Received: 31 July 2024 | Revised: 15 October 2024 | Accepted: 8 November 2024

DOI: 10.1111/vox.13774

ORIGINAL ARTICLE

Vox Sanguinis ISBT International Society of Blood Transfusion

# Missed opportunities: Lack of a diagnostic workup of anaemia results in a high prevalence of unidentified anaemia

Christian Carrier[1] | David Meltzer[2] | Micah T. Prochaska[1,2]

[1]Pritzker School of Medicine, University of Chicago, Chicago, Illinois, USA

[2]Section of Hospital Medicine, University of Chicago, Chicago, Illinois, USA

**Correspondence**
Micah T. Prochaska, Department of Medicine, University of Chicago, 5841 S. Maryland Ave., MC 5000, Chicago, IL 60637, USA.
Email: mprochas@bsd.uchicago.edu

**Funding information**
National Heart, Lung, and Blood Institute, Grant/Award Number: K23HL140132

## Abstract

**Background and Objectives:** Anaemia is a treatable common condition with various aetiologies and is prevalent in hospitalized patients. However, anaemia is inconsistently worked up and treated in the inpatient setting, in part because there is no standardized inpatient diagnostic and treatment approach to anaemia. Therefore, the objective of this study was to examine the diagnostic approach and prevalence of common aetiologies of anaemia in hospitalized patients and test for an association between aetiologies of anaemia and patient characteristics.

**Materials and Methods:** This study is a prospective observational study of hospitalized adult patients with anaemia. Patient laboratory data were used to assess the frequency of anaemia diagnostic workup and common aetiologies of anaemia.

**Results:** In a sample of 945 patients (mean age 58 years, 57% female and 72% Black), 30% patients had chronic anaemia, 11% had multifactorial anaemia, 5% had iron deficiency and 37% had insufficient laboratory data to determine their anaemia aetiology (unidentified aetiology). Patients with an unidentified aetiology received fewer transfusions and were more likely to be White, have longer hospital stays and have higher nadir haemoglobin levels.

**Conclusion:** A significant portion of hospitalized patients with anaemia did not have an identified aetiology. A standardized diagnostic algorithm could decrease this number and help patients receive appropriate treatment.

## Keywords

anaemia of chronic inflammation, diagnostic workup, transfusion, unidentified anaemia

## Highlights

- The most prevalent type of anaemia in hospitalized adult patients is chronic anaemia, followed by unidentified anaemia.
- The majority of patients with anaemia do not undergo a full standardized anaemia workup including nutritional, iron and haemolytic blood testing.
- Patients with unidentified anaemia receive significantly fewer transfusions than those with identified causes.

## INTRODUCTION

Anaemia is a common condition that affects 40%–70% of hospitalized patients [1, 2] and is associated with increased length of stay (LOS) and higher re-admission rates [3–5]. Anaemia is also associated with increased mortality, decreased quality of life and reductions in functional status [6, 7]. Accordingly, the presence of anaemia in hospitalized patients should trigger a diagnostic workup, because some aetiologies of anaemia are treatable and treatment may mitigate the adverse effects of anaemia. However, the causes of anaemia are not consistently evaluated by clinicians in the inpatient setting.

There are several reasons why anaemia is not consistently evaluated in the inpatient setting. First, data from trials informing restrictive transfusion practices may have inadvertently de-emphasized the significance of anaemia overall and the importance of a treatment approach that identifies and targets the underlying aetiology of anaemia rather than a patient's haemoglobin (Hb) level. Data from transfusion trials have shown that withholding transfusion until a patient's Hb drops below 7 g/dL (restrictive transfusion) is safe with respect to mortality, but few of these trials have measured the adverse effects of untreated anaemia [8, 9]. Moreover, rarely have inclusion/exclusion criteria and the results of these trials included or reported on patients' aetiology of anaemia. As a result, anaemia often is not considered significant in the inpatient setting until a patient's Hb is <7 g/dL. Clinicians have a diminished appreciation of the adverse consequences of untreated anaemia, and restrictive transfusion based on single Hb values is the standard of care irrespective of a patient's aetiology of anaemia. Furthermore, this focus on transfusion and subsequent lack of knowledge on the aetiology of a patient's anaemia shifts focus from alternative treatments of anaemia with known aetiologies. Several aetiologies of anaemia have known and definitive treatments, such as supplemental iron for iron deficiency anaemia, vitamin $B_{12}$ and folate supplements for these respective nutritional deficiencies and erythropoiesis-stimulating agents for anaemia due to chronic kidney disease [10]. Second, clinician's primary focus in hospitalized patients is treating acute illness, and treatment for non-life-threatening illness, like mild anaemia, is frequently deferred to the outpatient setting. Third, there is no standard, widely accepted diagnostic approach to evaluating the causes of and treating anaemia in hospitalized patients. One reason for this may be that the laboratory values useful in the diagnostic approach to anaemia in the ambulatory setting can be affected by acute illness and therefore often do not hold the same diagnostic value in hospitalized patients. As a result, transfusion trials do not address how to optimally treat anaemia [11]. Inpatient clinicians often dismiss mild anaemia as inconsequential and not needing treatment [12] and assume certain aetiologies of anaemia (i.e., anaemia of chronic inflammation [ACI]) rather than definitively diagnose them [13], and the workup and treatment of anaemia in hospitalized patients varies by the provider [14].

To address this variation, standardize the diagnosis and treatment of anaemia and improve patient care, data on the diagnostic laboratory tests ordered by clinicians and the prevalence of the different aetiologies of anaemia in hospitalized patients would be useful. Knowing how often and in which patients clinicians attempt to work up and identify the underlying aetiology of anaemia, and the overall prevalence of the different aetiologies of anaemia, could drive interventions that improve the evaluation and treatment of hospitalized patients with anaemia. Moreover, such data could be useful for designing studies to identify the optimal inpatient management strategies for the different aetiologies of anaemia that go beyond simply the decision of when to transfuse and ultimately help inform a standardized diagnostic and treatment algorithm for hospitalized patients. While a previous study in part characterized the prevalence of anaemia in hospitalized patients, the data collected for that study were not comprehensive, did not consider aetiologies of anaemia that are clinically relevant to the inpatient setting and was conducted internationally where practice patterns may be different than in the United States [3]. As a result, the purpose of this study was to (1) examine the diagnostic approach and prevalence of the different aetiologies of anaemia in hospitalized patients in a US academic medical centre, and (2) test for the association between the aetiologies of anaemia and patient's clinical and demographic characteristics.

## MATERIALS AND METHODS

### Study design

This was a prospective observational study of hospitalized general medicine patients with an Hb < 10.0 g/dL at the University of Chicago Medical Center (UCMC). Patients were recruited for this study between January 2019 and February 2020. The Institutional Review Board approved the study procedures, and all study subjects provided informed consent.

### Study eligibility and inclusion criteria

All general medicine inpatients at UCMC were approached for consent to the University of Chicago Hospitalist Project (UCHP), an established inpatient clinical research infrastructure at UCMC. Patients consenting to the UCHP and with an Hb level <10.0 g/dL at any point during hospitalization were eligible for this study. An Hb < 10.0 g/dL was the inclusion criterion because data for this study were collected as part of a larger study on anaemia and red blood cell transfusion, and for patients with an Hb > 10 g/dL, there was no equipoise with respect to the possibility of receiving transfusion.

### Diagnostic approach and aetiology of anaemia

Every laboratory test result for each patient during their admission was collected from hospital administrative data and was used to determine which patients received a diagnostic workup for their anaemia and the aetiology of the patient's anaemia. The aetiology of the patient's anaemia was determined by adapting diagnostic criteria

validated in large cohorts of patients with anaemia [15]. Patients were categorized as having the following: (1) anaemia due to nutritional deficiency, including iron deficiency, defined by a ferritin level <50 ng/mL, vitamin $B_{12}$ deficiency, defined by a vitamin $B_{12}$ level <20 pg/mL or $B_{12}$ <300 pg/mL with a corresponding methylmalonic acid >0.4 mmol/L, or folate deficiency, defined by a serum folate level <3.4 ng/mL or a red blood cell folate <316 ng/mL; (2) chronic anaemia, including ACI, defined by a ferritin >100 ng/mL and a C-reactive protein (CRP) > 5 mg/dL, and anaemia of chronic kidney disease, defined by a glomerular filtration rate <30 mL/min/body surface area; (3) acute blood loss anaemia, defined by an admission Hb > 11.5 g/dL. Although there is no clear cutoff for acute blood loss anaemia, an admission Hb of 11.5 g/dL was used because an Hb drop of 1.5 g/dL is considered clinically relevant and consistent with acute anaemia; (4) haemoglobinopathy, including either sickle cell anaemia or thalassemia based on an International Classification of Disease 10 code, and/or a mean corpuscular volume (MCV) < 80 fL without nutritional or chronic anaemia; (5) haemolytic anaemia defined by a haptoglobin <20 mg/dL and an MCV > 100 fL; (6) anaemia due to thyroid disease, defined by a thyrotropin <0.1 mcU/mL. Patients meeting criteria for more than one aetiology were categorized as having (7) multiple aetiologies of anaemia, while those with no laboratory values drawn during hospitalization or laboratory values not meeting criteria for any of the above anaemia aetiologies were classified as (8) having unidentified anaemia.

## Patient demographic data collection

Hospital administrative data were also used to determine patients' age, sex, race, ethnicity, Charlson Comorbidity Index (CCI) score [16], LOS and receipt of a transfusion.

## Statistical analysis

Descriptive statistics were used to characterize patient demographic and clinical characteristics as well as to quantify the frequency of diagnostic laboratory tests and the prevalence of anaemia aetiologies. Because of the small number of non-Black and non-White patients cared for at our institution, race was characterized as a categorical variable using the values of 'Black/African-American', 'White' and 'Other'. The mean was used to summarize normally distributed variables while the median and interquartile range were used for non-normally-distributed variables. Chi-squared (categorical variables) and *t*-tests (continuous variables) were used to test for clinical and demographic differences across the anaemia aetiology categories. Multivariable linear regression models were used to test for associations between clinical and demographic characteristics and anaemia aetiology. Sensitivity analyses were also conducted using different Hb cutoffs for acute blood loss anaemia but are not reported here because the results were not significantly or substantively different than using an Hb of 11.5 g/dL. Statistical analysis was performed using Stata statistical software (StataCorp, College Station, TX).

# RESULTS

## Patient characteristics

A total of 945 patients consented for study participation. Their mean age was 58 years, and 57% (538/945) were female. The race and ethnicity of the sample was 72% (684/945) Black, 22% (208/945) White, 6% (53/945) Other and 94% (888/945) non-Hispanic or non-Latine. The average LOS was 9.2 days, the mean Hb was 9.5 g/dL, the nadir Hb was 7.7 g/dL and 37% (345/945) received a transfusion.

## Diagnostic workup and prevalence of anaemia aetiologies

All enrolled patients (100%, 945/945) had a complete blood count (CBC), 98% (934/945) had a basic metabolic panel (BMP), 29% (276/945) had a reticulocyte count and 48% (454/945) had iron studies collected during their hospitalization (Table 1).

Based on the laboratory values drawn during patient's admission, 6% (56/945) had nutritional anaemia, 30% (281/945) had chronic anaemia with 4% (34/945) having anaemia solely due to chronic inflammation and 22% (208/945) having anaemia solely due to chronic kidney disease, 9% (83/945) had acute blood loss anaemia,

**TABLE 1** Distribution of diagnostic laboratory tests overall and by identified versus unidentified anaemia.

| Laboratory test | Overall ($N = 945$), *n* (%) | Identified ($N = 593$), *n* (%) | Unidentified ($N = 352$), *n* (%) |
|---|---|---|---|
| Basic metabolic panel | 923 (98) | 327 (55) | 110 (31) |
| Reticulocyte count | 276 (29) | 214 (36) | 62 (18) |
| Iron and total iron-binding capacity | 454 (48) | 329 (55) | 125 (36) |
| Transferrin and transferrin saturation | 454 (48) | 329 (55) | 125 (36) |
| Ferritin | 437 (62) | 327 (55) | 110 (31) |
| Vitamin $B_{12}$ | 268 (28) | 194 (33) | 74 (21) |
| Folate | 187 (20) | 134 (23) | 53 (15) |
| Methylmalonic acid | 4 (1) | 3 (0) | 1 (0) |
| Homocysteine | 9 (1) | 5 (1) | 4 (1) |
| C-reactive protein | 242 (26) | 168 (28) | 74 (21) |
| Thyroid-stimulating hormone | 316 (33) | 224 (38) | 92 (26) |
| Haptoglobin | 217 (23) | 168 (28) | 49 (14) |
| Coombs/direct antiglobulin test | 47 (5) | 38 (6) | 9 (3) |

6% (53/945) had sickle cell anaemia, 11% (107/945) had multifactorial anaemia and 37% (352/945) had unidentified anaemia (Table 2). There were also differences in the number of units of transfusion that patients with different aetiologies received (Figure 1). Given the unexpected and high number of patients with unidentified anaemia, subsequent analyses compared differences between patients with identified and unidentified anaemia. Additionally, because of the small number of patients with haemolytic anaemia and anaemia due to thyroid disease, these aetiologies were excluded from regression models.

**TABLE 2** Prevalence and distribution of aetiology of anaemia.

| | Total *N* (%), 945 |
|---|---|
| Nutritional anaemia (iron + $B_{12}$ + folate) | 56 (6) |
| Iron deficiency | 51 (5) |
| $B_{12}$ deficiency | 0 (0) |
| Folate deficiency | 4 (0) |
| Multiple nutritional aetiologies | 1 (0) |
| Chronic anaemia (ACI or CKD) | 281 (30) |
| Chronic inflammation | 34 (4) |
| Chronic kidney disease | 208 (22) |
| Multiple chronic aetiologies | 39 (4) |
| Acute anaemia | 83 (9) |
| Sickle cell | 53 (6) |
| Haemolytic anaemia | 3 (0) |
| Thyroid disease | 10 (1) |
| Multifactorial | 107 (11) |
| Unidentified | 352 (37) |

Abbreviation: ACI, anaemia of chronic inflammation; CKD, chronic kidney disease.

## Patient differences between unidentified and identified anaemia aetiologies

Compared to patients who had an identified aetiology of anaemia, those with unidentified anaemia were more likely to be White ($p < 0.01$), have a longer LOS (10.1 vs. 7.7, $p < 0.01$) and have higher nadir (7.9 vs. 7.5, $p < 0.01$) Hb levels. Additionally, patients with unidentified anaemia received significantly fewer units of red blood cell transfusion than patients with identified anaemia (0.8 units vs. 1.5 units, $p < 0.01$), and were less likely to receive a transfusion at all (32% vs. 39%, $p = 0.03$). Table 3 compares the baseline characteristics of patients with anaemia of identified causes to those of patients with anaemia of unidentified causes.

## Association between patient characteristics and unidentified anaemia

There were also significant associations between patient's age, their nadir Hb levels and whether they had anaemia with identified or

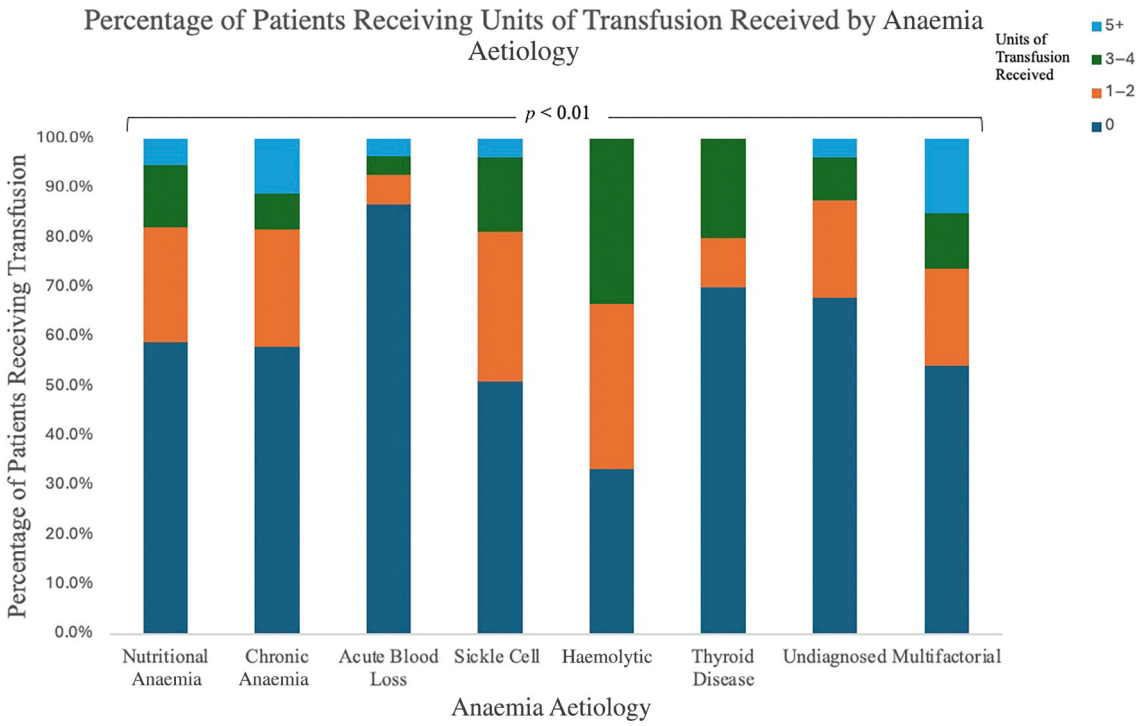


**FIGURE 1** Percentage of patients who received certain numbers of transfusions, stratified by their respective anaemia aetiology. The distribution of transfusion receipt varied significantly between these aetiologies, with all 945 patients accounted for. *p*-values represent a chi-squared test comparing the distribution of the quantity of transfusions received by anaemia aetiology.

**TABLE 3** Characteristics of patients with unidentified and identified aetiology of anaemia.[a]

| | Identified ($N = 703$) | Unidentified ($N = 242$) | *p*-value |
|---|---|---|---|
| Age (years) | 57 ± 18 | 60 ± 16 | 0.29 |
| Female patients, *n* (%) | 348 (58) | 190 (54) | 0.16 |
| Race, *n* (%) | | | |
| Black/African-American | 466 (79) | 218 (62) | |
| White | 95 (16) | 113 (32) | <0.01 |
| Other | 32 (5) | 21 (6) | |
| Ethnicity, *n* (%) | | | |
| Non-Hispanic or -Latine | 560 (94) | 328 (93) | 0.70 |
| Charlson Comorbidity Index score, *n* (%) | | | |
| 0 | 78 (13) | 48 (14) | |
| 1–2 | 154 (26) | 93 (27) | 0.84 |
| 3–4 | 130 (22) | 83 (24) | |
| 5+ | 223 (38) | 122 (35) | |
| Length of stay (days) | 10.1 [4.4, 12.6] | 7.7 [3.9, 9.8] | <0.01 |
| Haemoglobin (g/dL) | | | |
| Mean | 8.7 ± 1.3 | 8.8 ± 1.0 | 0.06 |
| Nadir | 7.5 ± 1.4 | 7.9 ± 1.2 | <0.01 |
| Transfusion | | | |
| Receipt of, *n* (%) | 232 (39) | 113 (32) | 0.03 |
| Number of units | 1.5 [0, 2] | 0.8 [0, 1] | <0.01 |

*Note*: Transfusion and length of stay rows report median and interquartile range.

[a]Age and haemoglobin rows report mean ± SD.

unidentified causes. The rate of anaemia of unidentified cause increased with patient age (18–44, 29%; 45–59, 39%; 60–74, 43%), except in the oldest age group where the fraction of anaemia without an identified cause decreased (75+, 35%) ($p < 0.001$) (Figure 2). Additionally, patients with lower nadir Hb level during hospitalization were less likely to have an unidentified cause of anaemia ($p < 0.001$) (Figure 3).

In the logistic regression model, patients' age, race and nadir Hb were all predictive of having an unidentified cause of anaemia. Patients between the age of 60 and 74 had 62% ($p = 0.01$) increased odds of having an unidentified cause of anaemia, compared to patients between the ages of 18 and 44. White patients had a 156% ($p < 0.01$) increased odds of having an unidentified cause of anaemia, compared to Black patients. Patients with a nadir Hb between 6.0 and 7.0 g/dL, between 7.0 and 8.0 g/dL, between 8.0 and 9.0 g/dL and between 9.0 and 10.0 g/dL had 110% ($p = 0.01$), 270% ($p < 0.01$), 210% ($p < 0.01$) and 250% ($p < 0.01$) increased odds of having an unidentified cause of anaemia, respectively, compared to patients with a nadir Hb ≤ 6.0 g/dL. When nadir Hb was modelled as a continuous variable (rather than a categorical variable), an increase in nadir Hb by 1.0 g/dL increased the odds of a diagnosis of unidentified cause of anaemia by 24% ($p < 0.01$).

## DISCUSSION

In this study of hospitalized patients with anaemia, nearly all patients received a CBC and BMP, around half had iron levels measured and around a quarter had additional laboratory studies drawn that would be considered part of a diagnostic workup of anaemia. This is

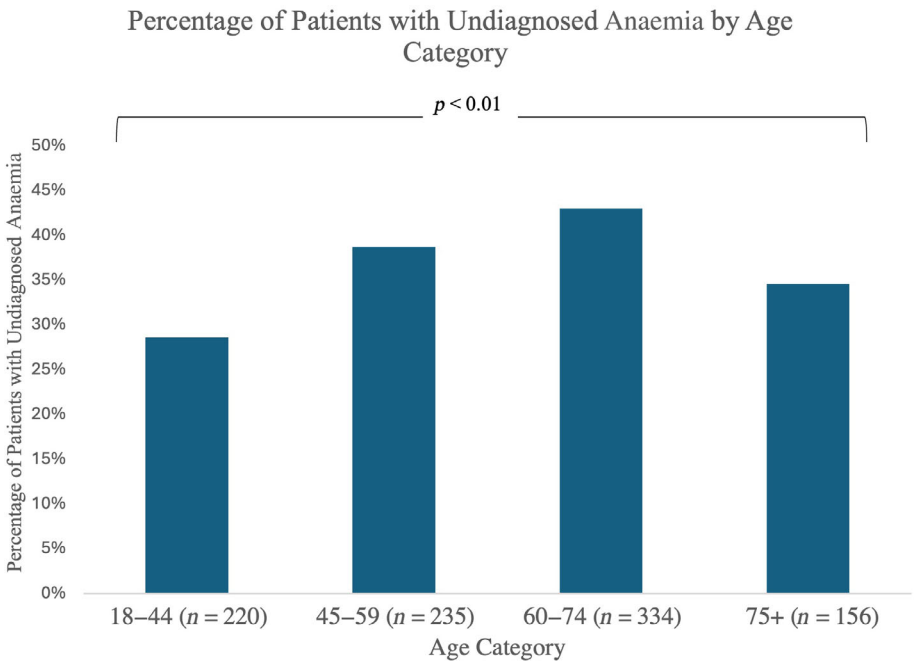


**FIGURE 2** Percentage of patients who did not have their aetiology of anaemia definitively worked up by their age. *p*-values represent a chi-squared test comparing percent unidentified anaemia by patient age.

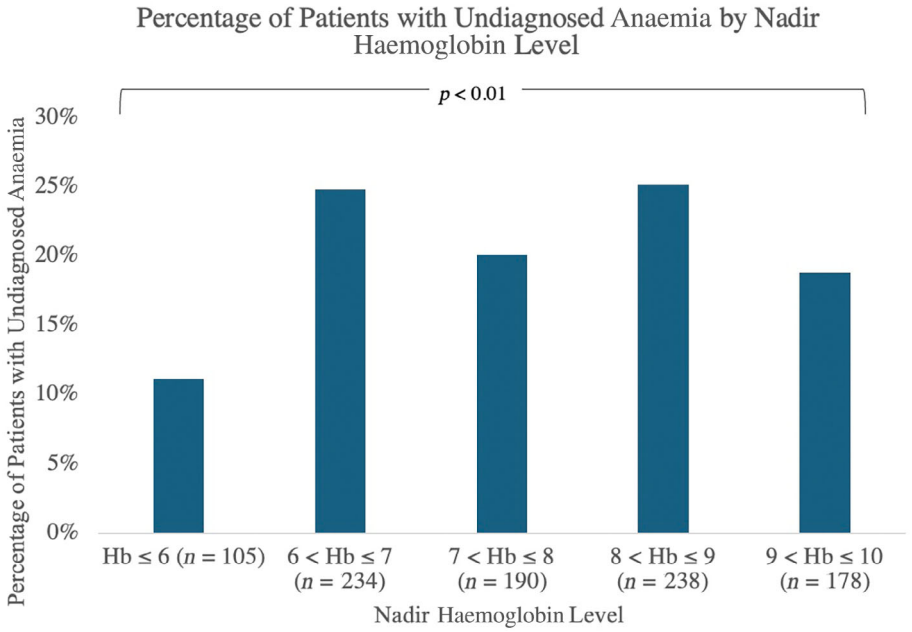


**FIGURE 3** Percentage of patients who did not have their aetiology of anaemia definitively worked up by their nadir haemoglobin (Hb) level. *p*-values represent a chi-squared test comparing percent unidentified anaemia by patient age.

inappropriate, given that standard treatment of anaemia (with or without transfusion) requires a prior thorough diagnostic workup to ensure that the correct underlying aetiology of a patient's anaemia is being treated. With only a fraction of patients receiving diagnostic tests that can be used as anaemia workup, there is the potential that a significant portion of patients are being treated inappropriately.

For example, similar to other studies and clinical settings, the most prevalent diagnosed aetiology of anaemia in our study of hospitalized adults was chronic anaemia [17, 18]. It is often regarded as the most difficult aetiology to treat [17] and erroneously approached as a diagnosis of exclusion [18] rather than definitively diagnosed as the aetiology of anaemia for patients with any chronic condition. However, if it is approached as such, and patients do not receive comprehensive anaemia workups, it calls into question whether chronic anaemia is being appropriately evaluated and, therefore, treated.

It is remarkable that a large portion of patients did not have a diagnostic workup that would allow the aetiology of their anaemia to be identified. Patients with unidentified anaemia in this study were more likely to be middle aged, White and have a higher nadir Hb level than patients with an identified cause of their anaemia. This is important because anaemia is a chronic condition with significant adverse health consequences that should be worked up and treated by inpatient clinicians, and if almost 40% of patients with anaemia are not receiving even iron studies, they may be receiving suboptimal treatment and care that could result in deleterious outcomes. With the data from this study, it is not possible to determine why there were identified clinical and demographic differences in patients with unidentified versus patients with identified anaemia. However, it is possible that the presence of anaemia is seen as more abnormal and more alarming to clinicians in patients when it occurs at younger and older ages, compared to those who are middle-aged. Similarly, the fact that patients with unidentified anaemia had higher nadir Hb levels may reflect that clinicians are just less concerned about mild anaemias than severe anaemias, even though mild anaemia is as predictive of adverse patient outcomes as more moderate and severe anaemias [19, 20].

Future studies that address the prevalence of unidentified anaemia could include prospective studies analysing a diagnostic algorithm for anaemia, or studies that investigate how electronic health records can be used to improve the workup and treatment of anaemia in the inpatient setting. If part of the reason why unidentified anaemia is tolerated is because physicians do not see it as clinically important, trials examining the outcomes of working up and treating anaemia in the inpatient setting and outpatient setting could be done as well. Future studies could examine the types of treatments patients with differing aetiologies of anaemia receive and whether it is concordant with their specific underlying cause or limited to a transfusion. Additionally, studies examining the restrictive versus liberal transfusion policy should examine anaemic patients by aetiology rather than lumping patients with anaemia into groups irrespective of their aetiology of anaemia. It is possible that better assessment and treatment of the causes of anaemia in the inpatient setting could reveal opportunities to further limit the use of transfusion in hospitalized patients and better understand the longer term outcomes and optimal treatment anaemia in hospitalized patients.

There are limitations to this study and our findings. This study included only patients with an Hb < 10 g/dL, and therefore did not capture data on patients with very mild anaemias. This, however, may have underrepresented the significance of our results, because we found that patients with higher Hb levels were less likely to have a diagnostic workup of anaemia. It is also possible that some patients

had clearly determined aetiologies of anaemia at hospital presentation that did not require further workup during their hospitalization, which could be the subject of future work. The definitions we chose for the aetiologies of anaemia are also not absolute and we did not consider every single potential aetiology of anaemia. There is no widespread acceptance of the specific laboratory values that define certain aetiologies of anaemia in the inpatient setting (i.e., iron deficiency), and so we chose the definitions most often used and found minimal differences when applying other accepted definitions. Lastly, this is an observational study that occurred at a single academic medical centre, and therefore the results may not be generalizable.

In conclusion, anaemia is a common chronic condition associated with adverse health outcomes, but no standard diagnostic workup for anaemia in the inpatient setting exists. The lack of a standard diagnostic workup results in significant variation in the workup and treatment of anaemia in hospitalized adults, and a significant percent of patients never have an aetiology of anaemia identified during their hospitalization. Future work should focus on how to best define, work up and manage anaemia in the inpatient setting to improve patient outcomes.

## ACKNOWLEDGEMENTS

M.T.P. and D.M. designed the study, conceived the presented idea and collected the data, analysis was performed by C.C., the first draft of the manuscript was written by C.C., all authors commented on previous versions of the manuscript and all authors read and approved the final manuscript.

## CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## ORCID

*Christian Carrier* https://orcid.org/0000-0001-7588-075X

## REFERENCES

1. Gaskell H, Derry S, Andrew Moore R, McQuay HJ. Prevalence of anaemia in older persons: systematic review. BMC Geriatr. 2008;8:1.
2. Zaninetti C, Klersy C, Scavariello C, Bastia R, Balduini CL, Invernizzi R. Prevalence of anemia in hospitalized internal medicine patients: correlations with comorbidities and length of hospital stay. Eur J Intern Med. 2018;51:11–7.
3. Randi ML, Bertozzi I, Santarossa C, Cosi E, Lucente F, Bogoni G, et al. Prevalence and causes of anemia in hospitalized patients: impact on diseases outcome. J Clin Med. 2020;9:950.
4. Nathavitharana RL, Murray JA, D'Sousa N, Sheehan T, Frampton CM, Baker BW. Anaemia is highly prevalent among unselected internal medicine inpatients and is associated with increased mortality, earlier readmission and more prolonged hospital stay: an observational retrospective cohort study. Intern Med J. 2012;42:683–91.
5. Migone de Amicis M, Chivite D, Corbella X, Cappellini MD, Formiga F. Anemia is a mortality prognostic factor in patients initially hospitalized for acute heart failure. Intern Emerg Med. 2017;12:749–56.
6. Woodman R, Ferrucci L, Guralnik J. Anemia in older adults. Curr Opin Hematol. 2005;12:123–8.
7. Cappellini MD, Motta I. Anemia in clinical practice-definition and classification: does hemoglobin change with aging? Semin Hematol. 2015;52:261–9.
8. Carson JL, Stanworth SJ, Roubinian N, Fergusson DA, Triulzi D, Doree C, et al. Transfusion thresholds and other strategies for guiding allogeneic red blood cell transfusion. Cochrane Database Syst Rev. 2016;10:CD002042.
9. Carson JL, Guyatt G, Heddle NM, Grossman BJ, Cohn CS, Fung MK, et al. Clinical practice guidelines from the AABB: red blood cell transfusion thresholds and storage. JAMA. 2016;316:2025–35.
10. Stauder R, Valent P, Theurl I. Anemia at older age: etiologies, clinical implications, and management. Blood. 2018;131:505–14.
11. Shander A, Goodnough LT. From tolerating anemia to treating anemia. Ann Intern Med. 2019;170:125–6.
12. Akpinar CK, Gurkas E, Aytac E. Moderate to severe anemia is associated with poor functional outcome in acute stroke patients treated with mechanical thrombectomy. Interv Neurol. 2018;7:12–8.
13. Eisenstaedt R, Penninx BWJH, Woodman RC. Anemia in the elderly: current understanding and emerging concepts. Blood Rev. 2006;20:213–26.
14. Donaldson AIC, Soiza RL, Hands KJ, Witham MD, Myint PK. Variability in the clinical management of iron deficiency anaemia in older adults: results from a survey of UK specialists in the care of older people. Ther Adv Drug Saf. 2019;10:2042098619854870.
15. Artz AS, Thirman MJ. Unexplained anemia predominates despite an intensive evaluation in a racially diverse cohort of older adults from a referral anemia clinic. J Gerontol A Biol Sci Med Sci. 2011;66:925–32.
16. Li B, Evans D, Faris P, Dean S, Quan H. Risk adjustment performance of Charlson and Elixhauser comorbidities in ICD-9 and ICD-10 administrative databases. BMC Health Serv Res. 2008;8:12.
17. Poggiali E, Migone De Amicis M, Motta I. Anemia of chronic disease: a unique defect of iron recycling for many different chronic diseases. Eur J Intern Med. 2014;25:12–7.
18. Madu AJ, Ughasoro MD. Anaemia of chronic disease: an in-depth review. Med Princ Pract. 2017;26:1–9.
19. Penninx BWJH, Pahor M, Cesari M, Corsi AM, Woodman RC, Bandinelli S, et al. Anemia is associated with disability and decreased physical performance and muscle strength in the elderly. J Am Geriatr Soc. 2004;52:719–24.
20. Culleton BF, Manns BJ, Zhang J, Tonelli M, Klarenbach S, Hemmelgarn BR. Impact of anemia on hospitalization and mortality in older adults. Blood. 2006;107:3841–6.

**How to cite this article:** Carrier C, Meltzer D, Prochaska MT. Missed opportunities: Lack of a diagnostic workup of anaemia results in a high prevalence of unidentified anaemia. Vox Sang. 2024.