Table S1: RAMESES reporting standards for realist evaluation

Item to be included	Page number/Section
TITLE 1. In the title, identify the document as a realist evaluation.	1
SUMMARY OR ABSTRACT 2. Journal articles will usually require an abstract, while reports and other forms of publication will usually benefit from a short summary. The abstract or summary should include brief details on: the policy, programme or initiative under evaluation; programme setting; purpose of the evaluation; evaluation question(s) and/or objective(s); evaluation strategy; data collection, documentation and analysis methods; key findings and conclusions. Sufficient detail should be provided to identify that a realist approach was used and that realist programme theory was developed and/or refined .	1
INTRODUCTION 3. Rationale for evaluation. Explain the purpose of the evaluation and the implications for its focus and design. 4. Programme theory. Describe the initial programme theory (or theories) that underpin the programme, policy or initiative. 5. Evaluation questions, objectives and focus. State the evaluation question(s) and specify the objectives for the evaluation. Describe whether and how the programme theory was used to define the scope and focus of the evaluation. 6. Ethical approval. State whether the realist evaluation required and has gained ethical approval from the relevant authorities, providing details as appropriate. If ethical approval was deemed unnecessary, explain why.	 1 1 2 9
METHODS 7. Rationale for using realist evaluation. Explain why a realist evaluation approach was chosen and (if relevant) adapted 8. Environment surrounding the evaluation. Describe the environment in which the evaluation took place 9. Describe the programme policy, initiative or product evaluated. Provide relevant details on the programme, policy or initiative evaluated 10. Describe and justify the evaluation design. A description and justification of the evaluation design (i.e. the account of what was planned, done and why) should be included, at least in summary form or as an appendix, in the document which presents the main findings. If this is not done, the omission should be justified and a reference or link to the evaluation design given. It may also be useful to publish or make freely available (e.g. online on a website) any original evaluation design document or protocol, where they exist 11. Data collection methods Describe and justify the data collection methods – which ones were used, why and how they fed into developing, supporting, refuting or refining programme theory. Provide details of the steps taken to enhance the trustworthiness of data collection and documentation. 12. Recruitment process and sampling strategy. Describe how respondents to the evaluation were recruited or engaged and how the sample contributed to the development, support, refutation or refinement of programme theory	 2 2 1-2 2-3 3 2

13. Data analysis. Describe in detail how data were analysed. This section should include information on the constructs that were identified, the process of analysis, how the programme theory was further developed, supported, refuted and refined, and (where relevant) how analysis changed as the evaluation unfolded	3
RESULTS	
14. Details of participants. Report (if applicable) who took part in the evaluation, the details of the data they provided and how the data was used to develop, support, refute or refine programme theory.	(Tables S3,S4)
15. Main findings. Present the key findings, linking them to contexts, mechanisms and outcome configurations. Show how they were used to further develop, test or refine the programme theory	6-8 Tables 2,3 Figure S1
DISCUSSION	
16. Summary of findings. Summarise the main findings with attention to the evaluation questions, purpose of the evaluation, programme theory and intended audience	8
17. Strengths, limitations and future directions. Discuss both the strengths of the evaluation and its limitations. These should include (but need not be limited to): (1) consideration of all the steps in the evaluation processes; and (2) comment on the adequacy, trustworthiness and value of the explanatory insights which emerged. In many evaluations, there will be an expectation to provide guidance on future directions for the programme, policy or initiative, its implementation and/or design. The particular implications arising from the realist nature of the findings should be reflected in these discussions	8
18. Comparison with existing literature. Where appropriate, compare and contrast the evaluation's findings with the existing literature on similar programmes, policies or initiatives	9
19. Conclusion and recommendations. List the main conclusions that are justified by the analyses of the data. If appropriate, offer recommendations consistent with a realist approach	9
20. Funding and conflict of interest. State the funding source (if any) for the evaluation, the role played by the funder (if any) and any conflicts of interests of the evaluators.	9

Table S2: Case study site characteristics

Primary care model	Site reference	Hospital size and serving population*	Setting	ED attendances per year	Care Quality Commission (CQC) rating**	GP service commissioning organisation	GP streaming	GP access to acute investigations	Date GP model introduced	Hours of coverage per week in GP service	Staff mix in GP service
No GP service	GPED02 Wales	800 beds; population 600,000 people***	City	84,000	n\a Welsh site						
	GPED12 Central England	350 beds; Trust serves 500,000 people in 4 hospitals	Town	65,000	Outstanding (report 04.12.19)						
	GPED15 Central England	500 beds for the 2 hospitals in Trust; population 250,000 people	Town	55,000	Requires improvement (report 29.11.19)						
Inside-integrated	GPED14 South of England	450 beds; population 450,000 people	Small town	78,000	Outstanding (report 29.04.16)	NHS Trust	No	Yes	2009/10	10am-10pm, 7 days a week; 65 - 72 hours	GPs
	GPED08 North of England	150 beds; population 120,000 people	Rural area	20,000	Good (report 28.10.16)	NHS Trust	No	Yes	2017	8am-6pm, 3-4 days per week; 33 - 40 hours	GPs
	GPED03 South West of England	550 beds; population 350,000 people	Small town in rural area	65,000	Good (report 28.09.17)	NHS Trust	Yes, and GPs self-select	Yes	2017	8am-11pm, 7 days a week; >80 hours	GPs

Inside-parallel	GPED09 South East of England	1000 beds; population 1.3 million people	Large city	165,000	Requires improvement (report 19.07.18)	Primary care provider	Model 1: yes Model 2: no	Model 1: No Model 2: Yes	2012	8am-9pm, 5 days a week; 57 - 64 hours	GPs
	GPED04 North of England	400 beds; population 200,000 people	Rural area	56,000	Good (report 24.02.16)	Primary care provider	Yes	Yes, but encouraged not to use	2015	6am-11pm weekdays, 10am-10pm weekends; 49 - 56 hours	GPs and ANPs
	GPED06 North of England	600 beds; population 200,000 people	Large town	115,000	Good (report 24.02.16)	Primary care provider	Yes, plus 111 and walk in patients	Yes, but encouraged not to use	2015	10am – 10 pm 7 days a week; 80 hours	GPs and ANPs
	GPED07 South West of England	700 beds; population 500,000 people	City	84,000	Requires improvement (report 10.08.16)	Primary care provider until May 2018 then NHS trust	Yes, plus 111 and walk in patients	No	2014	10am – 10pm 7 days a week; 80 hours	GPs, ANPs, Paramedics
Outside-onsite	GPED13 Central England	550 beds; population 250,000 people	City	70,000	Good (report 29.06.16)	NHS trust	Yes, plus 111 patients (no walk ins)	Yes	2017	10am - 10pm 5 days per week, 41 - 48 hours	GPs and ED ANPs
	GPED10 North of England	600 beds; population 400,000 people	Town	89,000	Good (report 14.03.18)	Local GP federation	Yes, plus 111 and walk in patients	No	2017	24 hours a day (includes OOH contract), 7 days a week; >80 hours	GPs and ANPs
	GPED11 Central England	800 beds; population 500,000 people	Large city hospital adults only	140,000	Requires improvement (report 13.06.16)	NHS trust and a Locum agency	Yes, plus 111 and walk in patients	No	2005	8am-10pm, 7 days per week; 73-80 hours	Locum GPs, mainly ANPs

Data taken from survey data unless stated otherwise *https://www.cqc.org.uk/sites, **for urgent and emergency care services, ***http://www.wales.nhs.uk/sitesplus/866/page/40419
(GPED01 omitted, pilot site; GPED05 omitted, streaming service staffed by emergency department staff not GPs)

Table S3: GP realist interview guide

Role of the GP and diagnostic approach	• There's this idea that **GPs may manage patients differently to ED clinicians**, being more comfortable with uncertainty using less investigations and admitting less patients)? What is your experience of this? What influences this? Prompts – certain conditions (chest pain/child with fever/abdominal pain)? Different situations? Time of day? Type of patient? Experience of doctor? Because GPs diagnose differently? More comfortable with risk taking? Availability of investigations? Expectation of doing investigations? • Are there any specific conditions that you **feel GPs manage well or not so well**? (prompts why why why) • Do you have any **safety concerns**? (explore positive, negative, mitigating factors) • There's this idea that **GPs may manage patients differently when working in an ED setting utilising more investigations and admitting more patients than they would if they saw the same patient working in the community or OOH** What's your experience of this? (same prompts as above, also personal experience, less knowledge about the patient, expectation to investigate, awareness higher risk of serious illness) • There's this idea that **GPs decision making and request for further investigation and referral may be influenced by the decision making of other healthcare professionals** e.g. the triage nurse/streamer allocating patients not thought to require investigations (low risk chest pain, headache, musculoskeletal injuries) or paramedic with a patient with normal ECG and chest pain Have you any experience of this? (prompts seniority of certain healthcare professionals, certain conditions, any learning/change in management?)
Skillset knowledge	• There's some evidence in the literature that **GPs working in a more integrated role in emergency departments see sicker patients than they usually deal with in practice or conditions outside of their skillset requiring acute investigations.** Have you any experience of this? (patient allocation – no streaming, rural setting, small hospital) • How have you dealt with this? (prompts – personal reading, specific course/training, in house training, senior advice, cherry picking patients)
Team working	• There's this idea that GPs working alongside ED staff **learn from each other** about management pathways in the community and in emergency care which improves the quality care for the patient care Do you have any experience of this? And how does this happen? (Prompts – same meetings/protocols/governance/social events/informal conversation?)
Wider system	• There's this idea that GPs in ED may give GPs the opportunity for a portfolio career and retain GPs in the NHS or alternatively deplete community general practice of its workforce. Have you any thoughts/experience of this? (local primary care recruitment/retention issues? Personal interest?)

Table S4: Staff semi-structured realist interview participants

Model	Site	Staff interviews	Telephone	Face-to-face on site
Inside-integrated	Hospital 14	Medical director (n=1) GP (n=2) GP consultant (n=1)		AC&ME (n=1) AC (n=2) AC&ME (n=1)
	Hospital 8	Clinical director (n=1) GP (n=2)	ME (n=1)	 AC (n=2)
	Hospital 3	Clinical director (n=1) ED Consultant (n=1) ED F1 doctor (n=1) ENP (n=2) ED staff nurse (n=2) GP (n=4)	 AC (n=1)	AC&ME (n=2) AC (n=1) AC (n=1) AC (n=1), ME (n=1) AC (n=2) AC (n=3)
Inside-parallel	Hospital 9	Clinical director (n=1) ED consultant (n=1) GP (n=2)	AC (n=1) AC (n=1)	AC&ME (n=1) AC (n=1) AC (n=1)
	Hospital 4	Clinical director (n=1) ED consultant (n=2) ED middle grade (n=2) ED CT1 doctor (n=1) ENP (n=2) Healthcare SW (n=1) GP (n=2) Primary care ANP (n=1)	ME (n=1) AC (n=1)	AC&ME (n=1) AC (n=1) AC (n=2) AC (n=1) AC (n=2) AC (n=1) AC (n=2) ME (n=1)
	Hospital 6	Clinical director (n=1) ED consultant (n=2) ENP (n=1) GP (n=4)	ME (n=1) AC (n=1)	AC&ME (n=1) AC (n=1), AC&ME (n=1) AC (n=1) AC (n=3)
	Hospital 7	Clinical director (n=1) ED Consultant (n=1) UTC senior nurses (n=2) GP (n=1)	ME (n=1) AC (n=1)	 ME (n=2) AC (n=1)
Outside-onsite	Hospital 13	Clinical director (n=1) Operations manager (n=1) GP (n=1) Primary care ANP (n=1)	ME (n=1)	 ME (n=1) AC (n=1) AC&ME (n=1)
	Hospital 10	Clinical director (n=1) ED Consultant (n=1) GP (n=4)	ME (n=1)	 AC (n=1) AC (n=4)
	Hospital 11	Clinical director (n=1) GP (n=3) Primary care ANP (n=1)	ME (n=1)	 AC (n=3) AC (n=1)
No GP service	Hospital 2	Clinical director (n=2)	ME (n=1)	AC&ME (n=1), AC (n=1)
	Hospital 12	Clinical director (n=1)	ME (n=1)	
	Hospital 15	Clinical director (n=1)	ME (n=1)	
Total		66 (5x clinical directors interviewed twice)	17 AC (n=6) ME (n=11)	54 AC (n=40), ME (n=5) AC&ME (n=9)

Table S5: Local patient safety incident reports from case study sites related to the GP service

Primary care model	Site reference	Incident reports available	No. of reports relevant to the GP service	Primary Incident type	Incident free text (key information extracted with minor edits for spelling and abbreviations only)	Patient harm*
Inside-Integrated	Hospital 14	Not available on site and no response to 3x follow up emails	n/a			
	Hospital 8	Not available on site. CD reported none involving GPs working in ED	n/a			
	Hospital 3	134 (3-month period Dec 2017 - March 2018, excluding pressure ulcers)	3	Triage/Streaming error	***"Patient triaged to (GP stream) and seen out of order due to lower position on computer (waited an hour longer than other patients with the same priority)***. Patient deteriorated and was transferred to majors."	Moderate
				Inadequate management	"ED protocol not followed, ***child with suspected NAI (non accidental injury) not admitted to paeds*** (paediatrics) and sent home for OPD (outpatient) follow up."	Unknown
				Inadequate management	"Patient sent to ED on advice of CAMHS (child and adolescent mental health service) as OOH (out of hours) and thought to be at risk of self-harm… ***GP unaware of policy should have been admitted for MH (mental health) assessment."***	Unknown
Inside-Parallel	Hospital 9	Not available on site. CD reported none involving GPs working in ED	n/a			
	Hospital 4	1162 reports, 430 reports excluding pressure ulcers (from 1.4.17 - 31.3.18)	2	Diagnostic error	"Patient seen by agency (primary care) NP (nurse practitioner). Had fallen downstairs C/O (complaining of) neck pain ***Diagnosis muscular injury Returned today Multiple unstable fractures of C1 and C2 (neck fractures)."***	Unknown
				Inadequate management	"GP was gluing the wound on the patient's forehead ***the glue inadvertently dripped down into the patients right eye gluing his eyelids shut*** ."	Low
	Hospital 6	365 reports in 2017 (majors 254, minors 111)	1	Triage/Streaming error	"Patient triaged to UTC. As shift lead I allocated patient to see an OOH GP. ***This patient was later discharged from (OOH) (adastra system) and subsequently discharged from medway (ED computer system). However, the patient in question was still in the department."***	Unknown

	Hospital 7	7 reports only since change of provider 1 month ago	1	Inaccurate documentation	"Patient admitted to PAU (paediatric assessment unit) from UTC (urgent treatment centre). Nurse handed over that patient's ***DOB (date of birth) was wrong on their system*** which would make her 3 when she is 2."	Unknown
Outside-onsite	Hospital 13	Not available on site and no response to 3x follow up emails	n/a			
	Hospital 10	68 complaints, 150 incidents (April 2017 - first 2 quarters 2018)	1	Investigation follow up	***"Positive MSU (mid-stream urine) reports filed without action being taken*** - if action needed this is now highlighted to community GP."	Unknown
	Hospital 11	11 WIC reports (24.2.18 - 16.10.18)	6	Investigation follow up	"After waiting in accident and emergency department for over 2 hours, 2 patients were inappropriately referred to the WIC (walk-in centre) from A&E when the WIC opened at 8am. Both patients had blood tests performed by A&E. ***The WIC nurse practitioners and locum GP are unable to, and not here to review A&E investigations***... Having requested these investigations to not have them reviewed poses potential risk to patient safety."	Unknown
				Triage/Streaming error	"***One hour after triage the patient was transferred to WIC on symphony but the patient claims she was not directed to go to the WIC by any one from A&E.*** The WIC nurses discharged patient as called no reply as patient was not in walk in centre. ***After waiting 5 hours the patient asked A&E reception and she was directed to the WIC."***	Unknown
				Referral delay	"Patient seen at WIC ?torsion of testicle requiring urgent Urology review. ***Unable to contact Urology core-trainee***, middle or consultant through Vocera, just keep getting put through to switch who say nothing they can do to contact anyone from Urology."	Unknown
				Prescribing error	"Locum doctor prescribed Mirtazapine for a patient with depression. ***On the prescription he did not specify the quantity***."	Low
				Prescribing error	"Patient returned today with handwritten prescription. Patient said pharmacist said ***prescription was not legible*** so advised patient to return to the walk in centre to have prescription re written. Clinical notes checked and patient re-examined and further prescription was issued."	Low
				Prescribing error	"A patient was given a handwritten FP10 prescription for a community pharmacy with the ***wrong patient details."***	Unknown

Key: ED emergency department; CD Clinical Director; UTC urgent treatment centre, OOH out of hours; MSU mid-stream urine; * World Health Organization International Classification for Patient Safety definitions https://www.who.int/patientsafety/taxonomy/icps_full_report.pdf

Figure S1: Programme theory to illustrate factors perceived to facilitate GPs delivering safe patient care in ED settings