

Protecting the most vulnerable during COVID-19 and beyond: a case report on the remote management of heart failure patients with cardiac implantable electronic devices

Fozia Zahir Ahmed ^{1,2*}, Carol Crosbie ³, Matthew Kahn⁴, and Manish Motwani ^{1,2}

¹Division of Cardiovascular Sciences, Faculty of Biology, Medicine and Health, University of Manchester, UK; ²Department of Cardiology, Manchester University Hospitals NHS Foundation Trust, Manchester, UK; ³Department of Cardiology, Manchester University Hospitals NHS Foundation Trust, Wythenshawe, UK; and ⁴Department of Cardiology, Fairfield General Hospital, Pennine Acute Hospitals NHS Trust, Bury, UK

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Background

Heart failure (HF) patients with cardiac implantable electronic devices (CIEDs) represent an important cohort. They are at increased risk of hospitalization and mortality. We outline how remote-only management strategies, which leverage transmitted health-related data, can be used to optimize care for HF patients with a CIED during the COVID-19 pandemic.

Case summary

An 82-year-old man with HF, stable on medical therapy, underwent cardiac resynchronization therapy implantation in 2016. Modern CIEDs facilitate remote monitoring by providing real-time physiological data (thoracic impedance, heart rate and rhythm, etc.). The 'Triage Heart Failure Risk Score' (Triage-HFRS), available on Medtronic CIEDs, integrates several monitored physiological parameters into a risk prediction model classifying patients as low, medium, or high risk of HF events within 30 days. In November 2019, the patient was enrolled in an innovative clinical pathway (Triage-HF Plus) whereby any 'high' Triage-HF risk status transmission prompts a phone call-based virtual consultation. A high-risk alert was received via remote transmission on 11 March, triggering a phone call assessment. Upon reporting increasing breathlessness, diuretics were initiated. The prescription was remotely issued and delivered to the patient's home. This approach circumvented the need for all face-to-face reviews, delivering care in an entirely remote manner.

Discussion

The challenges posed by COVID-19 have prompted us to think differently about how we deliver care for patients, both now and following the pandemic. Contemporary CIEDs facilitate the ability to remotely monitor HF patients by providing rich physiological data that can help identify individuals at elevated risk of decompensation using automated device-generated alerts.

Keywords

Heart failure • ICD • Pacemaker • COVID-19 • Remote monitoring • Case report

*Corresponding author. Department of Cardiology, Manchester University Hospitals NHS Foundation Trust, Oxford Rd, Manchester, UK. Tel: + 44 161 276 3336.

Email: Fozia.ahmed@mft.nhs.uk

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Learning points

- During the COVID-19 pandemic, many HF services are defaulting to telephone assessments in place of usual in-person appointments. However, telephone assessments alone are limited by the relative paucity of available clinical data in comparison with in-person assessment.
- Contemporary CIEDs facilitate the ability to remotely monitor patients by providing rich physiological data that can help identify patients at elevated risk of decompensation using automated device-generated alerts.
- The rich real-time physiological data provided by CIEDs can also be used to complement virtual phone call-based assessment.

Introduction

Modern cardiac implantable electronic devices (CIEDs) facilitate remote monitoring by providing real-time physiological data (e.g. thoracic impedance, heart rate/rhythm, atrial arrhythmias, and activity levels). One validated algorithm in use (for Medtronic CIEDs such as the patient reported here) is the 'Triage Heart Failure Risk Score' (Triage-HFRS) which integrates several monitored physiological parameters into a risk prediction model classifying patients as low, medium, or high risk of heart failure events within 30 days.^{1,2}

disease (CKD 3B), and aortic stenosis for which the patient was under follow-up but, due to co-morbidities and frailty, was for conservative management.

In November 2019 the patient was enrolled in an innovative remote monitoring clinical care pathway (Triage-HF Plus; ClinicalTrials.gov Identifier: NCT04177199), whereby any 'high' Triage-HF risk status transmission triggers a phone call-based virtual consultation with a member of the hospital HF team (*Figure 1*). In February 2020, device-based physiological measurements began to signal a change in health-related data, culminating in a 'high' Triage-HF risk status remote transmission on 11 March 2020, triggering a phone call-based virtual assessment as per the clinical pathway.

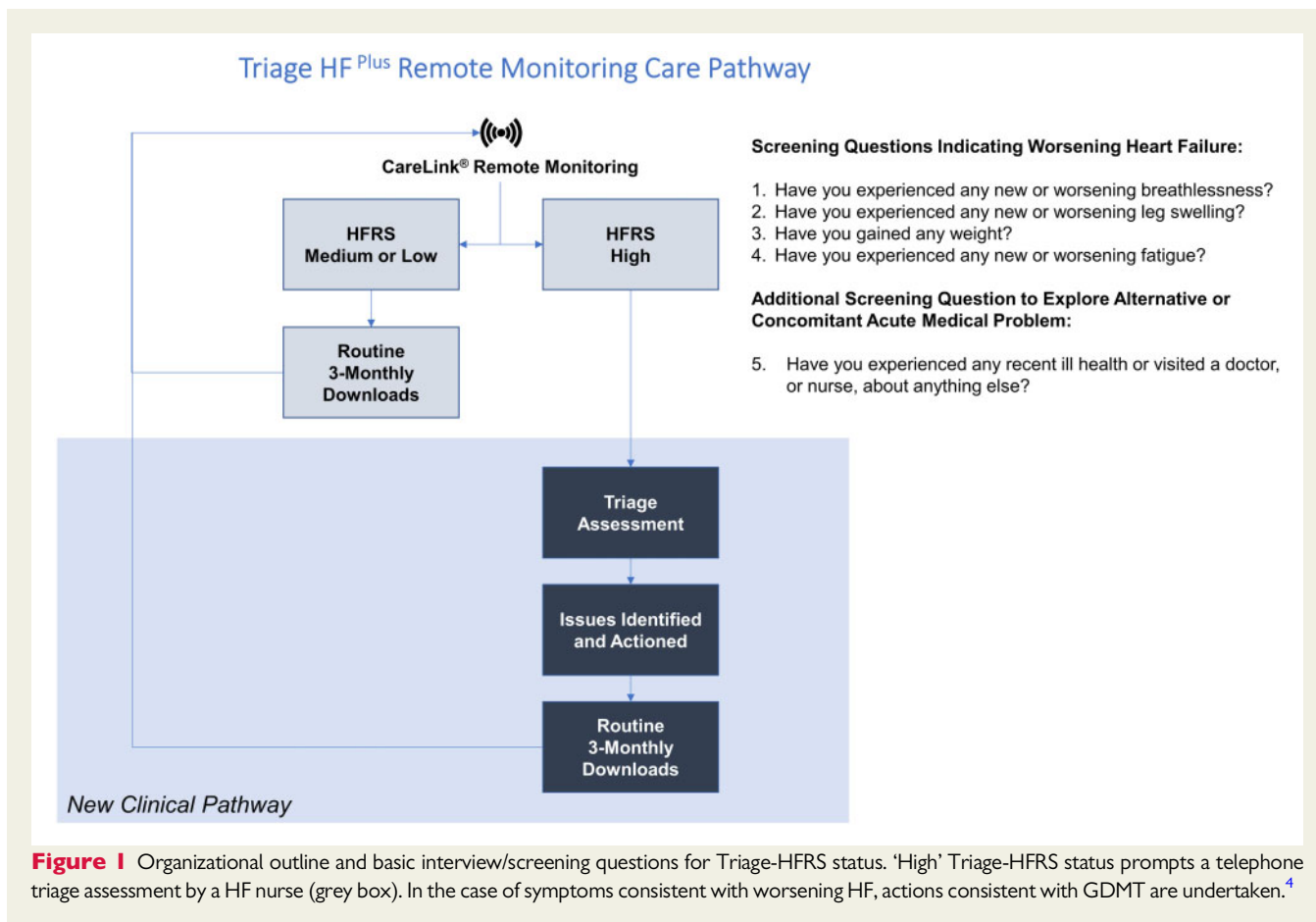
Timeline

2016	Patient undergoes CRT-D implant	
November 2019	Enrolled in Triage-HF Plus remote monitoring care pathway as part of a clinical evaluation	Baseline medication <ul style="list-style-type: none"> • Bisoprolol 10 mg o.d. • Candesartan 8 mg o.d. • Eplerenone 25 mg o.d. • Atorvastatin 80 mg o.d. • Rivaroxaban 15 mg o.d.
23 February 2020	Day 1 of current high-risk status episode	
11 March 2020	High Triage-HF risk status remote transmission	Contacted by HF specialist nurse for over the phone virtual assessment Diuretic prescription (furosemide 40 mg o.d.) issued remotely Patient reports improved symptomatic status during telephone follow-up
23 March 2020		
18 April 2020	Remote transmission	

Case presentation

An 82-year-old man with severe left ventricular (LV) dysfunction (ischaemic cardiomyopathy), on guideline-directed medical therapy (GDMT) for heart failure (HF), underwent cardiac resynchronization therapy defibrillator (CRT-D) implant in 2016 (Medtronic Viva[®] XT CRT-D DTBA2D4). His usual functional status was New York Heart Association (NYHA) Class III. Past medical history included treated hypertension, atrial fibrillation, previous stroke, chronic kidney

The diagnostic challenge was to differentiate between false alerts, worsening HF that may lead to decompensation, or an alternative acute medical issue that could explain the recent shift in health-related data. Routine phone call screening questions (*Figure 1*) identified that the patient had previously been relatively stable. However, in recent weeks, he reported worsening shortness of breath (NYHA Class IV) but without peripheral oedema. Accordingly, review of the transmitted CIED health-related data showed changes starting around February 7, culminating in a transition to a 'high' Triage-HFRS



a few weeks later. In addition, suboptimal ventricular rate control, biventricular pacing $\leq 75\%$, markers of excessive fluid, and reduced physical activity, correlating with his worsening functional status, were observed (Figure 2).

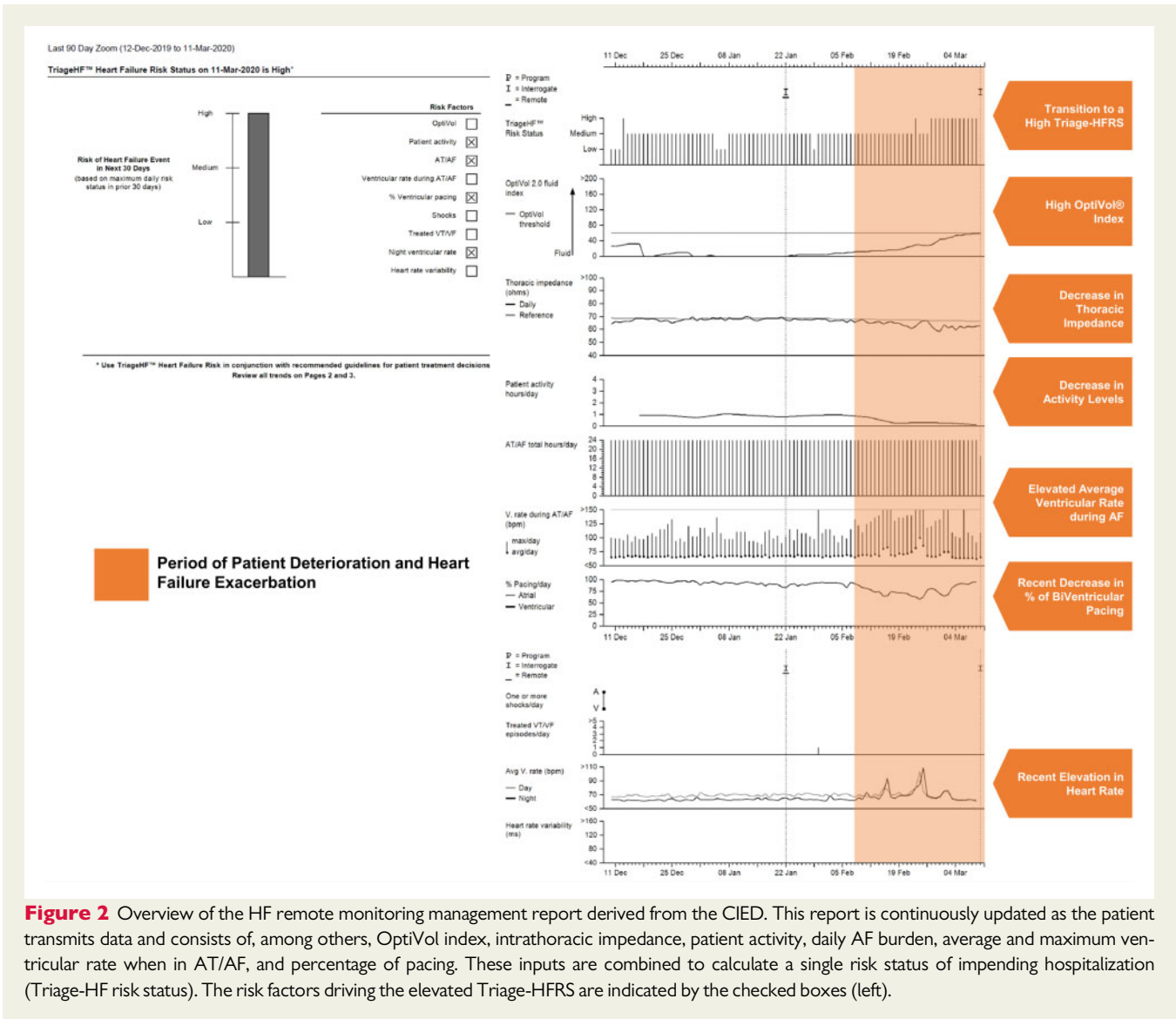
Community nurses undertook renal profile sampling which demonstrated stable renal function [estimated glomerular filtration rate (eGFR) 32 mL/min]. The patient was commenced on a diuretic. The prescription was issued remotely, filled by the community pharmacy, and delivered to his home. This approach circumvented the need for face-to-face review and delivered care in an entirely remote manner from decompensation identification through to prescription and telephone follow-up. The patient's symptoms improved, repeat renal profile was satisfactory, and he remains well to this time. In keeping with this, repeat remote transmission undertaken on 18 April demonstrated temporal improvements in fluid index, heart rate, and activity. The HFRS transitioned from a 'high' to 'medium' Triage-HFRS on 14 March (Figure 3).

Discussion

The unexpected novel coronavirus (COVID-19) pandemic has disrupted healthcare delivery across the UK's National Health Service (NHS), as it has elsewhere, and is bound to transform global patient care. Official advice includes self-isolation, social distancing, and

intense focus on hand and surface sanitation with the intent of drastically slowing spread of COVID-19, and enabling healthcare structures to cope with unanticipated excess demands. The universal operational strategy for managing the pandemic has focused on the need to accommodate sick inpatients with COVID-19, and many healthcare professionals have been re-deployed to front-line areas other than their own. In view of these considerations, like many specialties, HF services have been significantly impacted. Decongesting healthcare structures of non-urgent cases, including ambulatory patients with chronic conditions who ordinarily receive repetitive input, is therefore of paramount importance. This case study highlights how remote management of HF patients, facilitated by innovative technologies within contemporary CIEDs, can play an important role in the effort to shield patients, avoid in-hospital attendance, and ultimately 'flatten the curve', as well as protect healthcare systems from similar scenarios.

There are ~ 1 million people with HF in the UK.³ Contemporary management of a long-term condition such as HF ideally involves configuring services such that even cases with frequent instability are managed as much as possible in the outpatient setting, i.e. avoiding admission. HF patients with CIEDs (especially those with NYHA Class III–IV) are a distinct patient group, requiring close surveillance and frequent management—an exceptional challenge in the current circumstances. International guidelines recommend that all HF patients be reviewed at least twice a year, or more frequently depending on



clinical need.⁴ Comprehensive review includes assessment of functional capacity, fluid status, cardiac rhythm, cognition, nutrition, renal function, and review of medication.

Traditional HF follow-up is mostly built around in-person reviews. The argument for in-person assessment is normally based on process efficiencies, availability of specialist equipment, and its perception as being clinically superior to telephone assessment. However, reports of increased mortality from COVID-19 in patients with underlying cardiovascular disease means that HF patients need to be shielded as far as possible; and with the potential of future similar scenarios, this may be the optimal default position going forwards.⁵

Patients with HF often have a CIED, but HF and device management have historically been divided between two separate clinical teams. An innovative pathway in our local region (Greater Manchester) is examining the use of health-related data collected by these implanted devices to remotely monitor HF stability (Figure 1).⁶

Modern CIEDs include enough sensors to closely replicate most in-person measurements—but currently this rich real-time data source is underutilized. Exercise capacity is reported by accelerometers, fluid status approximated by intrathoracic impedance, and cardiac rhythm status is monitored continuously. These parameters can be dynamically combined to reliably classify patients as high, medium, or low risk of impending hospitalization.^{1,2}

In Greater Manchester, a nursing team consisting of 40.1 Full-Time Equivalents (FTE) is managing a population of 2.84 million (prevalence of HF 0.7–1%). With the advent of the COVID-19 pandemic, the service has transitioned to remote management in line with government guidance. Nursing staff use remote access to a centralized Email box to audit CareLink alerts and undertake phone calls from home, or the office, to facilitate social distancing for patients and healthcare practitioners alike.

Remote monitoring with CIEDs can play an important role in unburdening hospital-based care and minimizing exposure of vulnerable HF patients to higher risk environments, while maintaining their

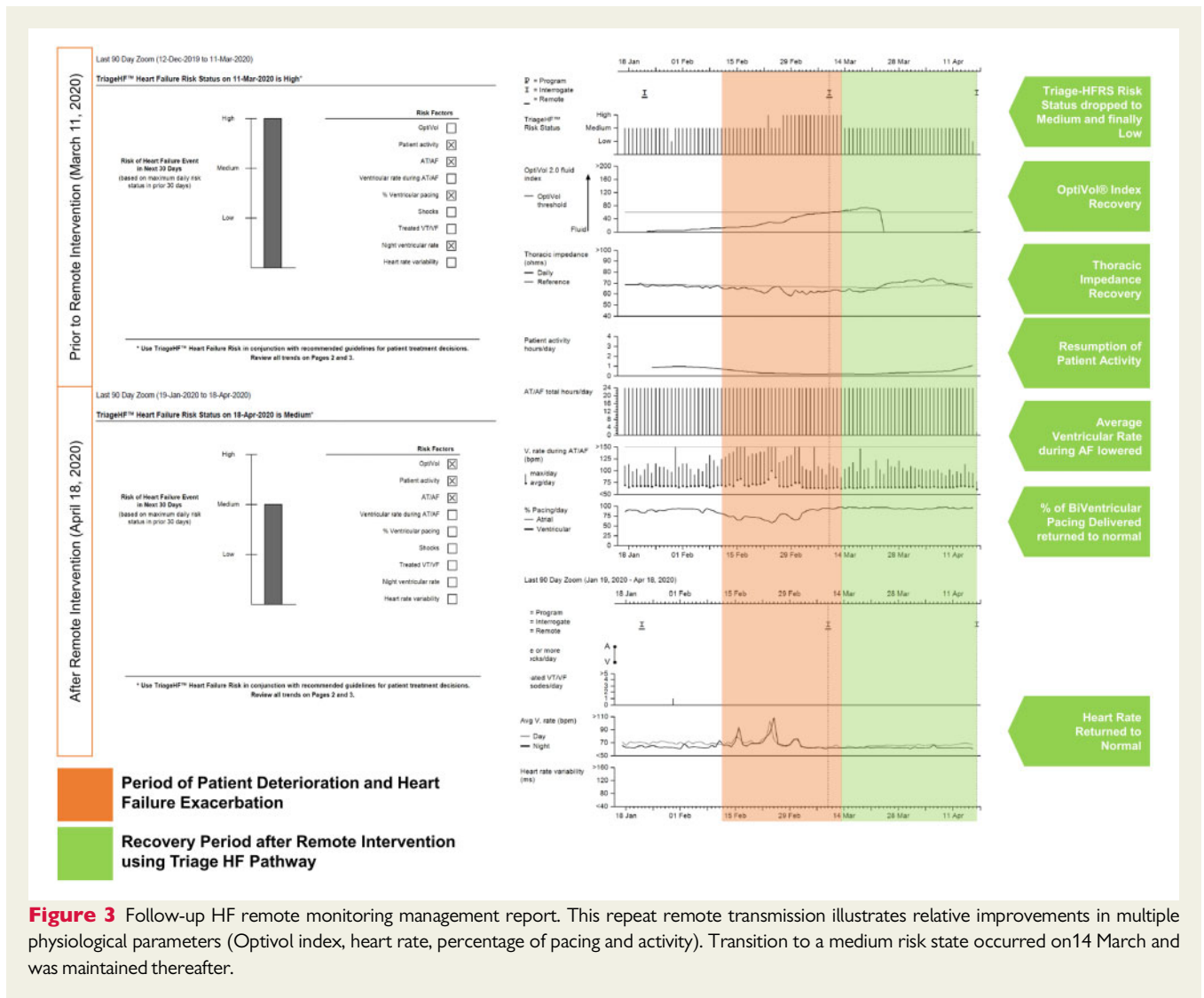


Figure 3 Follow-up HF remote monitoring management report. This repeat remote transmission illustrates relative improvements in multiple physiological parameters (OptiVol index, heart rate, percentage of pacing and activity). Transition to a medium risk state occurred on 14 March and was maintained thereafter.

active surveillance and management. Such novel technologies offer the means to reconfigure HF follow-up services in ways aligned to the realities of the current pandemic and beyond.

Lead author biography



Fozia Ahmed graduated from the University of Manchester in 2003 and undertook specialist in cardiology in the North-West region. In 2015 she was appointed as a consultant cardiologist at Manchester University Hospitals, where she specialises in heart failure and cardiac devices. She is the NIHR specialty co-lead for cardiovascular research in Greater Manchester. Her research interests broadly span the themes of remote monitoring and management of heart failure, and prevention of cardiovascular infection.

Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as [Supplementary data](#).

Consent: The authors confirm that written consent for submission and publication of this case report including data and associated text has been obtained from the patient in line with COPE guidance.

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