Performance and Usability of Risk Calculators Among Ambulatory Heart Failure Patients: A Cohort Study of the Vancouver General Hospital Cardiac Function Clinic

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Background

- Heart Failure with Reduced Ejection Fraction (HFrEF) is associated with high, but variable mortality[1,2].
- Several validated mortality risk calculators exist for use by clinicians, which differ in amount and types of variables needed for use[1,2].
- Risk calculators can be helpful in prognosticating HF patients and can aid in making informed treatment decisions[3].
- However, it is unclear if these risk calculators provide similar estimates in predicted mortality for an individual patient.
- Large differences in predicted mortality estimates among risk calculators may worsen uncertainty or lead to conflicting decisions.

Research Objectives

- To evaluate the agreement in 1 year mortality estimates by various HF risk calculators among an ambulatory HF population at the Vancouver General Hospital (VGH) Cardiac Function Clinic.
- To evaluate feasibility of using these calculators in a busy HF Clinic.

Methods

- **Study Design**: Retrospective cohort study; target sample n= 210.
- **Inclusion Criteria:**
  - Patients with HFrEF (Left Ventricular Ejection Fraction ≤40%)
  - Initial visit to the VGH Cardiac Function Clinic (CFC) between October 2018 and December 2019.

- **Risk Calculators Included in Study:**
  - 3-CHF[4]
  - Barcelona (BCN) BioHF[5]
  - Meta-Analysis Global Group in Chronic HF(MAGGIC)[6]
  - PREDICT HF[7]
  - Seattle Heart Failure Model (SHFM)[8]

- **Primary Outcome:**
  - **Agreement between 1 year predicted mortality estimates by risk calculators, defined as:**
    - Strict, if ≤5%
    - Lenient, if 6-10%
    - Disagreement, if greater than 10%

- **Secondary Outcome:**
  - Ease of use, total time required to obtain collect, input and obtain predicted mortality estimates.

- **Analysis:**
  - Descriptive statistics using Microsoft Excel v. 2019.
  - For missing variables, imputed cohort mean value
  - Spearman's rho correlation to comparing scatterplot of predicted mortality of various calculators to MAGGIC.

Table 1: Baseline Characteristics (n=210)

Age, y	68±14.5	**Comorbidities**	
Male, n (%)	145 (70)	Atrial Fibrillation, n (%)	54 (26)
NYHA, n (%)		COPD, n (%)	24 (11)
Class I	29 (14)	Diabetes, n (%)	70 (33)
Class II	130 (62)	Prior MI, n (%)	61 (29)
Class III	48 (23)	**Medications**	
Class IV	3 (1)	ACE Inhibitors/ ARBs, n (%)	156 (74)
Ejection Fraction (EF), %	29 ±7	ARNI, n (%)	8 (4)
HF Hospitalization in prior 12 months	91 (43)	Beta Blockers, n (%)	195 (93)
Laboratory Values		MRA, n (%)	95 (45)
BNP (median, IQR), n=162	669 (295 -1349)	Furosemide, n (%)	144 (69)
eGFR (median, IQR), n= 209	61 (43-83)	Statin, n (%)	150 (71)

Table 2: Comparison of strict level of agreement among HF risk calculators, n (%)

	3-CHF	BCN-BioHF	MAGGIC	PREDICT HF
BCN-BioHF	114 (54)			
MAGGIC	77 (37)	121 (58)		
PREDICT HF	105 (50)	132 (63)	112 (53)	
SHFM	87 (41)	111 (53)	105 (50)	107 (51)

Figure 1: Predicted mortality estimates using MAGGIC as a comparator, (%)
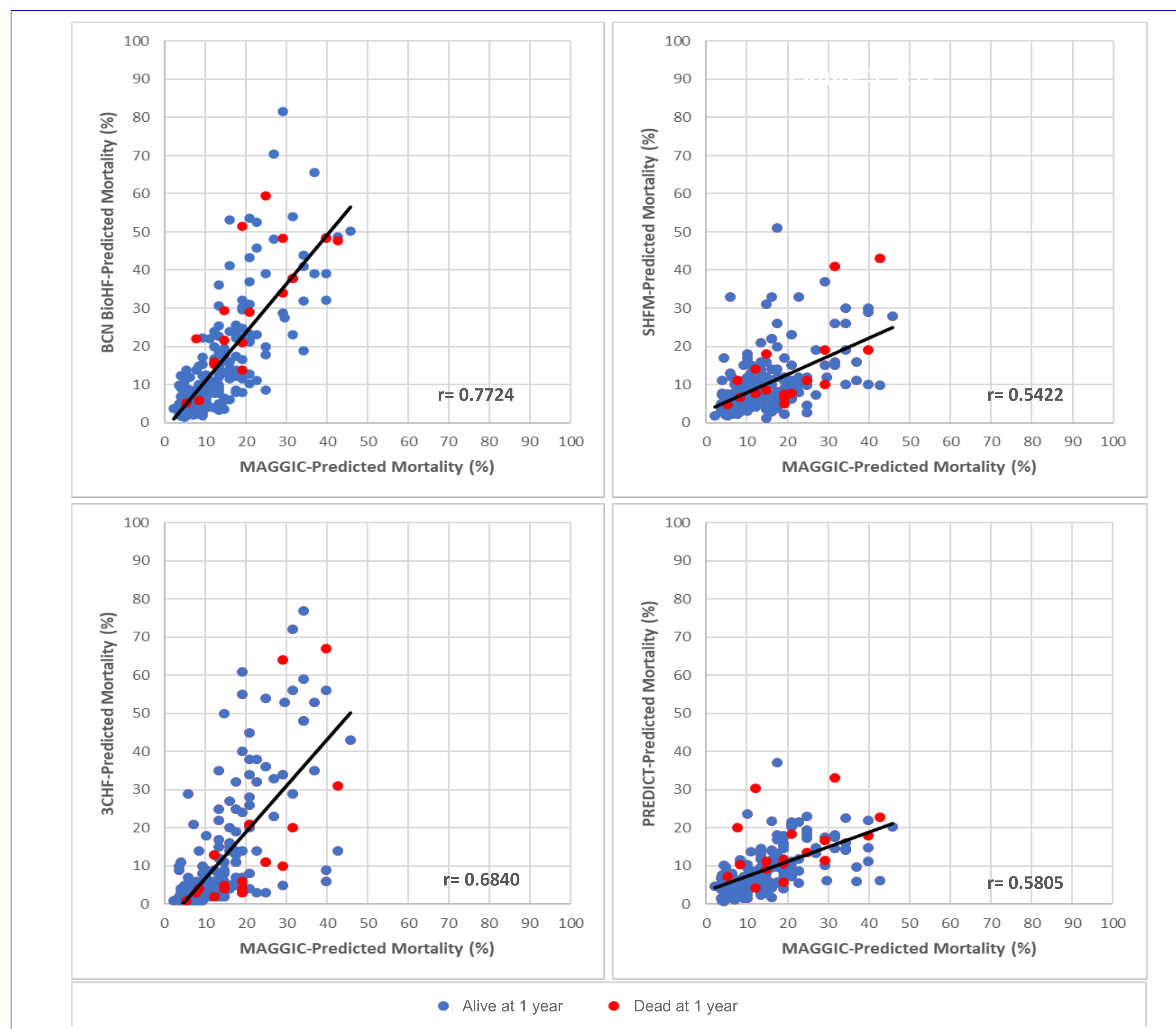
Table 3. Risk score characteristics impacting ease of use

	3-CHF	BCN-BioHF	MAGGIC	PREDICT HF	SHFM
Clinical Variables	3	6	9	7	7
Medications/Devices	2	8	2	2	5
Medical Conditions	4	0	4	1	0
Laboratory Values	1	6	12	1	5
Total number of variables	10	20	27	11	17
Average time required (mean ±SD)	1:42 ±0:33	2:38 ±0:17	1:37 ±0:10	2:45 ±0:28	5:06 ±0:40

Results

- PREDICT HF-BCN BioHF pair demonstrated the highest strict agreement (63%).
- BCN-BioHF and PREDICT-HF demonstrated at least 50% strict agreement with all other calculators.
- MAGGIC and SHFM demonstrated least strict agreement with 3-CHF (37% and 41%, respectively).
- Based on *Figure 1*, BCN-BioHF and 3-CHF calculated higher predicted mortality when compared to MAGGIC.
- PREDICT HF most often had missing variables for Uric Acid (88%), Albumin (68%), LDL and Total Cholesterol (40%).

Limitations

- Missing variables imputed using mean values; consistent with standard practice in other publications.
- Race-based data not available and therefore PREDICT HF underestimated risk in Asian and black populations.
- Level of agreement thresholds assigned arbitrarily and may not correlate with clinical significance; definitions consistent with similar publications and limited literature to provide guidance.

Conclusions

- The highest level of strict agreement observed among a HF risk calculator pair was only 63%, with most pairs achieving 50%.
- BCN-BioHF and 3-CHF calculated higher mortality risk compared to MAGGIC, which is built into clinic's electronic medical records.
- 3-CHF not favorable due to variability in level of strict agreement.
- PREDICT HF demonstrated at least 50% strict agreement with all calculators; required less variables and time, but underestimation of impact of race makes level of agreement results less reliable.
- No clear trends observed in predicted mortality estimates for patients who died at 1 year.
- Overall, no single risk calculator was most optimal for use.
- Clinicians should be aware that the choice of risk calculator used can significantly affect prognostic predicted mortality and have implications for treatment decisions.

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