quality (AHRQ) held a National Conference where the idea of paramedicine in Massachusetts was discussed. Since then, the Commissioner has allowed EMS-related pilot projects through the Office of Emergency Medical Services.

By providing population health information on sepsis risk by town, policy makers in Massachusetts can work with medical providers outside of the hospital to improve timely response and treatment to sepsis and set the standard on how other states could streamline their sepsis screening.

Rather than reform the entire EMS education system, Massachusetts could provide more opportunities for EMS personnel to obtain sepsis specific basic information. By utilizing geospatial analysis to show the areas in Massachusetts that could benefit most from enhanced sepsis screening, focusing on these specific areas to implement a sepsis policy change would make the process more efficient and feasible.

Methods

By stratifying on population-health and publicly available accessibility-to-healthcare data, seven sepsis variables were assessed. Risk factor variables were equally weighted and reclassified based on low to high risk within the state region. Raster calculations were generated for each variable and a multivariate geospatial analysis was conducted using zonal statistics to characterize the average risk percentage of sepsis for each town in the state of Massachusetts. Unweighted sepsis scores ranged from 10 (low risk) to 28 (high risk).

Population Sepsis Risk Factor Variables

- Long-term Care Facility Density
- Age > 65 years*
- Syringe Drop-off Density
- Lung Cancer Incidence*
- Diabetes Mellitus Prevalence
- Drive Time to Nearest Hospital
- Aids Incidence

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Data Sources: CDC, Census Data, Mass GIS, MDPH

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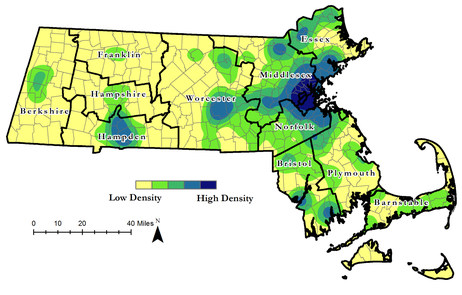
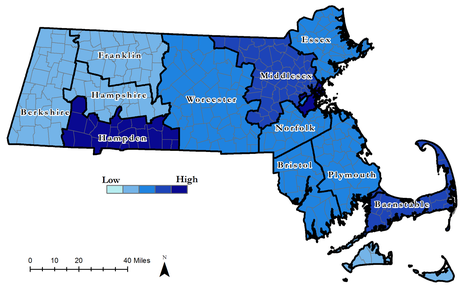
Density of Long-term Care Facilities

Massachusetts residents requiring longitudinal care are a vulnerable population and often present to hospitals with multiple comorbidities, thus they are at greater risk of developing infection and sepsis. Kernel density was used to measure long-term care facilities as a risk factor for sepsis by accounting for high density areas.



Incidence of Aids

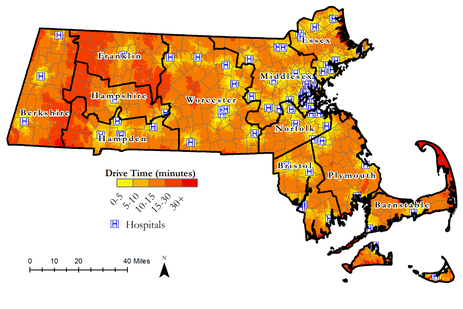
Populations living with AIDS have a weakened immune response to infection and their immunocompromised state puts them more at risk for developing sepsis. By manually reclassifying Aids Incidence from low to high, areas with highest incidence of AIDS can be correlated to being more at risk for developing sepsis.



Drive Time to Nearest Hospital

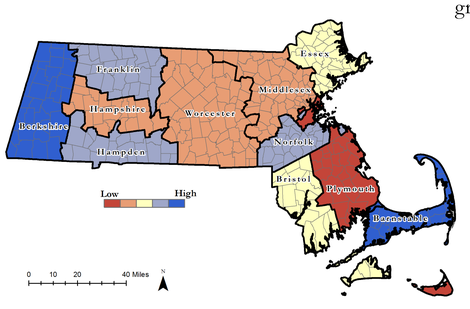
As early recognition and intervention correlated to successful treatment and outcome in sepsis patients, proximity to nearest hospital was included. To

Calculate drive time to nearest hospital, a proximity analysis was used.



Prevalence of Diabetes

Because health effects secondary to diabetes mellitus include peripheral nephropathy and chronic kidney disease, a high prevalence of diabetes is a useful risk factor to include in our Massachusetts sepsis model. Prevalence of diabetes was included in our unweighted sepsis model by raster calculation and spatial analyst tools.



Density of Syringe Drop-off Locations

Density of syringe drop-off locations was used to account for areas with a greater risk of HIV/Aids exposure due to immunocompromised health status. Accompanying risk factors attributable to sepsis, such as cellulitis, necrotizing fasciitis, and endocarditis were considered with the addition of this variable and kernel density was used to measure greater risk of sepsis.