

# A physiologic, precision-medicine approach to guided pharmacological treatment of hypertension substantially improves blood pressure control in a large community-based cohort

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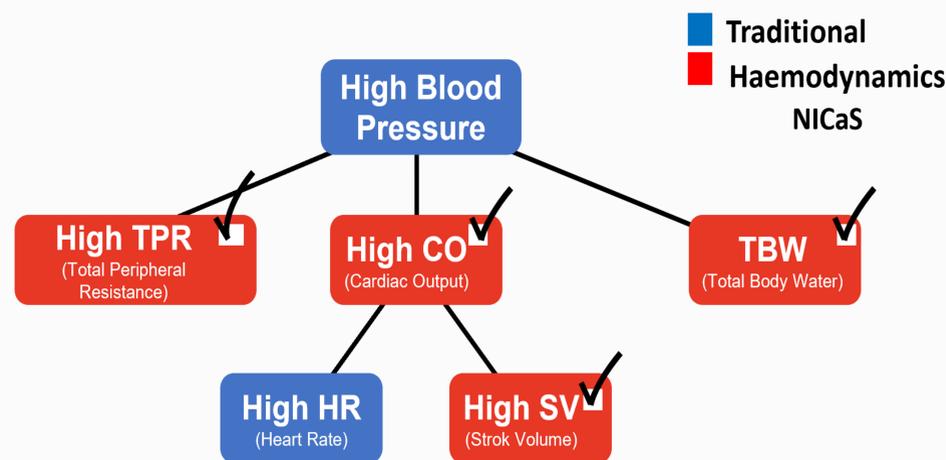
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## BACKGROUND

Rates for blood pressure (BP) control are poor worldwide. Guidelines on hypertension provide BP targets and treatment algorithms but pay little attention to the underlying haemodynamic reason for hypertension (Figure 1). A more personalized approach might increase patient engagement and achieve better control of BP.

Figure 1 Comprehensive Blood Pressure Evaluation

## HYPERTENSION HAEMODYNAMICS



## PURPOSE

Improve rates of BP control by selecting treatments that match an individual patient's haemodynamic profile (Figure 3), and present personal information to patients and physicians to increase engagement. (Figure 4).

## METHODS

**Hypertensive patients** were identified from electronic medical records (EMR) of two US primary care groups between 2014 & 2023. When BP was >140/90, the haemodynamic profile was assessed non-invasively using Impedance Cardiography (ICG) (NICaS – NI Medical, Israel). Physiologic measurements/calculations included BP, mean arterial pressure, cardiac index, cardiac power index, total peripheral resistance index, stroke index, heart rate and total body water.

ICG haemodynamic profiles (Figure 2) were classified as:

- **Vasoconstriction**
- **Hyperdynamic** (high heart rate (HR) or high stroke index (SI))
- **Mixed Pattern** (combination of the above)

Printed clinical decision support (CDS) tools and later an EMR integrated CDS application (MedsEngine – MediSync, USA) were used to communicate recommendations to physicians and patients.

Printed reports were shared with patients (Figure 4).

Rates of BP control were tracked using EMR data.

Figure 2 NICaS ICG Results

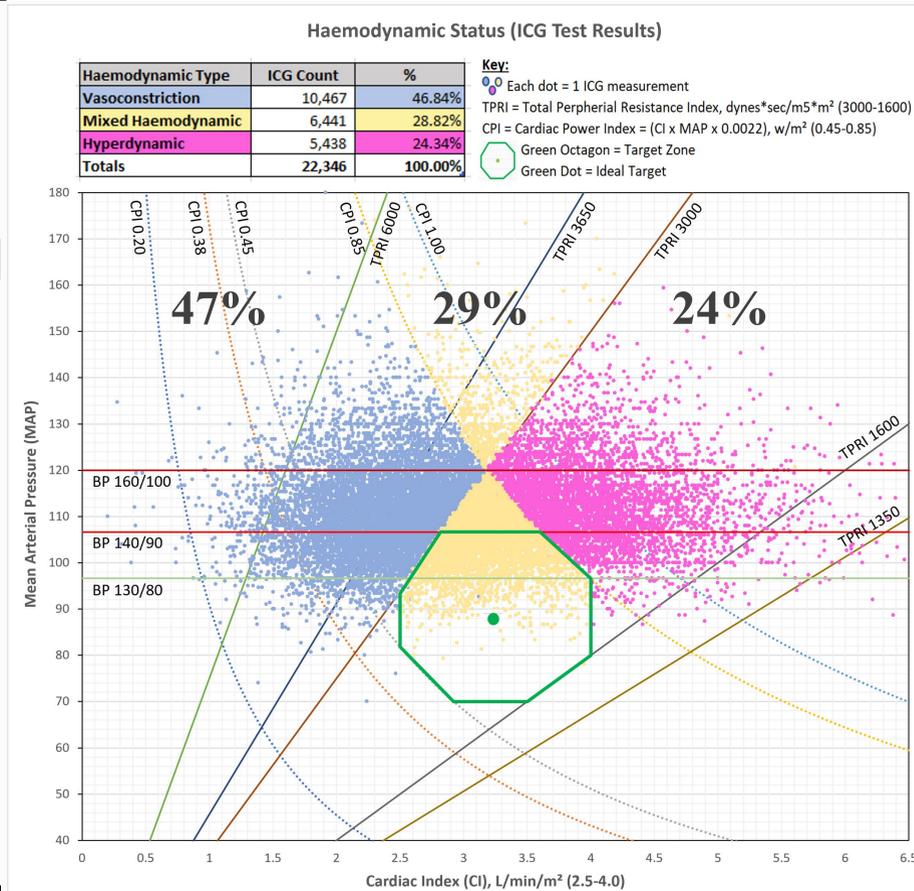
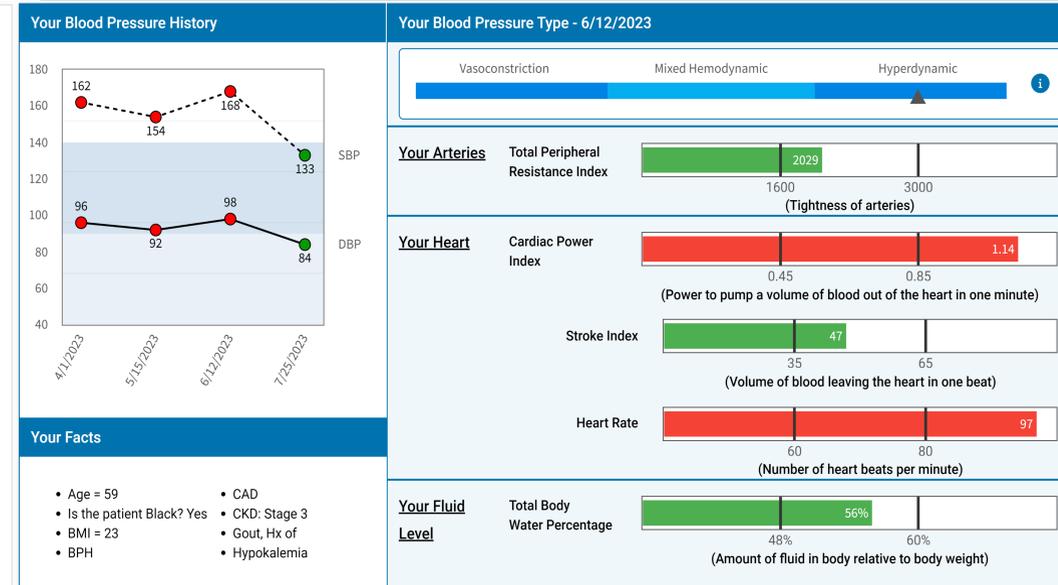


Figure 3 Drug Class Matches Haemodynamics

Drug Class	Relative BP Effect			
	Vasoconstriction (TPRI)	Heart Rate (CPI-HR)	Contractility (CPI-SI)	Fluid (TBW%)
ACEis	↓↓↓↓			
ARBs	↓↓↓↓			
CCB Dihydropyridines	↓↓↓↓			
Vasodilators	↓↓↓↓			
Thiazide/Thiazide-like Diuretics	↓↓			↓
Aldosterone Antagonists	↓↓			↓
Beta Blockers		↓↓↓↓	↓↓	
CCB Non-Dihydropyridines	↓↓↓	↓↓	↓↓↓	
Central Alpha Agonists	↓	↓↓	↓	
Beta Blockers: Vasodilating	↓	↓↓↓↓	↓↓	
CCB Non-Dihydropyridines	↓↓↓	↓↓	↓↓↓	
Loop Diuretics				↓↓↓↓

Figure 4 MedsEngine Display of ICG Results



## RESULTS

Of **14,698** patients included, 14% were black, 50% were women, 17% age 18-49, 45% age 50-69, and 38% age ≥70 years.

Altogether, **22,346** ICGs were done, which were classified as (Figure 2)

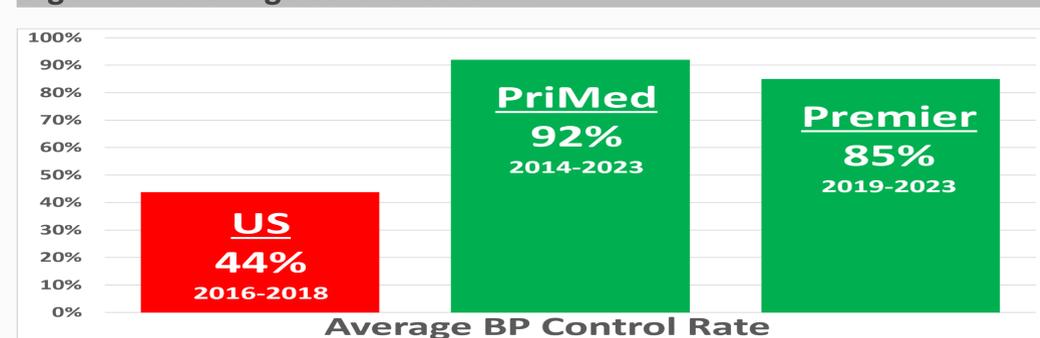
- **Vasoconstriction: 47%**
- **Hyperdynamic: 24%,**
- **Mixed Pattern: 29%**

➤ **No demographic features predicted the physiologic grouping.**

➤ 8,489 patients in the first cohort (PriMED Physicians – Dayton, Ohio) were treated from 2014-2023, obtaining >**92%** BP control rate. This high control rate has been sustained for 10 years.

➤ 6,209 patients in the second cohort (Premier Med Assoc. – Pittsburgh, PA) were treated from 2019-2023, obtaining >**85%** BP control rate (Figure 5).

Figure 5 Average BP Control Rate



## CONCLUSION

**Haemodynamic data may help personalize anti-hypertensive therapy and improve BP control to 92%. Providing patients and healthcare professionals with insights about why BP is high and providing a rationale for treatment selection may motivate prescribing in addition to increasing patient adherence and persistence with therapy.**