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16. Abstract

**INTRODUCTION.** The purpose of the study is to determine if there is a medical vs. human factors/experience risk tradeoff for pilots operating under BasicMed. The hypothesis would be that, while the rate of mishaps caused by medical factors is greater for older pilots, the rate of mishaps caused by human factors is lower for these pilots. **METHODS.** The analysis followed three steps: (1) examine the ratio of medically caused mishap rates to human factors/experience caused mishap rates for BasicMed pilots by age decade, (2) examine the similar ratio of medically caused mishap rates to human factors/experience caused mishap rates for 3rd class medical certificate pilots by age decade, and (3) compare the mishap rate ratios determined in steps 1 and 2 among age decade. The analysis relied on three primary data sources: for the 3rd Class Medical pilot counts and hours flows by age group the Federal Aviation Administration (FAA) Airman Medical Certification System (AMCS) and Document Imaging Workflow System (DIWS); for the BasicMed pilot counts by age group, the FAA Accident Incident Data System (AIDS); and for the mishap reports, the National Transportation Safety Board (NTSB) Aviation Accident Database. **RESULTS.** Step 1 determined that there appears to be some tradeoff for BasicMed pilots between the human factors and medical mishap rates. However, there is insufficient observed events to infer a pattern. Step 2 determined that there was no discernable similar tradeoff for 3rd Class Medical pilots and found that older 3rd Class pilots have higher mishap rates for both medically caused and human factors caused mishaps. And step 3 determined that, starting at age 40, 3rd Class pilot rates were higher than BasicMed pilot rates for both medically caused and human factors caused mishaps. **DISCUSSION.** A comparison between human factors and medical mishap rates suffers from the issue of very small sample sizes, especially for the BasicMed cohort, there being no such data before 2017 and little reliable data during the pandemic years 2020 and 2021. In addition, at least two of the assumptions used to develop the modified rule bear further scrutiny: flight hour counts for 3rd Class Medical pilots are based on reported rather than independently measured flight hours for the last six months from most recent medical exam and flight hour counts for BasicMed pilots are based on those 3rd Class Medical Counts.

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# Determining if there is a medical vs. human factors/experience risk tradeoff in pilots operating under BasicMed

Presented to:

By: Richard Greenhaw and Anthony Tvaryanas

Date: 9/26/2023

Federal Aviation Administration

# Background

- This study is premised on a comment in the Mitchell and Evans 2004 paper [6]
- In this paper the authors suggest the possible detriment to flight safety of retiring experienced pilots on medical grounds and replacing them with younger, less experienced pilots
- The current study examines the possibility of such a risk tradeoff for pilots operating under BasicMed or 3rd Class Medical Certification

# Study Objectives

I. Examine the ratio of medically caused mishap rates to human factors/experience caused mishap rates by age group for BasicMed pilots

II. Examine the ratio of medically caused mishap rates to human factors/experience caused mishap rates by age group for 3rd Class medical certificate pilots

II. Compare the mishap rate ratios determined in I and II (i.e., 3rd Class and BasicMed) among age groups

# Methods: Overall Plan

- For the BasicMed pilot cohort and the 3rd Class Pilot cohort:
  - Determine medically caused mishap rates by age group
  - Determine human factors caused mishap rates by age group
  - Compare medically caused mishap rates and human factors caused rates by age group to evaluate the hypothesis that there is an experience/age risk tradeoff by age within each cohort
- Compare the medically caused and human factors caused mishap rates between BasicMed and 3rd Class Pilot cohorts

# Methods: Cohorts, Variables, and Data Sources

- **BasicMed pilots** are pilots certified as BasicMed at the time of the mishap (for years 2017, 2018, and 2019) based on the FAA Accident Incident Data System (AIDS) as of August 2023 [3]
- **3rd Class pilots** are pilots certified as 3rd Class Medical, but not BasicMed, at the time of the mishap (years 2017, 2018, and 2019) based on the FAA Document Imaging Workflow System (DIWS) as of August 2023 [4]
- A medically caused mishap or a human factors caused mishap is an accident or incident reported and classified as such in the National Transportation Safety Board (NTSB) Aviation Accident Database [1]
- A **mishap rate** for a cohort age group is the number of mishaps for that group divided by the number of flight hours for that group

# Methods: Cohorts, Variables, and Data Sources

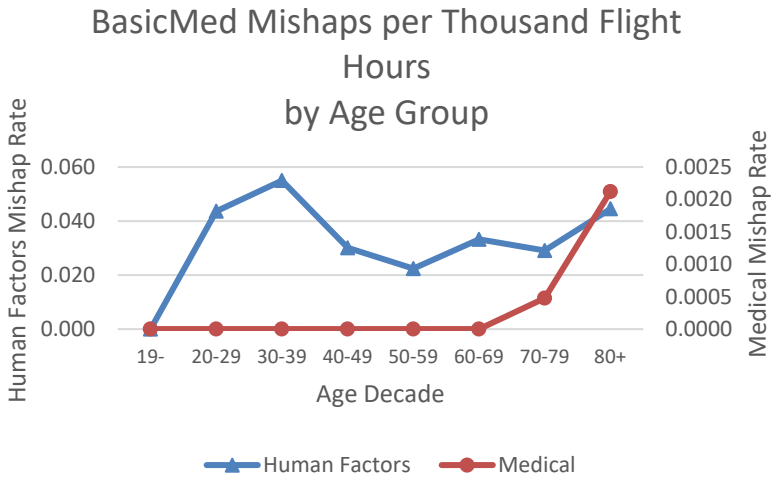
- **Flight hours** for a cohort age group are estimated by:
  - Calculating the mean annual flight hours by age group for active 3rd Class pilots (pilots reporting non-zero flight hours on their most recent medical examination) by doubling their reported (DIWS) number of flight hours for the past 6 months
  - Multiplying the mean annual flight hours by the estimated number of active pilots in that cohort age group (BasicMed and 3rd Class cohorts separately) based on active pilot counts found in AIDS, DIWS, and the report to Congress [5] for that cohort year giving annual flight hours for each cohort year
  - Summing the annual flight hours for each cohort year over the cohort range (2017 through 2019)

# Methods: Assumptions

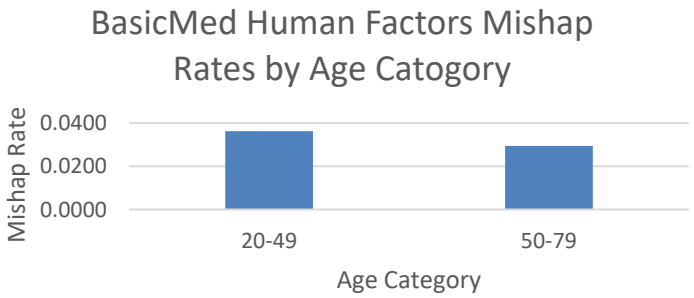
- Flight hour counts for 3rd Class Medical pilots are based on reported flight hours for last six months from most recent medical exam
  - Hours are reported by the pilots are not independently measured
  - Annual hours are extrapolated from those reported for the most recent six months
- Flight hour counts for BasicMed pilots are based on those 3rd Class Counts
  - Since BasicMed requirements do not include the same level of medical examination or reporting there is no direct basis for determining BasicMed hours flown by pilot
- The three-year period, 2017 through 2019, yields a useful, representative sample of mishap and flight hour data
  - The BasicMed program began in 2017, so no BasicMed data before that year
  - The pandemic caused the years 2020 and 2021 to be anomalous in terms of flight hours, and flight and mishap data after 2021 is currently incomplete

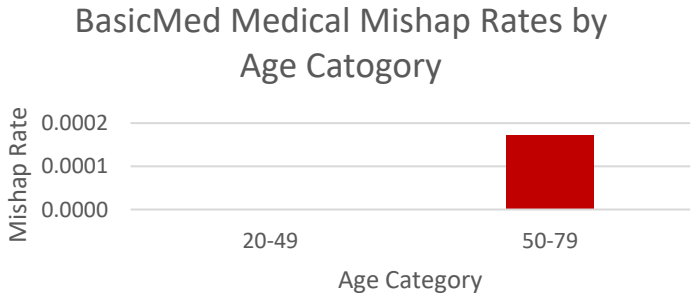
# Results: BasicMed

| Age Group | Decade | Mishap Count | | Flight Hours (000s) | Mishap Rate per Thousand Hours | |
|---|---|---|---|---|---|---|
| | | Human Factors | Medical | | Human Factors | Medical |
| 19- | 1 | 0 | 0 | 0 | 0 | 0 |
| 20-29 | 2 | 1 | 0 | 22 | 0.044 | 0 |
| 30-39 | 3 | 5 | 0 | 91 | 0.055 | 0 |
| 40-49 | 4 | 14 | 0 | 466 | 0.030 | 0 |
| 50-59 | 5 | 28 | 0 | 1,250 | 0.022 | 0 |
| 60-69 | 6 | 82 | 0 | 2,468 | 0.033 | 0 |
| 70-79 | 7 | 61 | 1 | 2,098 | 0.029 | 0.001 |
| 80+ | 8 | 21 | 1 | 472 | 0.045 | 0.002 |
| all | all | 212 | 2 | 6,866 | 0.031 | 0.000 |



# Discussion: BasicMed

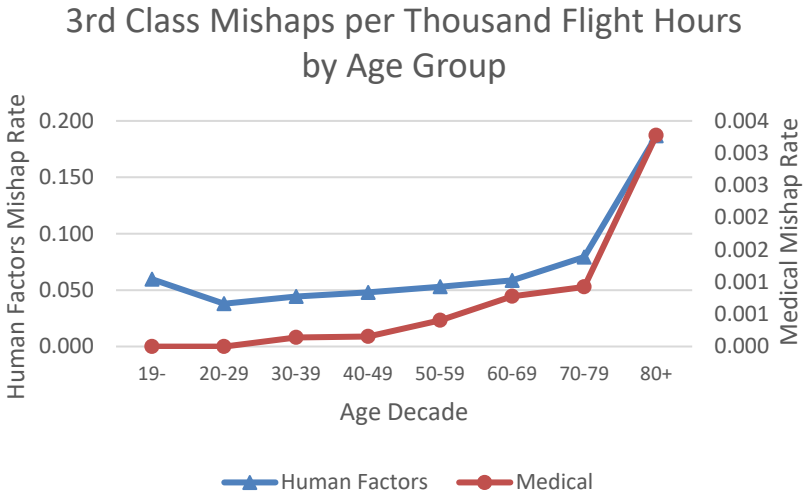


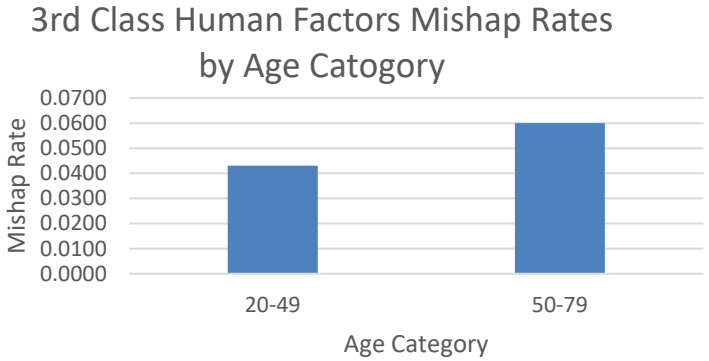

The first objective was to determine if there is a medical vs. human factors/experience risk tradeoff for pilots operating under BasicMed. Eliminating the endpoints for ages < 20 and >= 80, the lower (ages 20 -49) and higher (ages 50 – 79) categories show little difference for human factors mishaps and a larger difference for medical mishaps. *There appears to be some tradeoff between the HF rates and MED mishap rates.* However, there is insufficient observed events to infer a pattern. A statistical test would not show a significant difference.

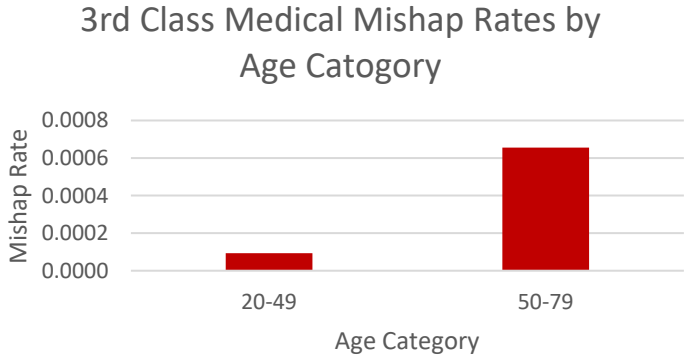
# Results: 3rd Class

| Age Group | Decade | Mishap Count | | Flight Hours (000s) | Mishap Rate per Thousand Hours | |
|---|---|---|---|---|---|---|
| | | Human Factors | Medical | | Human Factors | Medical |
| 19- | 1 | 44 | 0 | 736 | 0.060 | 0 |
| 20-29 | 2 | 307 | 0 | 8,073 | 0.038 | 0 |
| 30-39 | 3 | 314 | 1 | 7,071 | 0.044 | 0 |
| 40-49 | 4 | 307 | 1 | 6,398 | 0.048 | 0 |
| 50-59 | 5 | 391 | 3 | 7,376 | 0.053 | 0 |
| 60-69 | 6 | 451 | 6 | 7,697 | 0.059 | 0.001 |
| 70-79 | 7 | 257 | 3 | 3,240 | 0.079 | 0.001 |
| 80+ | 8 | 57 | 1 | 305 | 0.187 | 0.003 |
| all | all | 2128 | 15 | 40,896 | 0.052 | 0.000 |



# Discussion: 3rd Class

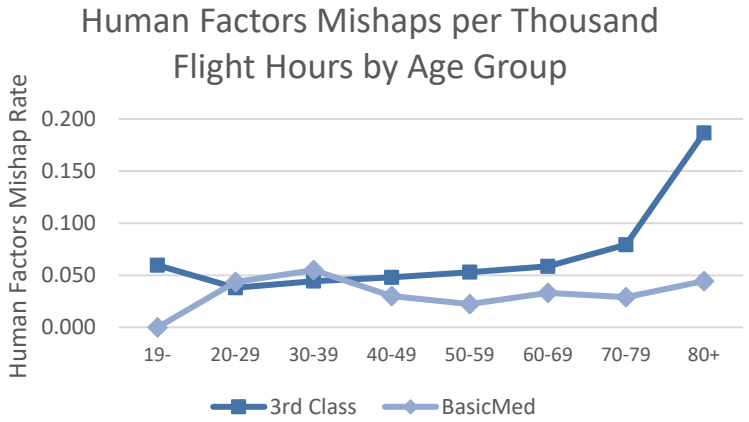


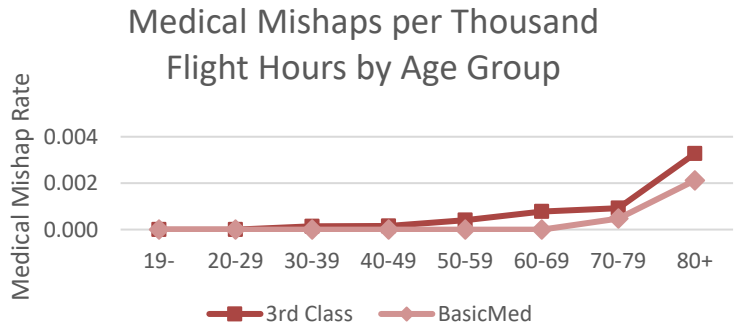




The second objective was to determine if there is a medical vs. human factors/experience risk tradeoff for pilots operating under 3rd Class Medical Certification. *There does not appear to be a tradeoff between age categories for 3rd Class Medical pilots.* The pilots in the 50-79 category show a higher mishap rate that those in the 20-49 age category for both human factors and medical mishaps. For 3rd Class Medical pilots both human factors and medical mishap rates increase monotonically with age decade.

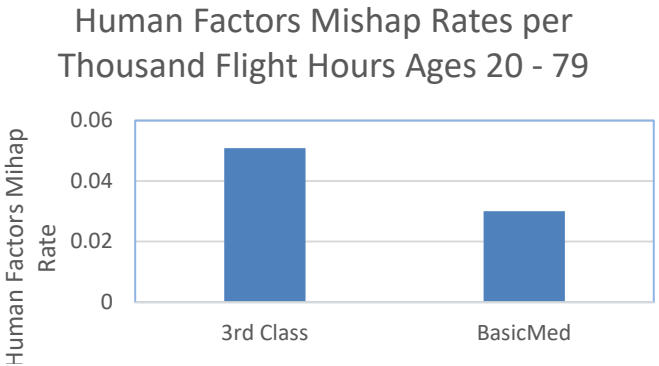
# Results: 3rd Class and BasicMed Comparison

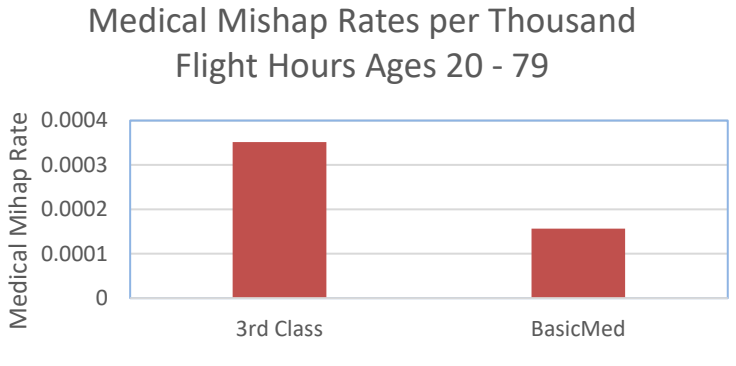
| Age Group | Decade | Human Factors Mishaps Rate per Thousand Hours | | Medical Mishap Rate per Thousand Hours | |
|---|---|---|---|---|---|
| | | 3rd Class | BasicMed | 3rd Class | BasicMed |
| 19- | 1 | 0.060 | 0 | 0 | 0 |
| 20-29 | 2 | 0.038 | 0.044 | 0 | 0 |
| 30-39 | 3 | 0.044 | 0.055 | 0 | 0 |
| 40-49 | 4 | 0.048 | 0.030 | 0 | 0 |
| 50-59 | 5 | 0.053 | 0.022 | 0 | 0 |
| 60-69 | 6 | 0.059 | 0.033 | 0.001 | 0 |
| 70-79 | 7 | 0.079 | 0.029 | 0.001 | 0.001 |
| 80+ | 8 | 0.187 | 0.045 | 0.003 | 0.002 |
| all | all | 0.052 | 0.031 | 0.000 | 0.000 |



# Discussion: BasicMed and 3rd Class Comparison




The third objective was to compare 3rd class and BasicMed mishap rates. As the bar charts show, *3rd Class rates exceed BasicMed rates for both human factors and medical when comparing ages 20 to 79*. And the line graphs indicate that the 3rd Class human factors rates increase significantly in the later two decades while BasicMed rates remain relatively constant. Medical mishap rates follow a similar pattern for both operational categories. However, the very small medical mishap sample size, especially for BasicMed mishaps, signals caution in inferring a definite pattern.

# Sources


1. National Transportation Safety Board (NTSB). Aviation Accident Database & Synopses Washington, DC2017 [8/28/2017]. accessed August 2023 https://app.ntsb.gov/avdata/Access/.
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5. Effects of Regulatory Changes to Medical Certification of Certain Small Aircraft Pilots. Federal Aviation Administration (FAA) report to Congress on the progress in meeting the requirements of Section 2307 of the FAA Extension, Safety, and Security Act of 2016 (P.L. 114-190) (FESSA). FESSA (Pub. L. 114-190), Section 2307 (h)
6. Mitchell SJ, Evans AD. Flight safety and medical incapacitation risk of airline pilots. Aviat Space Environ Med 2004;75:260–8.
7. Project OC 17.6: Medical / Human Factors Risk Tradeoff Data Tables, Excel Spreadsheet. August 2023.