# JUST-CT Final Results


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# *Disclosures*

- Nothing to disclose.

# *Steps in Analysis*

- ✓ Data validation
- ✓ Create combined data set
- ✓ “Cleaning Data” step (following preset protocol)
- ✓ Arbitration step (following preset protocol): Arbitrage whenever disagreement between two auditors Score original matched ESR iGuide exam. Arbitration also for specialty type & body regions
- ✓ Create Data Set for Analysis (following preset protocol), including definition of dependent & explanatory variables
- ✓ Descriptive Statistics
- ✓ Statistic Analysis
- ✓ Final report by country following preset template

# *Analysis Team*

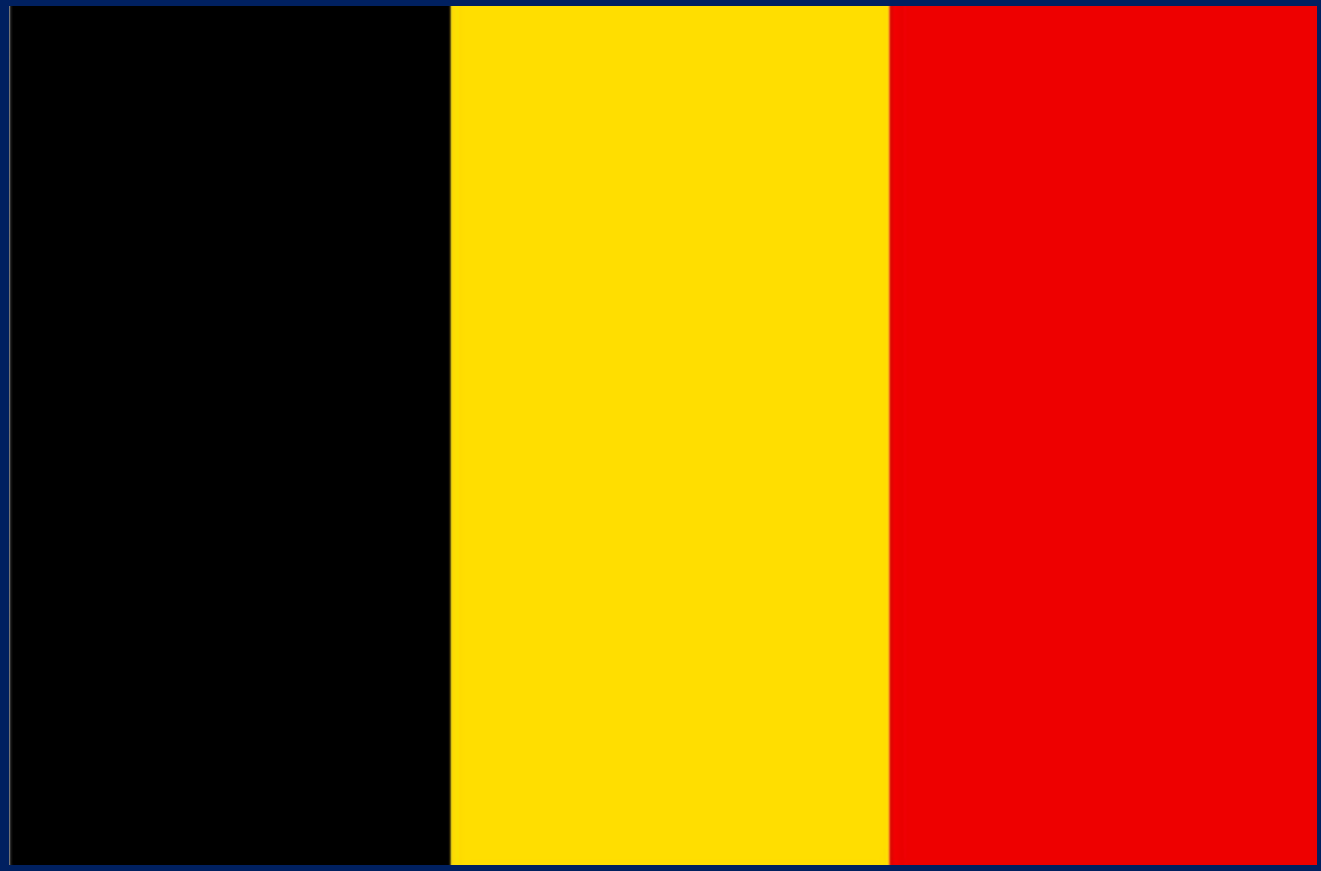
- Dr. Clara Singer (Israel)
- Lucia Bergovoy Yellin (Israel)
- Dr. Mor Saban (Israel)
- Supervised by Prof. Jacob Sosna (Israel)
- Arbitration iGuide: Prof. Boris Brkljacic (Croatia)
- Arbitration body regions & specialty type: Prof. Jacob Sosna (Israel)

SHEBA Tel HaShomer City of Health | Gertner Institute

Research Center for Medical Technology Policy & Innovation

# *And Now to the Results*

# *Belgium*



# *Belgium*
# *Sample Overview*

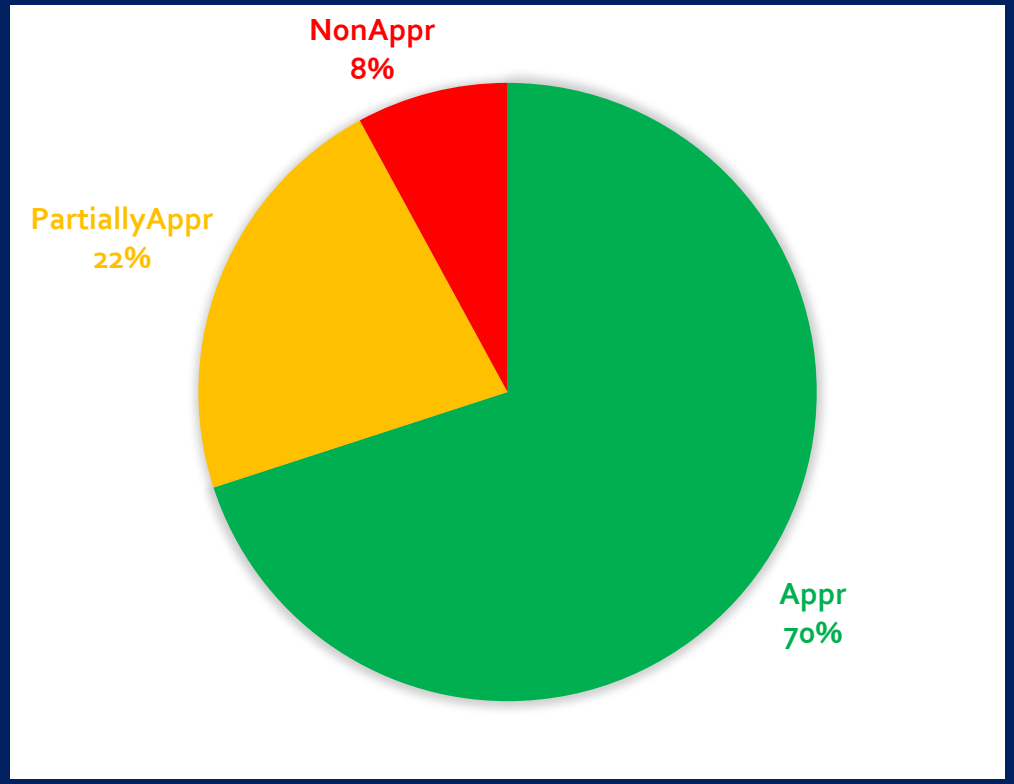
| | N | % Of Total | % Of Scored |
|---|---|---|---|
| Number of audited referrals (Total) | 1,006 | 100% | |
| Of which removed from analysis (duplicates, invalid data) | 22 | 2.2% | |
| Of which unscored referrals (no/insufficient clinical data) | 10 | 1.0% | |
| Of which scored | 974 | 96.8% | |
| • Fully appropriate (score 7-9) | • 745 | • 74.1% | • 76.5% |
| • Partially appropriate (score 4-6) | • 155 | • 15.4% | • 15.9% |
| • Inappropriate (score: 1-3,0*) | • 74 | • 7.4% | • 7.6% |

# *Belgium*
# *Sample Overview Cont.*

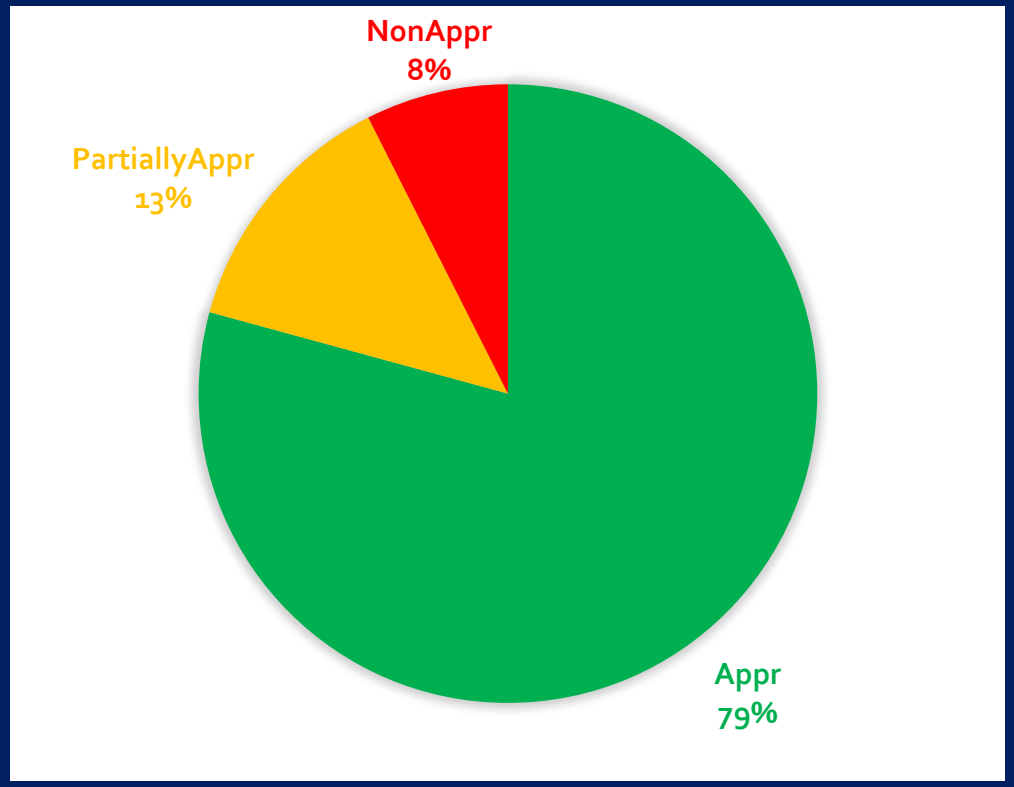
- **Data quality:** Generally good (only 1% referrals unscored due to insufficient clinical data).
- **Source file:** 1,006 records. Of these, 3.2% were removed from the study / unscored due to insufficient clinical data → 974 records in analysis.
- **Classification:**
  - 76.5% of scored population (745 / 974) → "Fully appropriate" (score 7-9).
  - 23.5% of scored population (229 / 974) → "Inappropriate" (score <7, when binary).

# *Belgium*
# *AR by Institution Type*

**PRIVATE**



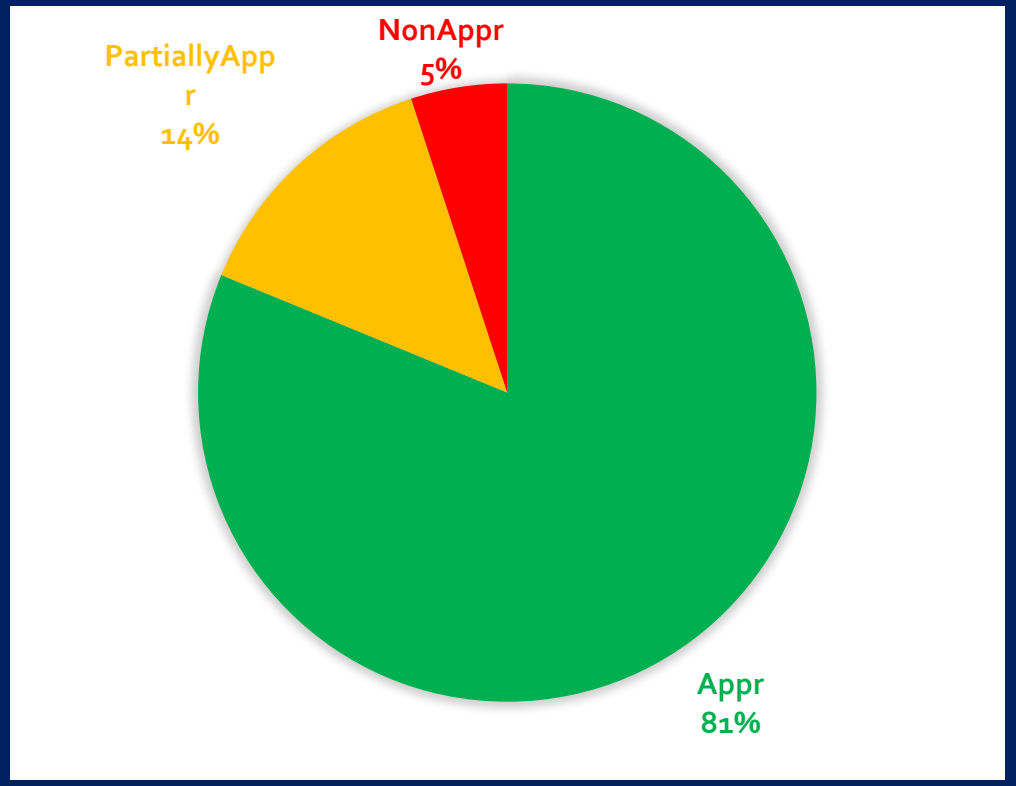

**PUBLIC**



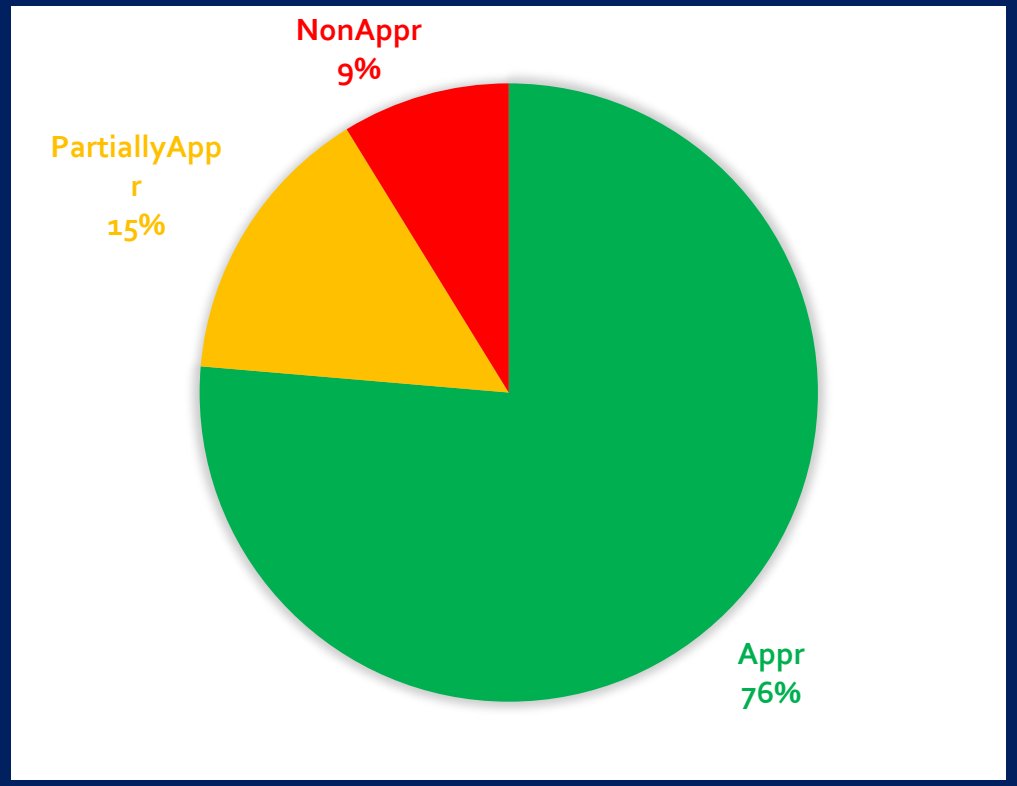

AR was significantly higher in PUBLIC institutions as compared to PRIVATE institutions **(79% vs 70%, p=0.002).**

# *Belgium*
# *AR by Patient Status*

## INPATIENT / EMERGENCY




## OUTPATIENT

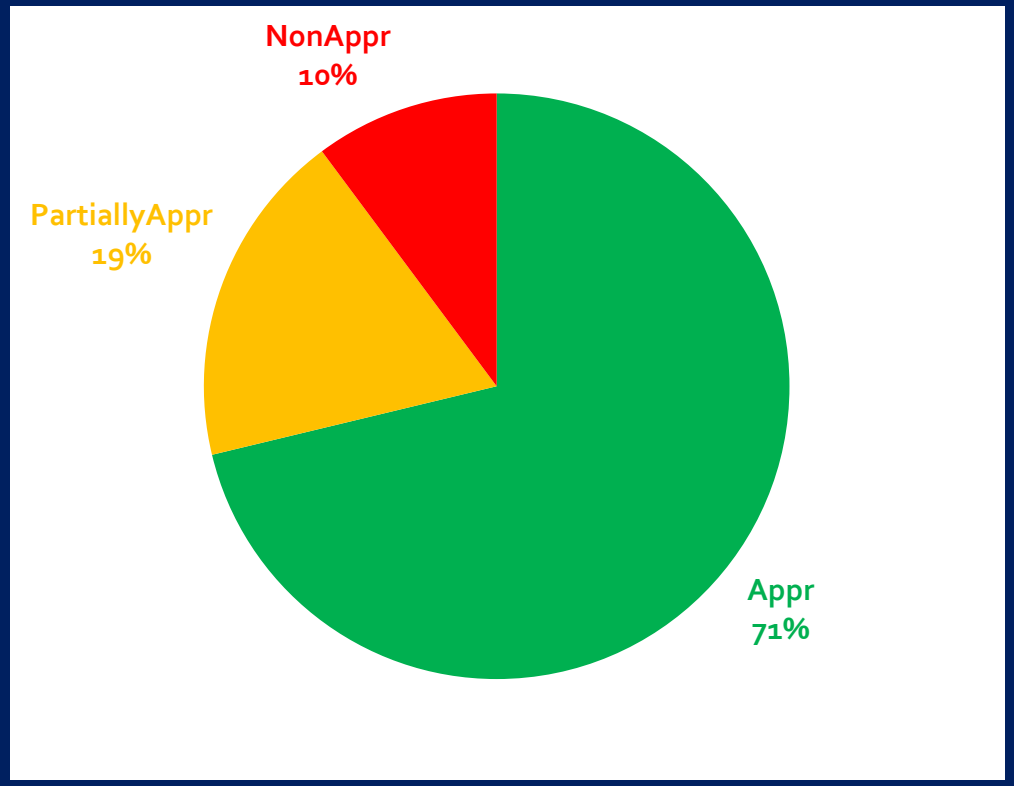



AR was higher in HOSPITALIZATION as compared to OUTPAITENT, although not significant

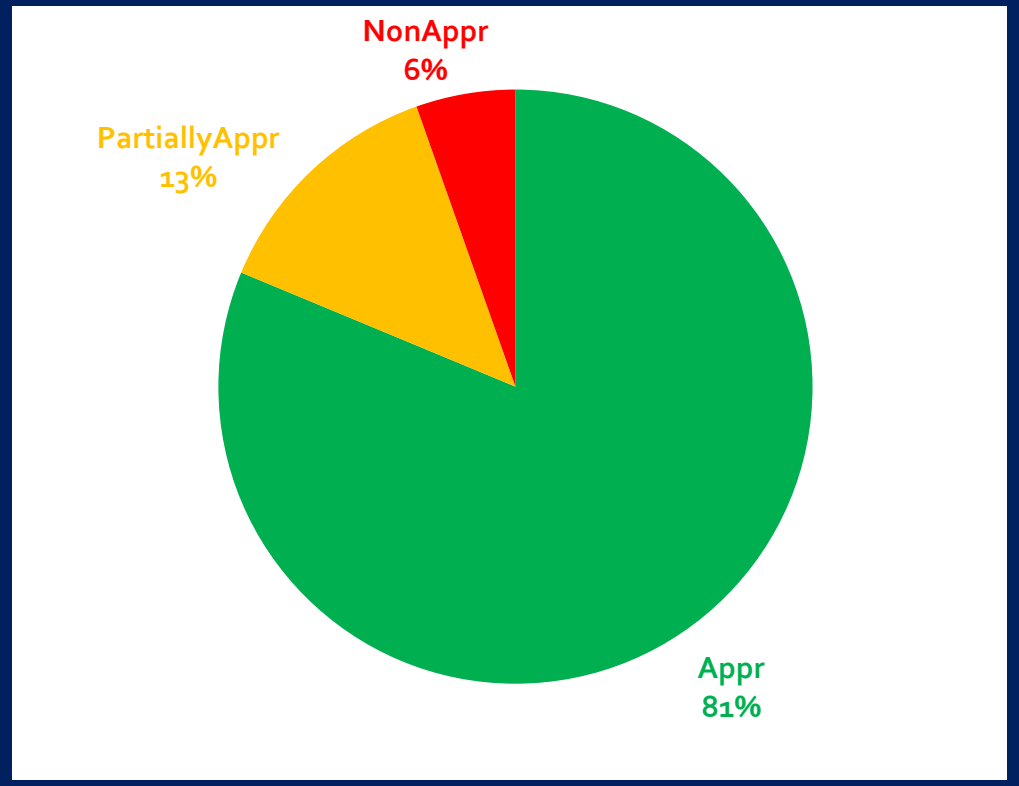
**(81% vs 76%, respectively; p=0.107)**

# *Belgium*
# *AR by Gender*

**FEMALE**



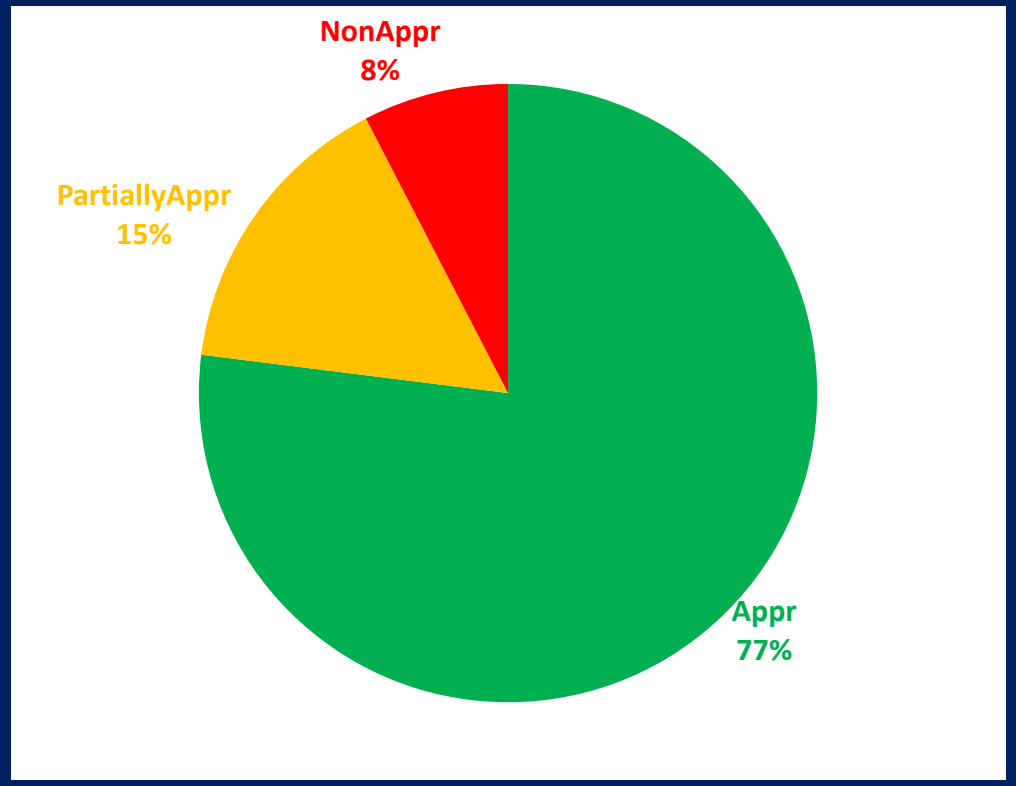

**Male**



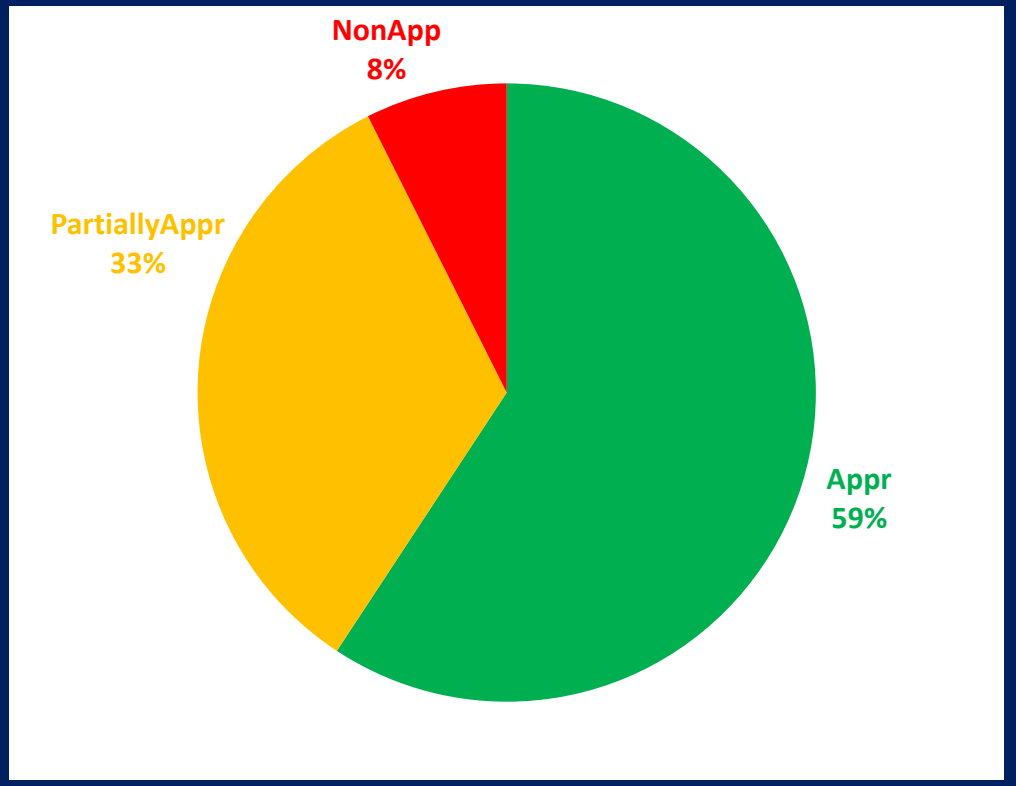

AR was significantly higher in MALE as compared to FEMALE **(81% vs 77%; p<0.001)**.

# *Belgium*
# *AR by Age Group*

**ADULT**



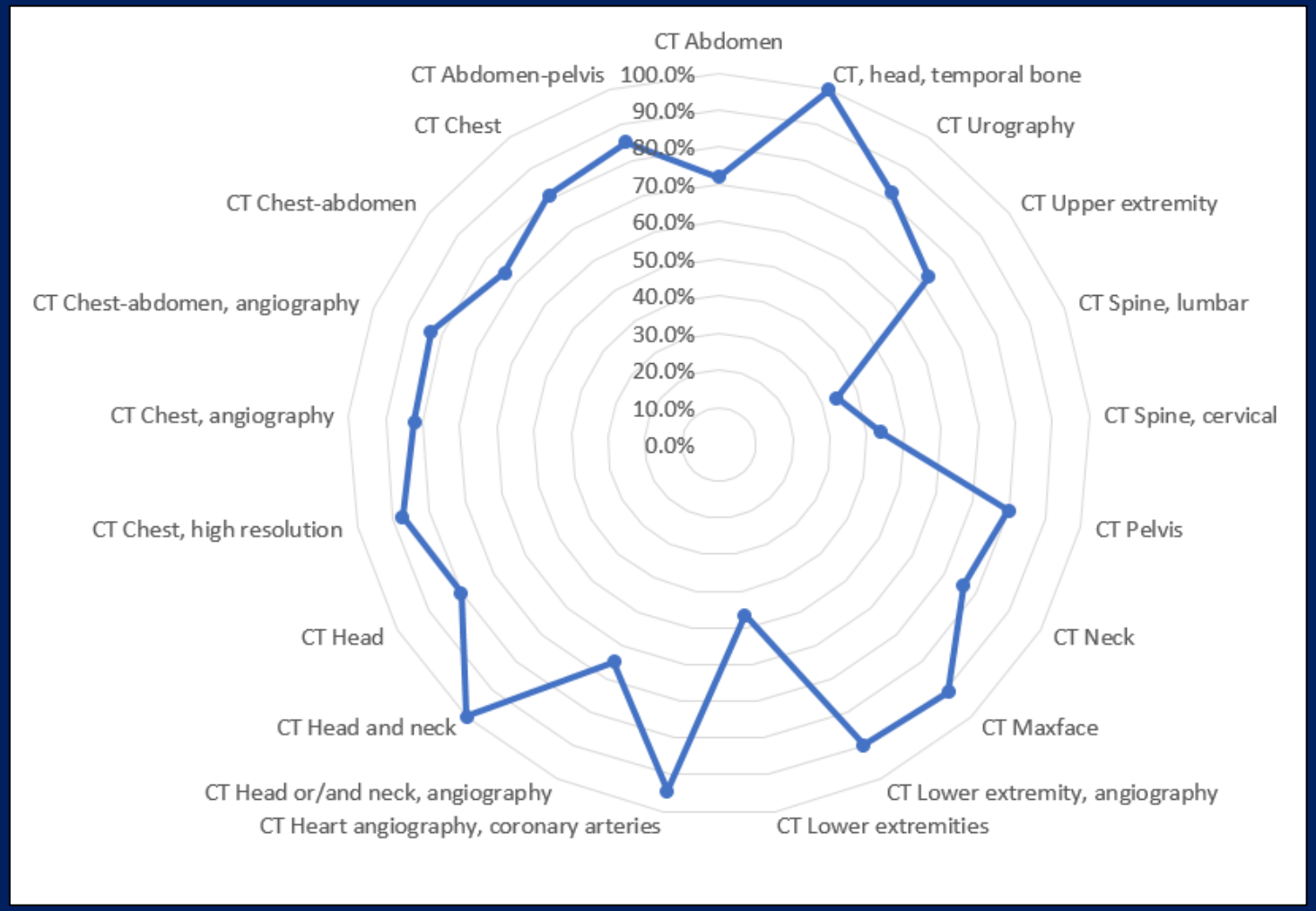

**CHILD**



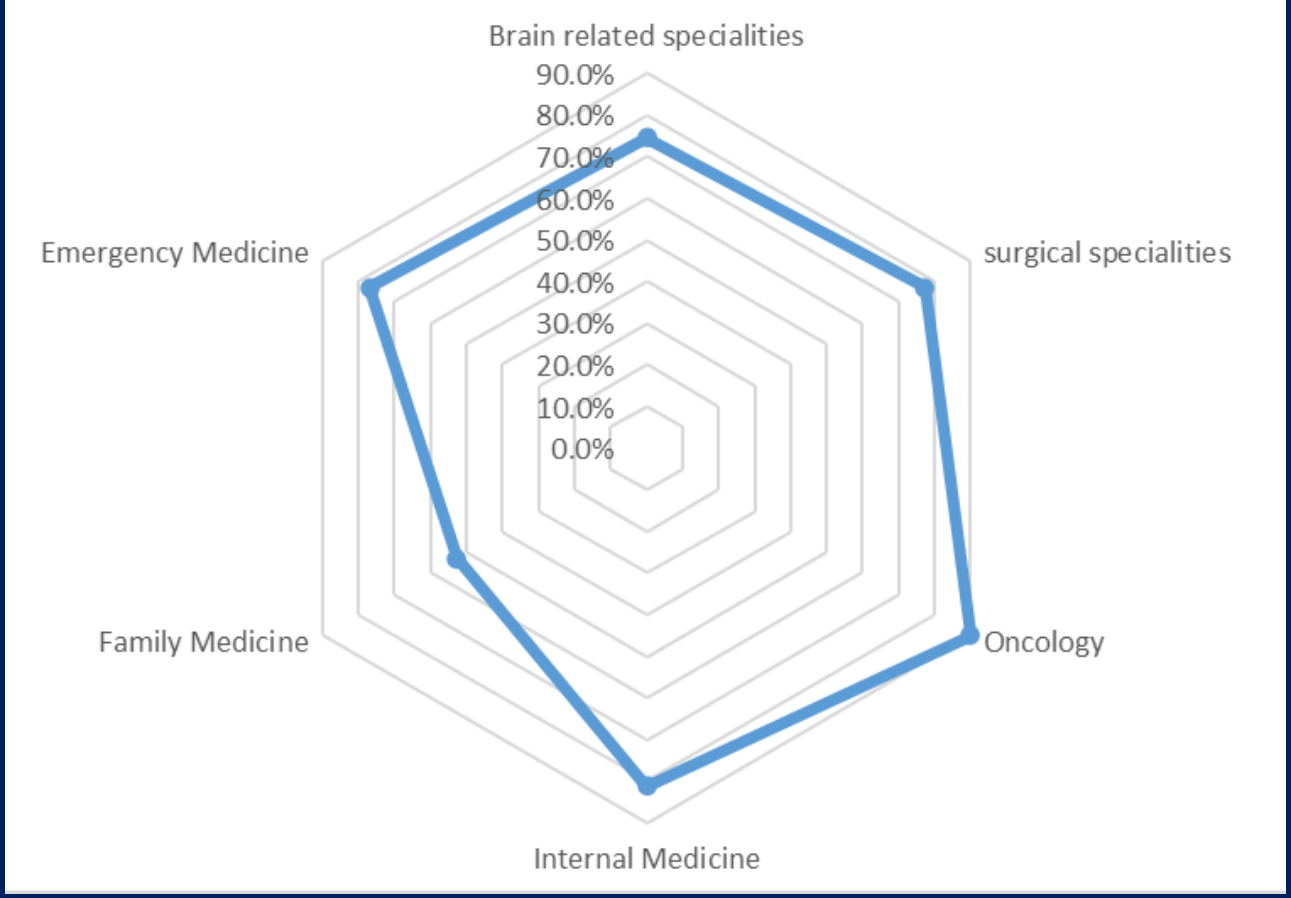

AR was significantly higher in ADULTS compared to CHILDREN **(77% vs 59%, p=0.04).**

**However, only 27 children.**

# *Belgium*
# *AR by Requested Exam*



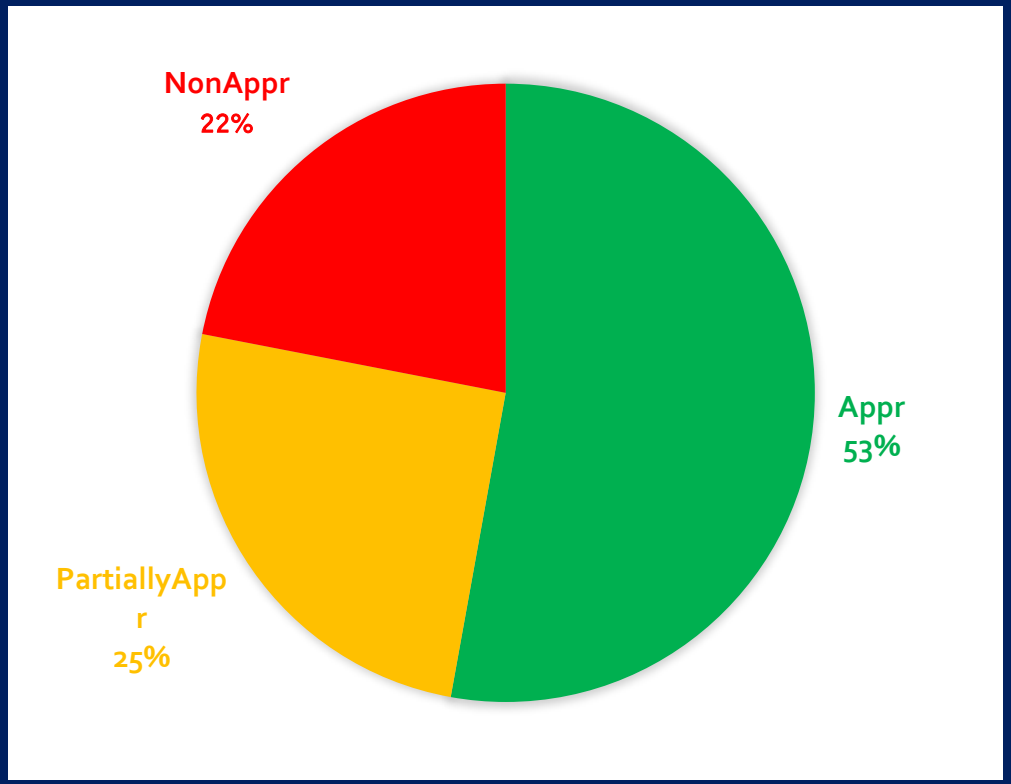
# *Belgium*
# *AR by Referrer Specialty*



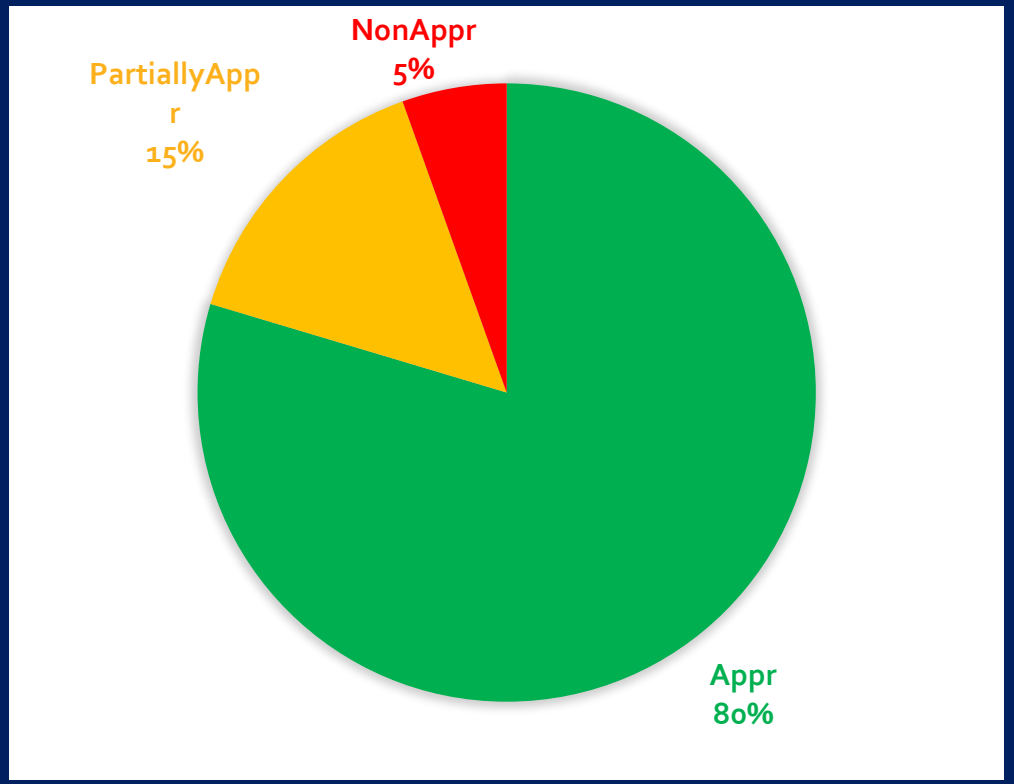

In general, AR significantly higher for CTs referred by MEDICAL SPECIALISTS (oncology 89%, internal medicine 81%, surgical specialties & emergency medicine 77%, brain related specialties 74.5%,) rather than by GP (53%), **p<0.001.**

# *Belgium*
# *AR by Referrer Specialty*

## FAMILY / GENERAL DR




## SPECIALIST DOCTOR

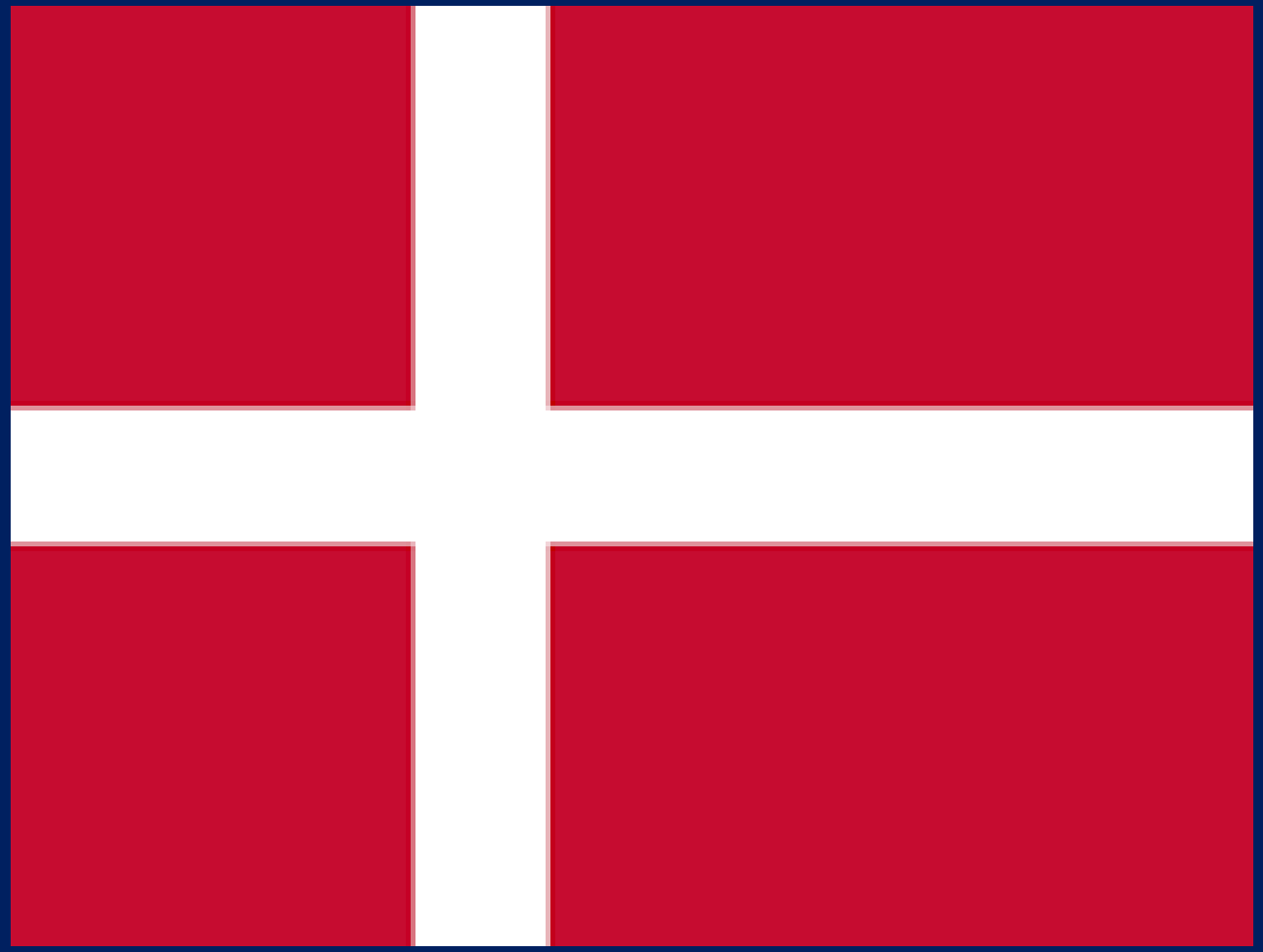



AR was <u>higher</u> for requests referred by MEDICAL SPECIALISTS rather than by GP **(80% vs 53%, p < 0.001).**

# *Belgium*
# *Conclusions*

- 1,006 records → 3.2% removed → 974 records were included in statistical analysis.
- 76.5% of scored population (745 / 974) were rated as "Fully appropriate" (score 7-9).
- Significant associations were found with: i**nstitution type (p=0.002), gender of patient (p<0.001), age group of patient (p=0.04)** & **expertise of referring physician (p<0.001)**.
    - Higher AR in PUBLIC SECTOR compared to PRIVATE SECTOR (79% vs 70%) & for MALES compared to FEMALES (81% vs 71%). Lower AR in CHILDREN compared to ADULTS (59% vs 77%), although only 27 children were included, & for GP compared to SPECIALIST DOCTOR (53% vs 80%).

# *Denmark*



# Denmark
# Sample Overview

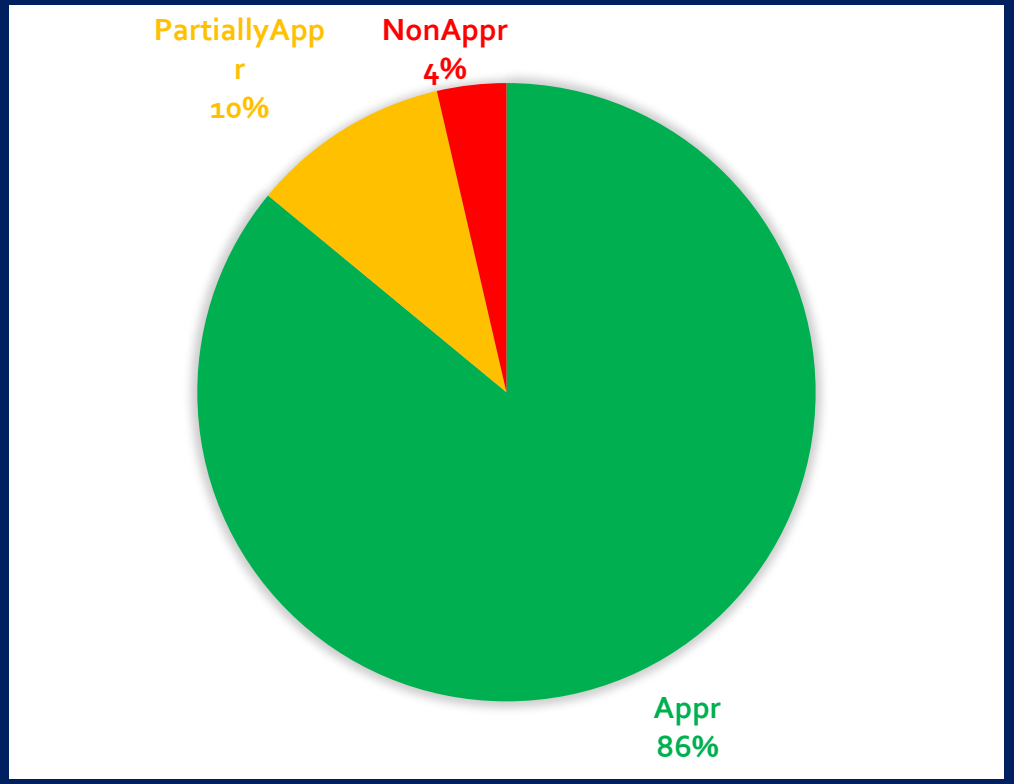
| | N | % Of Total | % Of Scored |
|---|---|---|---|
| Number of audited referrals (Total) | 1,012 | 100% | |
| Of which removed from analysis (duplicates, invalid data) | 71 | 7.02% | |
| Of which unscored referrals (no/insufficient clinical data) | 19 | 1.88% | |
| Of which scored: | 922 | 91.11% | |
| • Fully appropriate (score 7-9) | • 792 | • 78.26% | • 85.9% |
| • Partially appropriate (score 4-6) | • 97 | • 9.58% | • 10.52% |
| • Inappropriate (score: 1-3,0*) | • 33 | • 3.26% | • 3.58% |

# *Denmark*
# *Sample Overview Cont.*

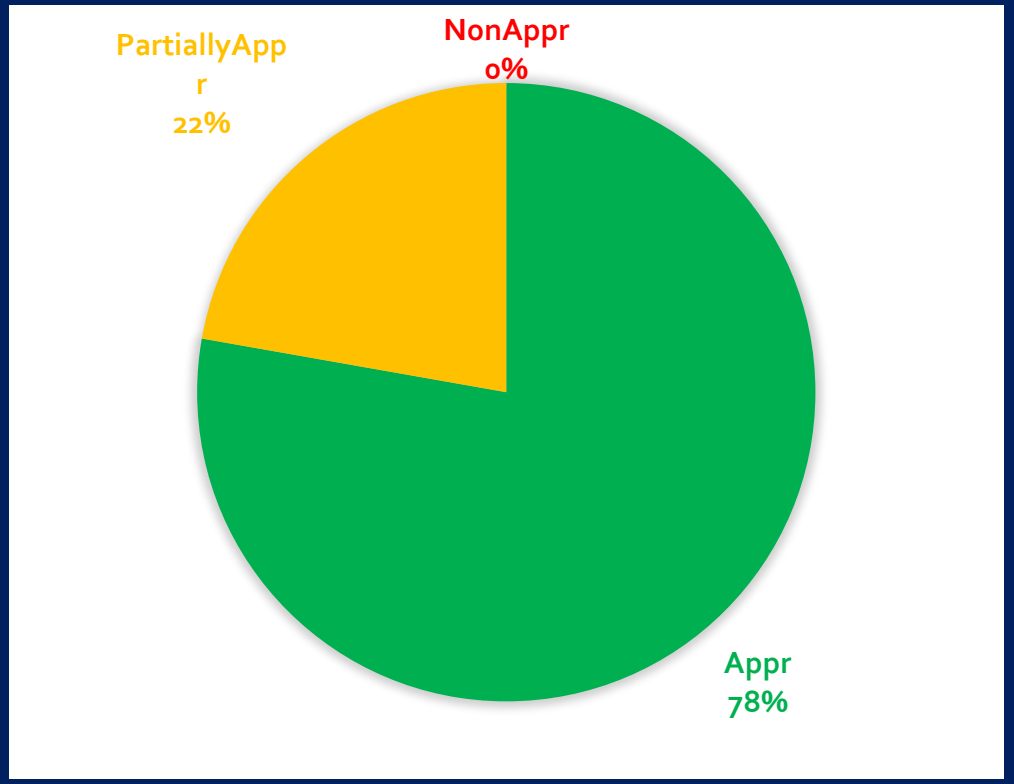
- **Data quality:** relatively good with ~91% of referrals scored.
- 8.89% unscored population. Of these, 7% (n=71) was removed from analysis & 1.88% was unscored due to insufficient clinical data (classified as inappropriate).
- **Classification:**
  - 85.9% of scored population (792 / 922) → "Fully appropriate" (score 7-9)
  - 14.1% of scored population (130 / 922) → "Inappropriate" (score <7, when binary).

# *Denmark*
# *AR by Institution Type*

**PUBLIC**



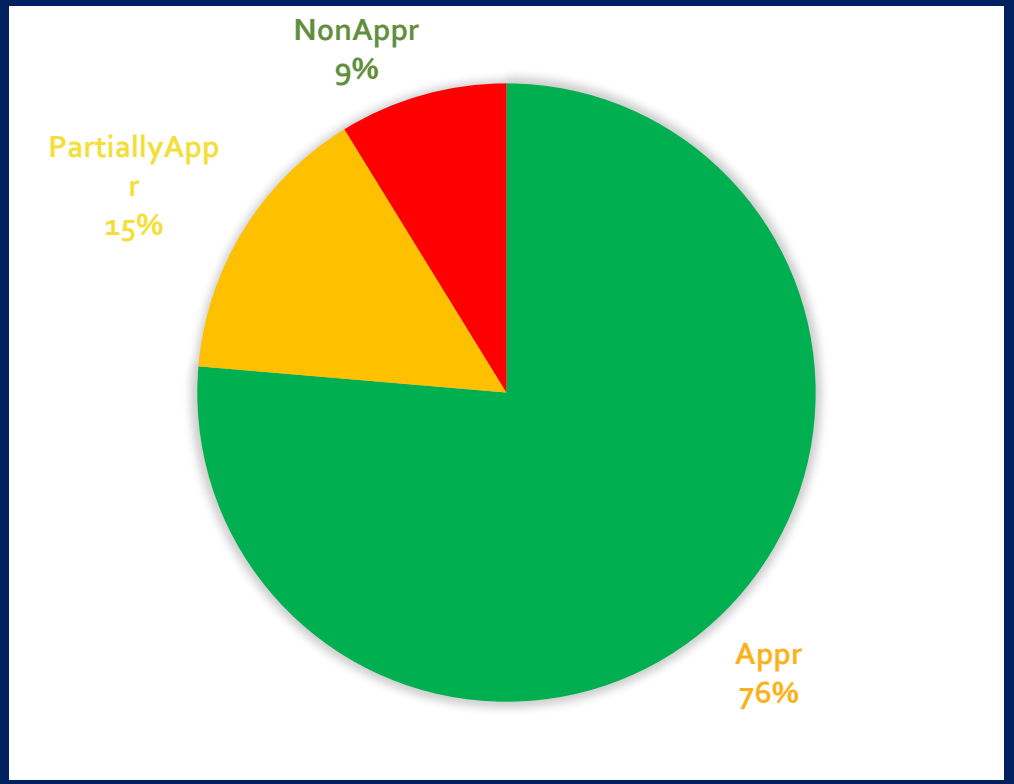

**PRIVATE**



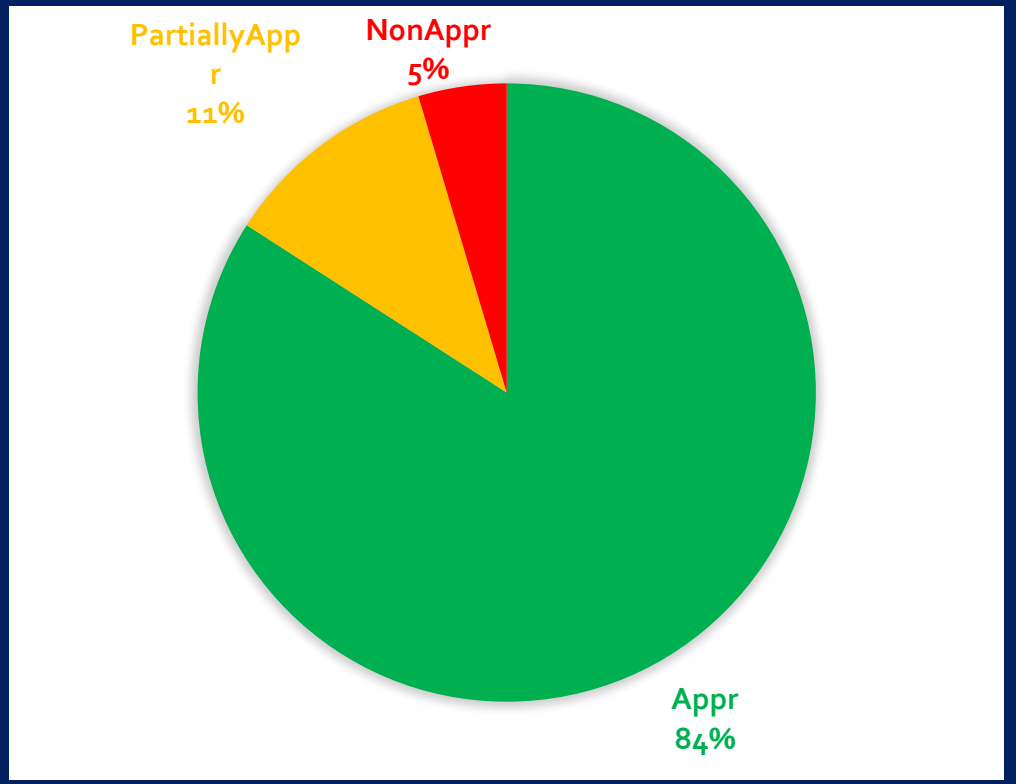

No significant association was found between degree of appropriateness according to ESR-iGuide & institution type **(86% vs 78%, p=0.37).**

# *Denmark*
# *AR by Patient Status*

## INPATIENT / EMERGENCY



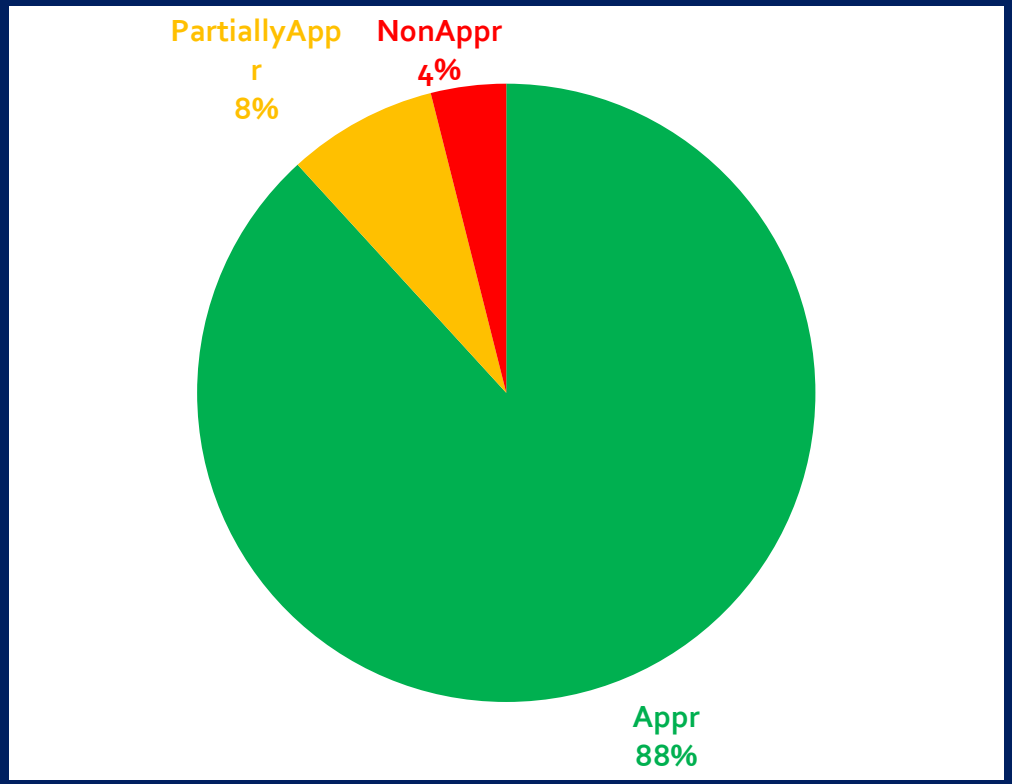

## OUTPATIENT



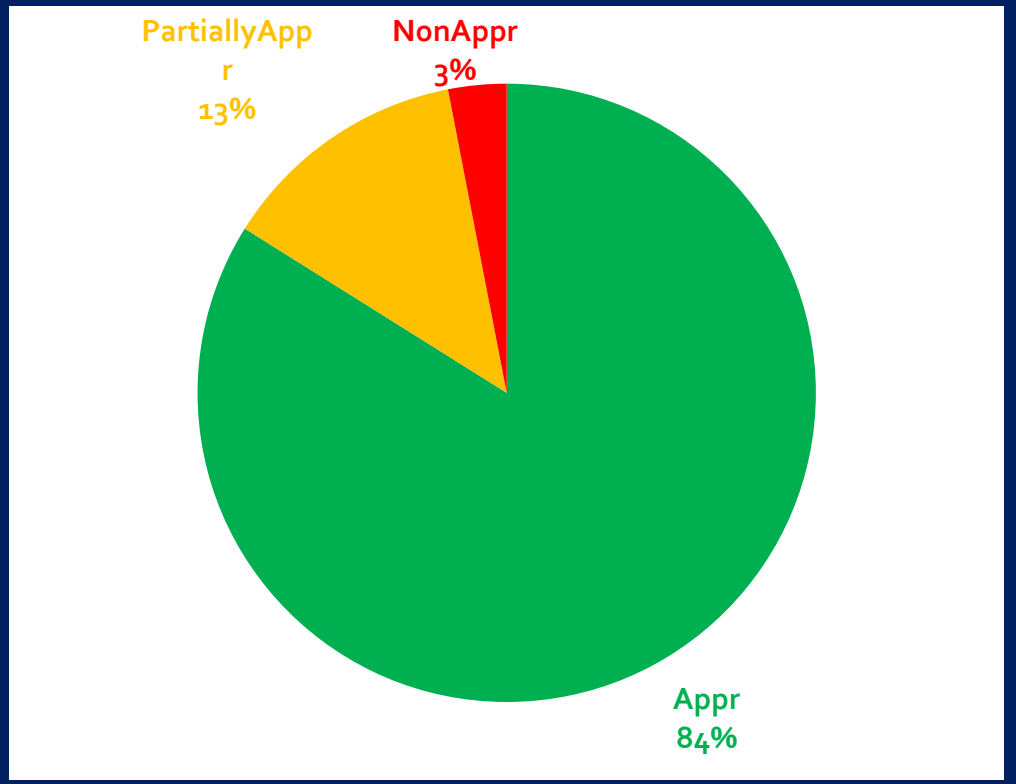

No significant association between degree of appropriateness according to ESR-iGuide & **Patient Status**. AR slightly higher in HOSPITALIZATION as compared to AMBULATORY CARE **(87% vs 84%; p=0.23).**

# Denmark
# AR by Gender

## FEMALE

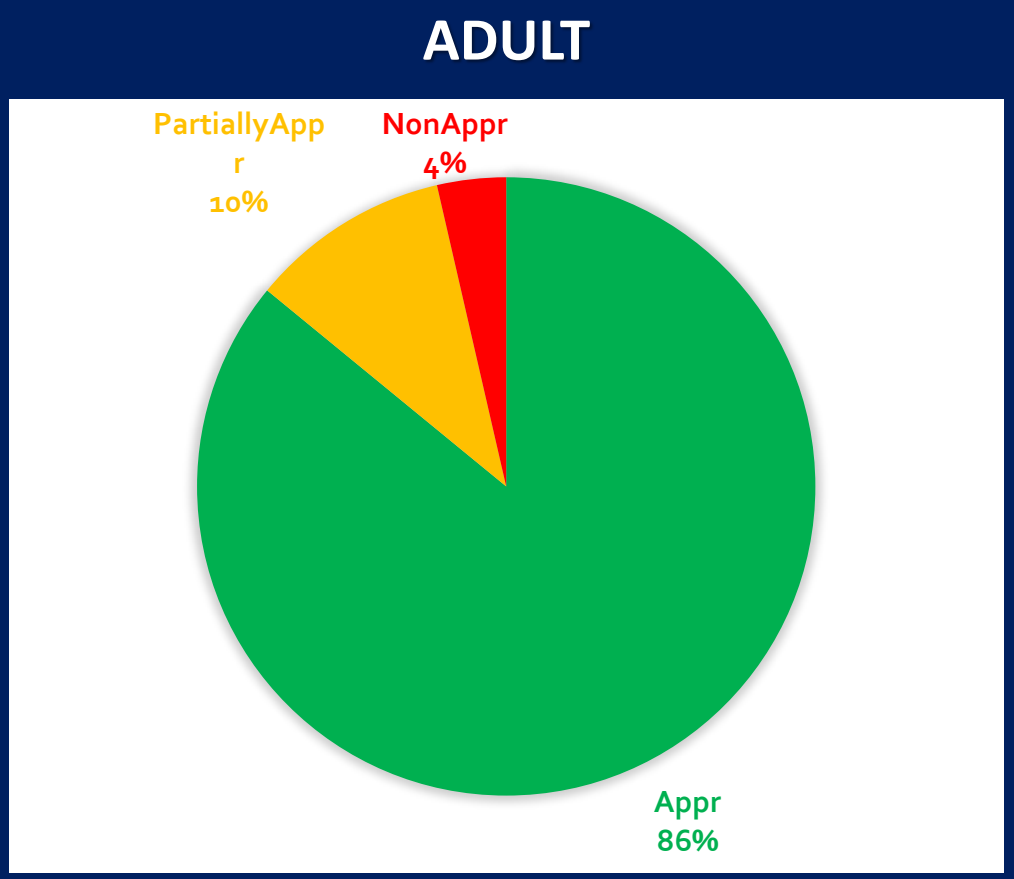



## MALE




AR higher in FEMALE compared to MALE **(88% vs 84%, p=0.03)**, although association was borderline significant when using a binary variable for appropriateness (p=0.06), suggesting differences are mainly in the ratio between partially appropriate & non-appropriate.

# *Denmark*
# *AR by Age Group*



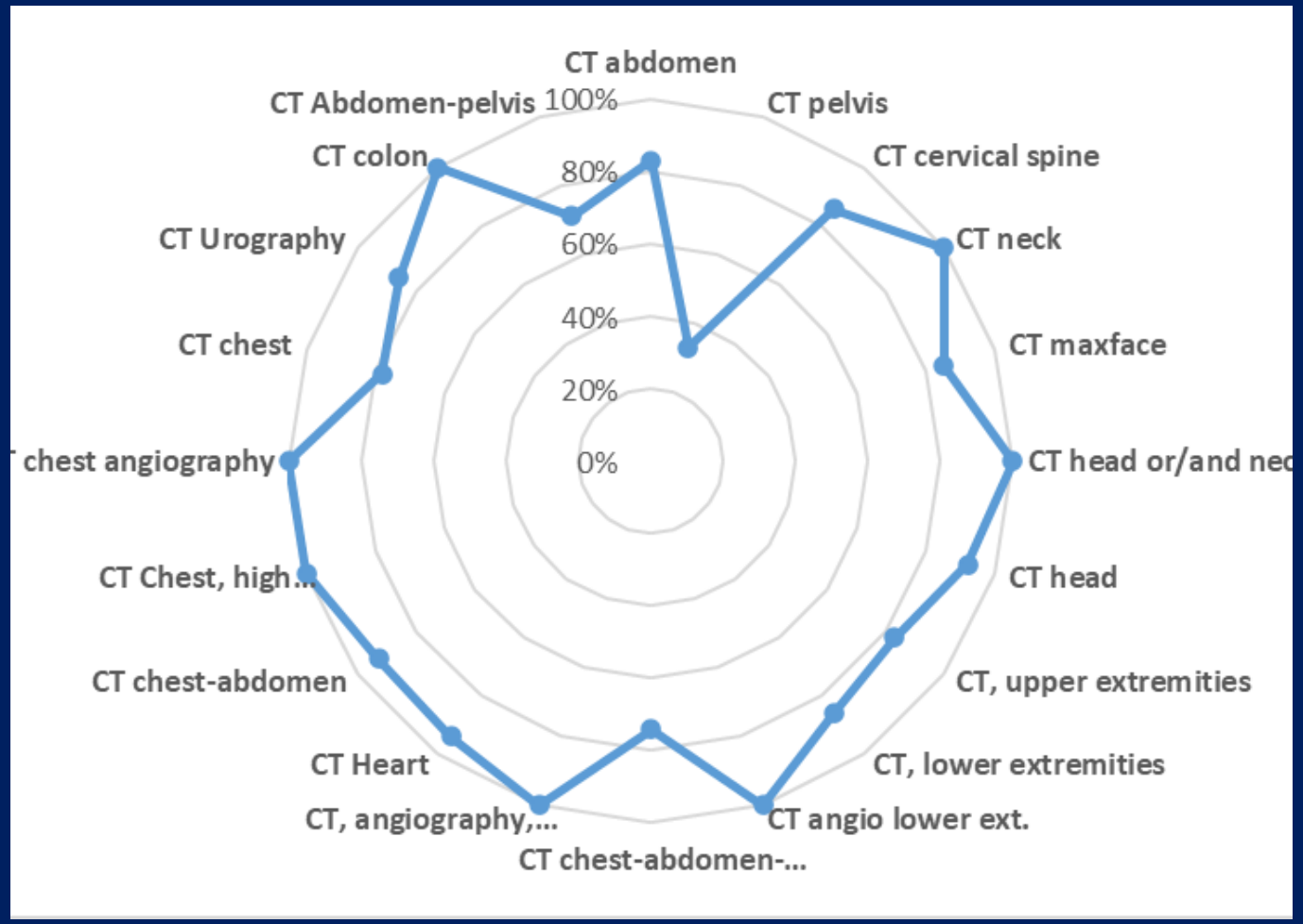

No further analysis was done since children (<18 years old) were under-represented (5 / 922 referrals scored).

AR for ADULTS: 86%.

# *Denmark*
# *AR by Requested Exam*

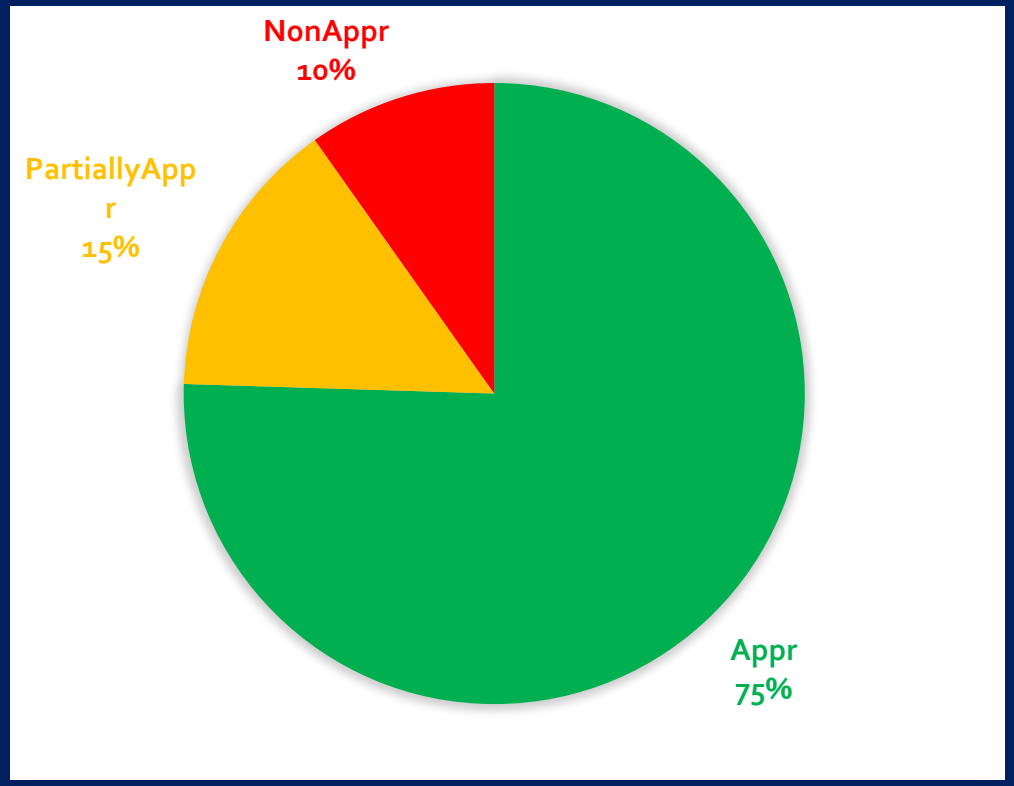
- No definitive conclusions could be made about type of CT examination concerning appropriateness (many cells with very low excepted counts & Chi-square didn't converge).

- Highest AR: CT Angiography heart, coronary arteries (100%); CT Heart (94%); HRCT (100%); CT Angiography Chest (100%); CT Chest-abdomen (93%); & CT Head (92%).

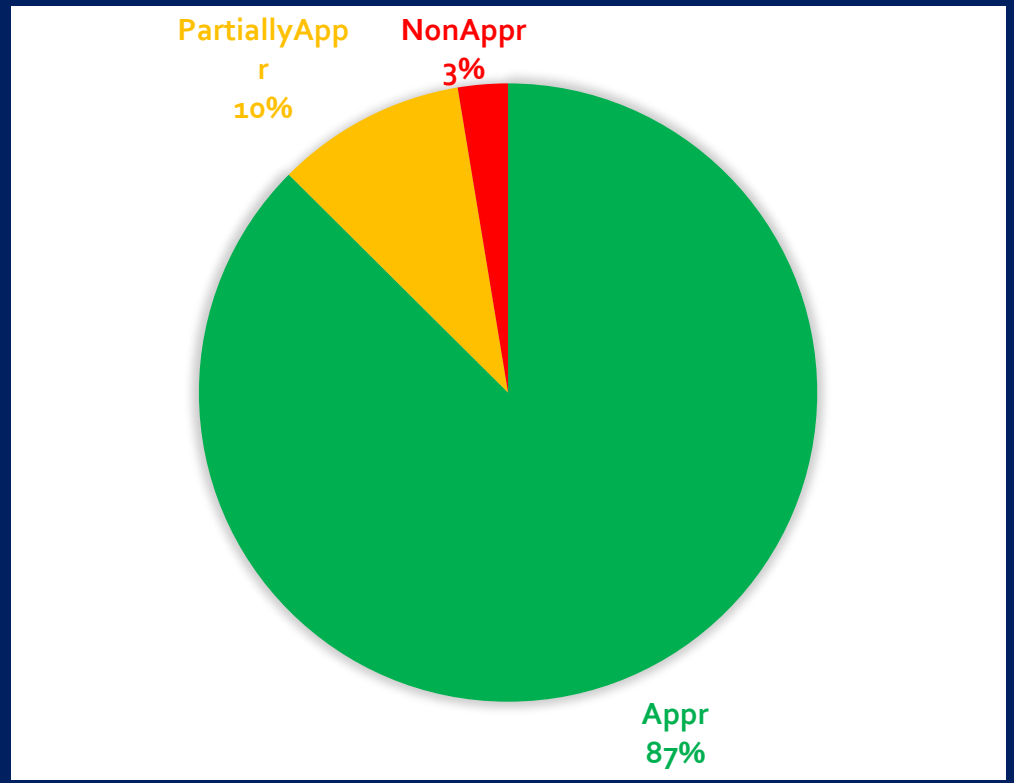


# *Denmark*
# *AR by Referrer Specialty*

## FAMILY / GENERAL DOCTOR

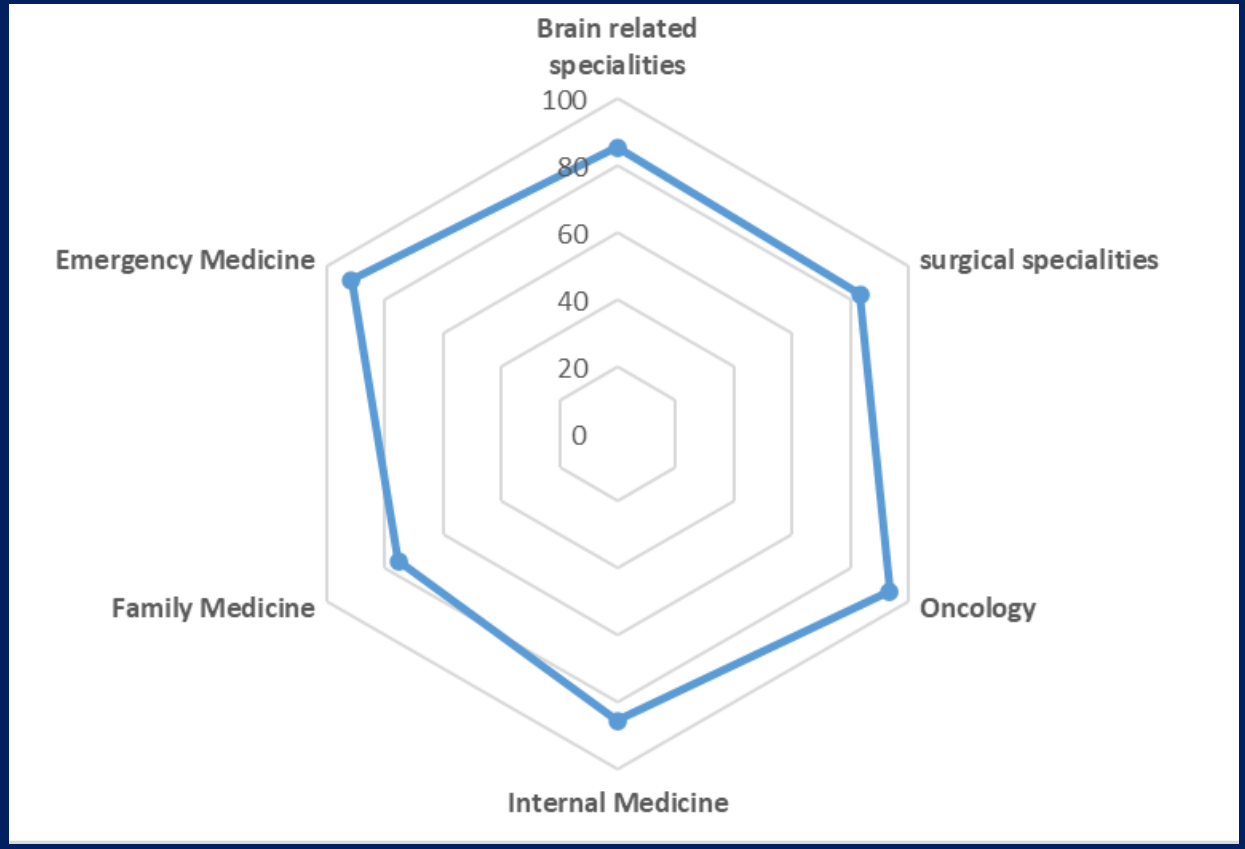



## SPECIALIST DOCTOR



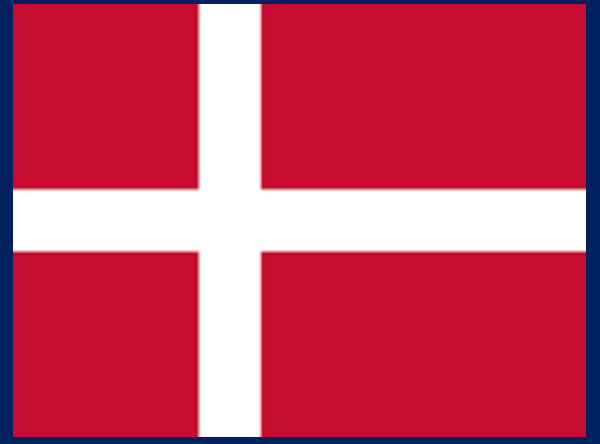

AR was higher for requests referred by Medical Specialists rather than by GP **(87% vs 75%, p = 0.0005).**

# *Denmark*
# *AR by Referrer Specialty*




In general AR was higher for requests referred by MEDICAL SPECIALISTS (oncology 94%, emergency medicine 92%, brain related specialties 85%, internal medicine 85%, & surgical specialties 83%) rather than by GPs (75%), **p=0.0005.**

# *Denmark*
# *Conclusions*



- 1,012 records → 8.89% removed → 922 records included in statistical analysis.
- 85.9% of scored population (792 / 922) rated "Fully appropriate" (score 7-9).
- AR higher in FEMALE compared to MALE **(88% vs 84%, p=0.03)**, although borderline significant when binary variable for appropriateness (p=0.06).
- Significant association between degree of appropriateness according to ESR-iGuide & **expertise of referring physician**: AR was higher for Specialists rather than GP **(87% vs 75%, p = 0.0005).**
- Specifically, highest AR: oncology doctors (94%) & emergency medicine doctors (92%).

# *Estonia*

# *Estonia*
# *Sample Overview*

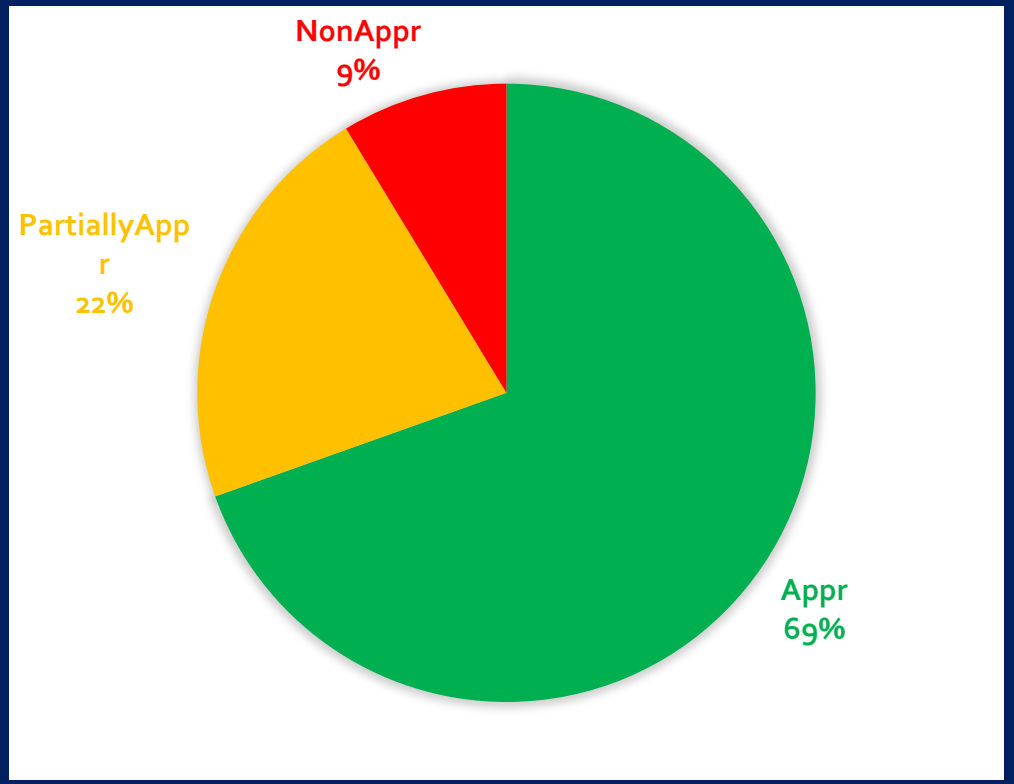
| | N | % Of Total | % Of Scored |
|---|---|---|---|
| Number of audited referrals (Total) | 1013 | 100% | |
| Of which removed from analysis (duplicates, invalid data) | 10 | 0.99% | |
| Of which unscored referrals (no/insufficient clinical data) | 57 | 5.63% | |
| Of which scored: | 946 | 93.39% | |
| • Fully appropriate (score 7-9) | • 647 | • 63.87% | • 68.39% |
| • Partially appropriate (score 4-6) | • 208 | • 20.53% | • 21.99% |
| • Inappropriate (score: 1-3) | • 91 | • 8.98% | • 9.62% |

# *Estonia*
# *Sample Overview Cont.*

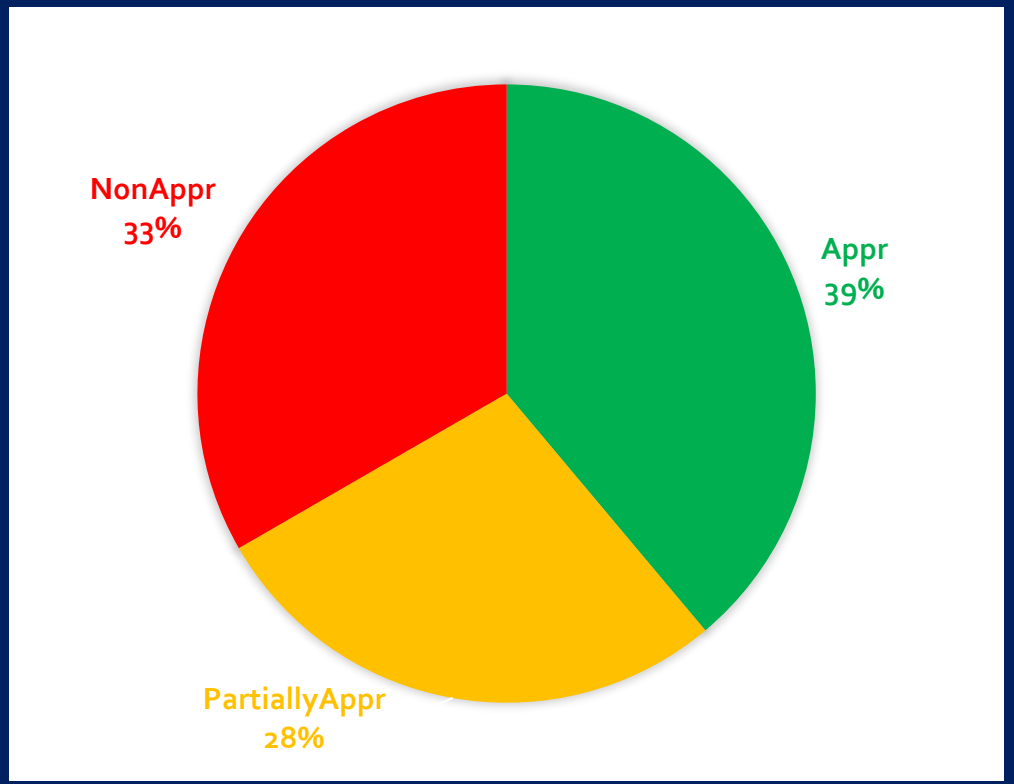
- **Data quality:** relatively good with ~93% of referrals scored.
- 6.6% unscored referrals: Of these, 1% (n=10) removed from analysis & 5.6% was unscored due to insufficient clinical data (considered as inappropriate).
- **Classification:**
  - 68% of scored population (647 / 946) → "Fully appropriate" (score 7-9).
  - 31.6% of scored population (299 / 946) → "Inappropriate" (score <7, when binary). This is relatively high compared to other countries in the study.

# *Estonia*
# *AR by Institution Type*

**PUBLIC**



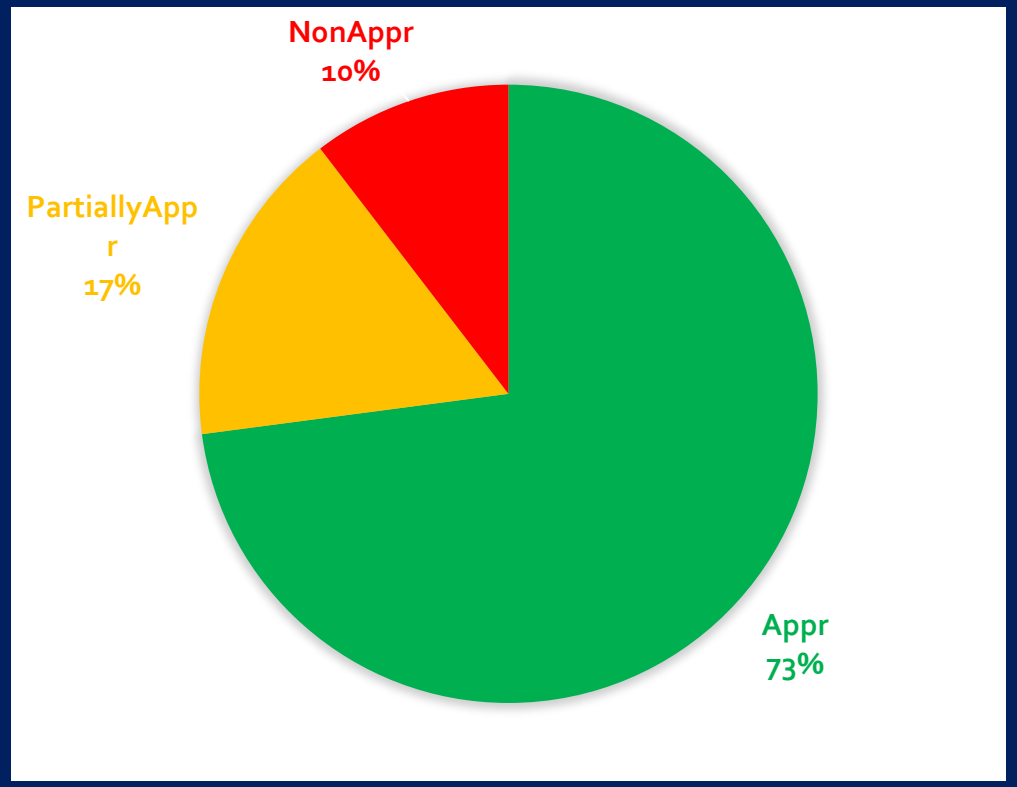

**PRIVATE**



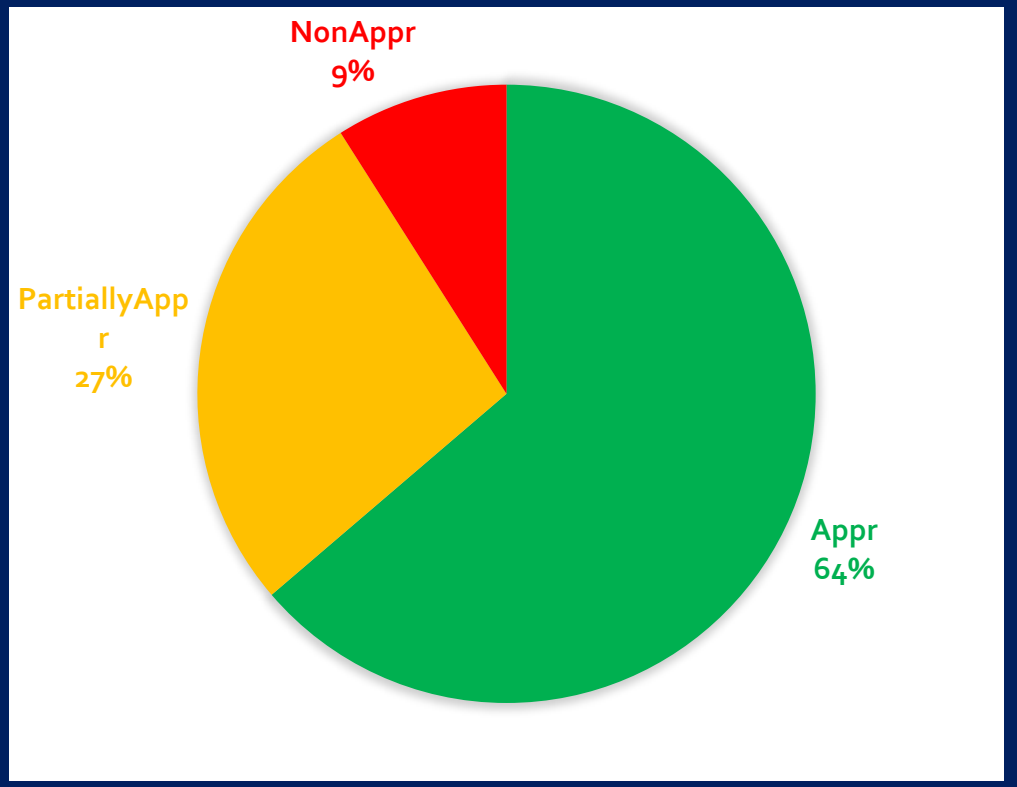

AR was higher in PUBLIC INSTITUTIONS as compared to PRIVATE INSTITUTIONS **(69% vs 39%, p<.0001).**

# *Estonia*
# *AR by Patient Status*

## INPATIENT / EMERGENCY



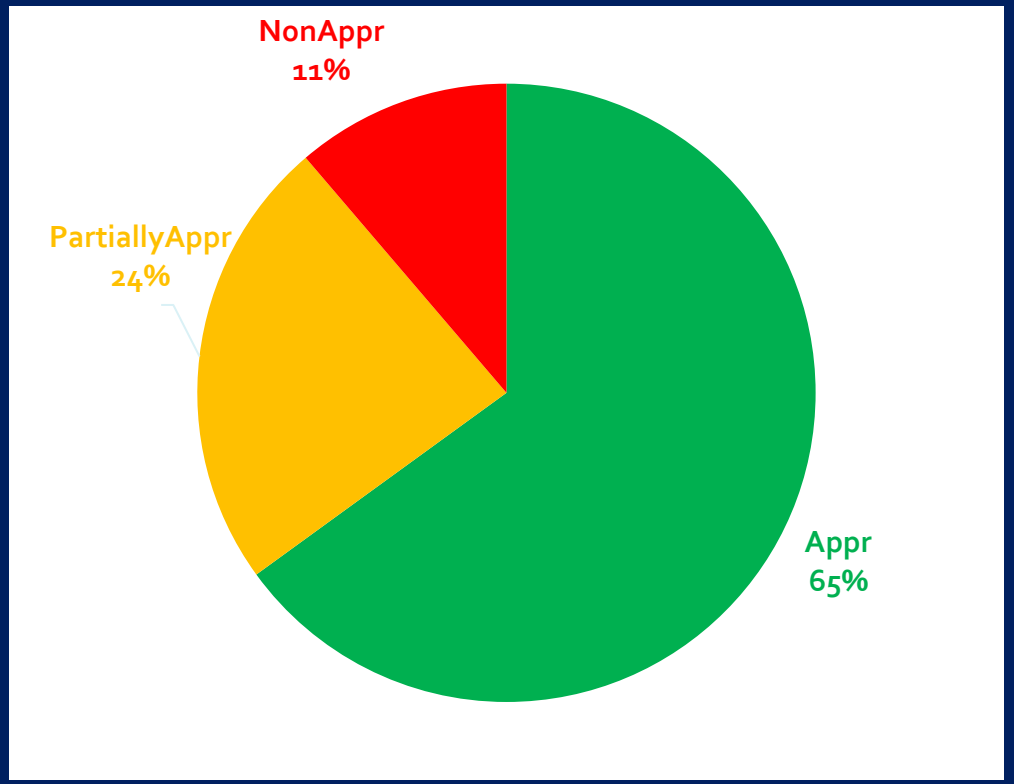

## OUTPAIENT



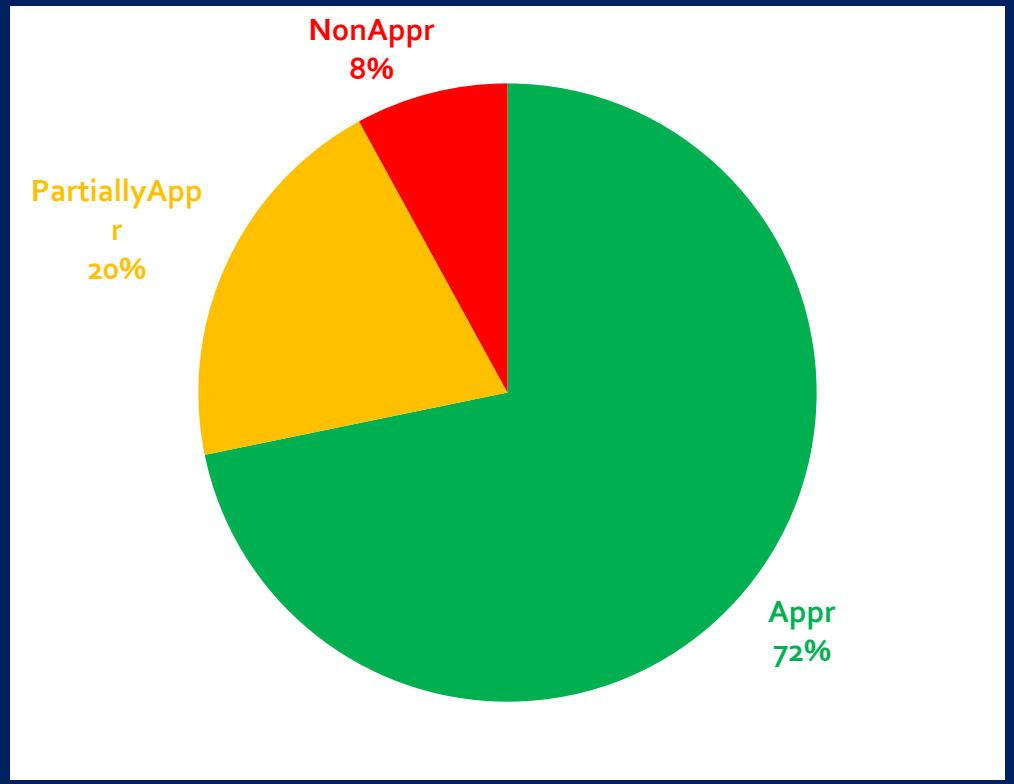

AR was higher in HOSPITALIZATION as compared to AMBULATORY CARE **(73% vs 64%, p=0.0005).**

# *Estonia*
# *AR by Gender*

**FEMALE**



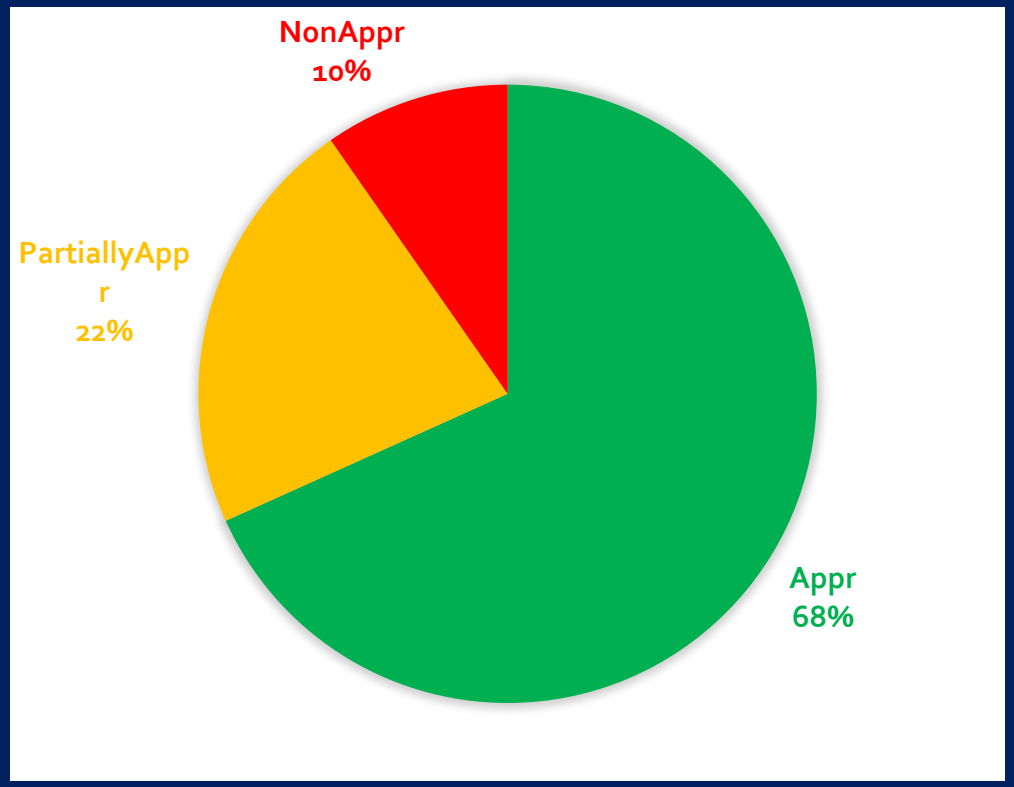

**MALE**




AR was <u>higher</u> in MALE compared to FEMALE patients **(72% vs 65%, p=0.06)**, the association being borderline significant.

# *Estonia*
# *AR by Age Group*

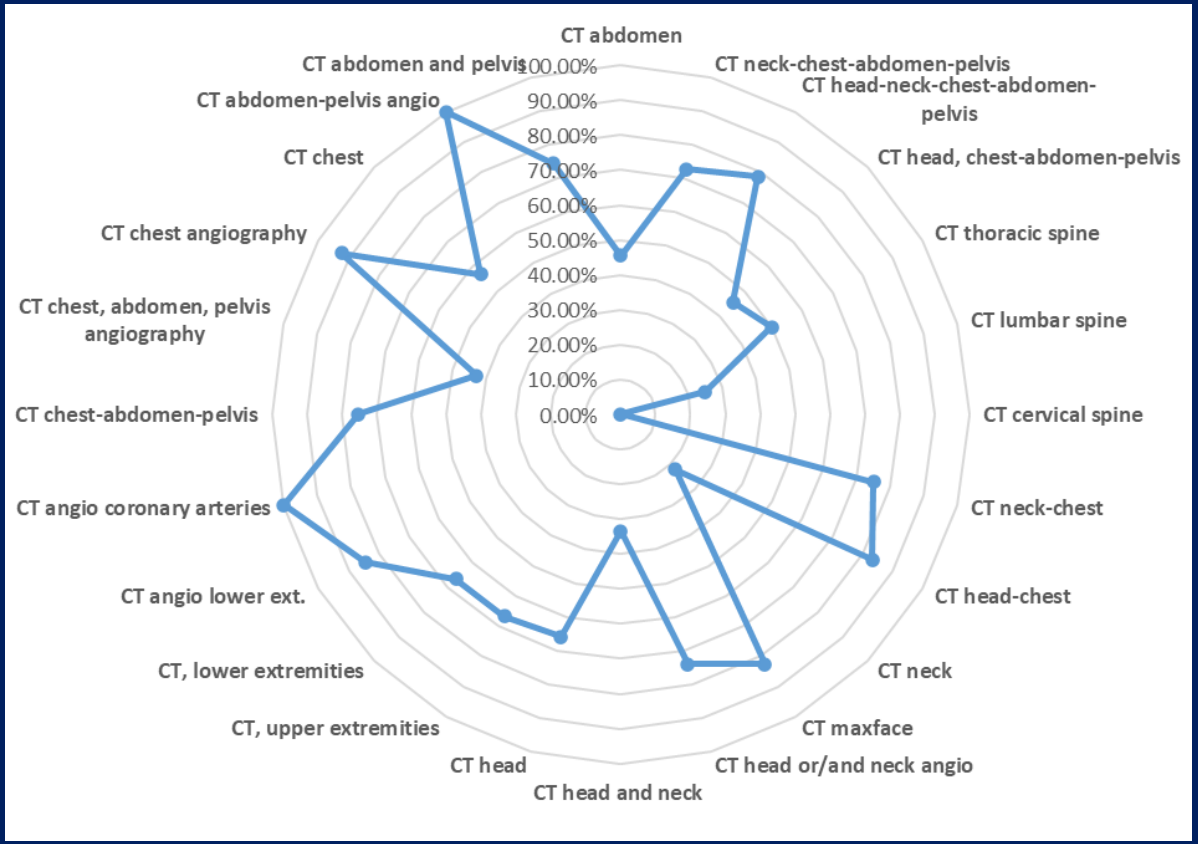
**ADULT**




- No further analysis was done since children (<18 years old) were under-represented. Only 7 children / 946 referrals (0.7%).
- AR for Adults was 68%.

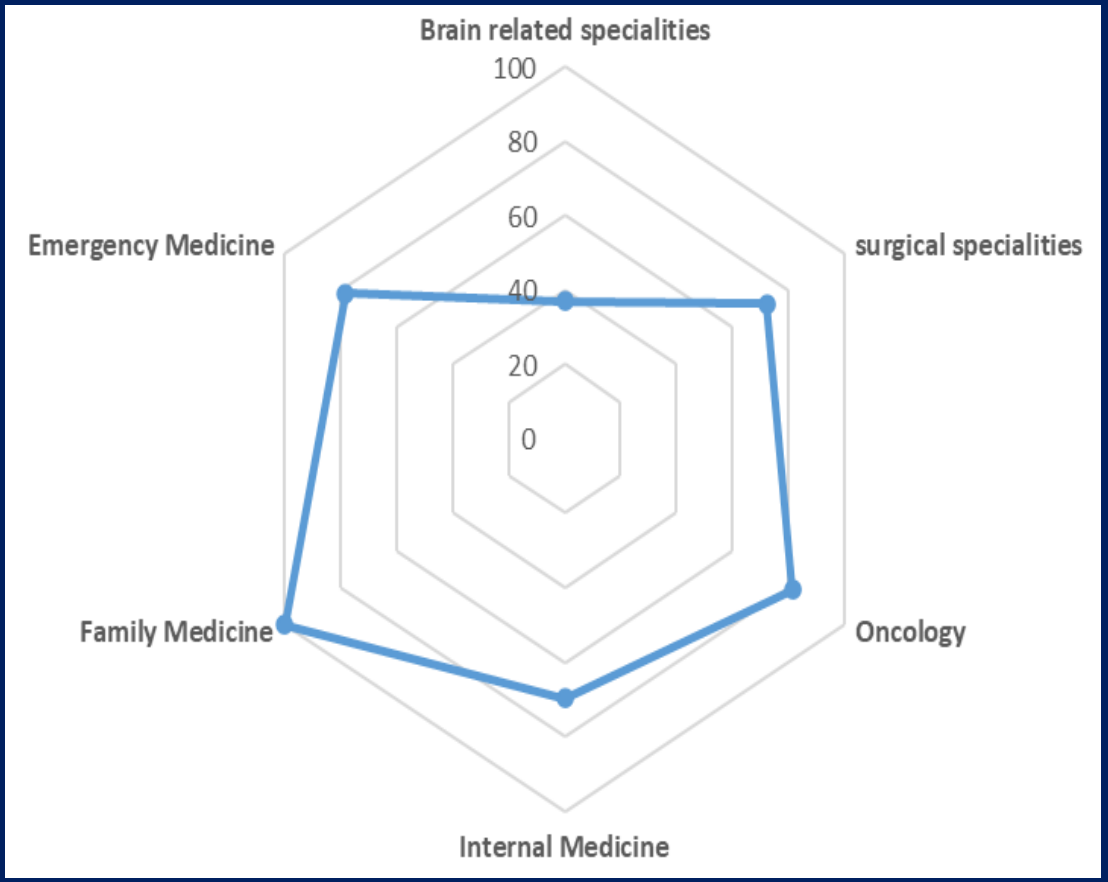
# *Estonia*
# *AR by Requested Exam*

- No definitive conclusions about CT type concerning appropriateness (many cells with low excepted counts, Chi-square didn't converge).
- Highest AR (CT with n<5 not considered): CT angio coronary arteries (100%); CT angio abdomen-pelvis (100%); CT angio chest (92%); CT angio lower extremities (85%); CT maxface (83%); & CT head-chest (83%).



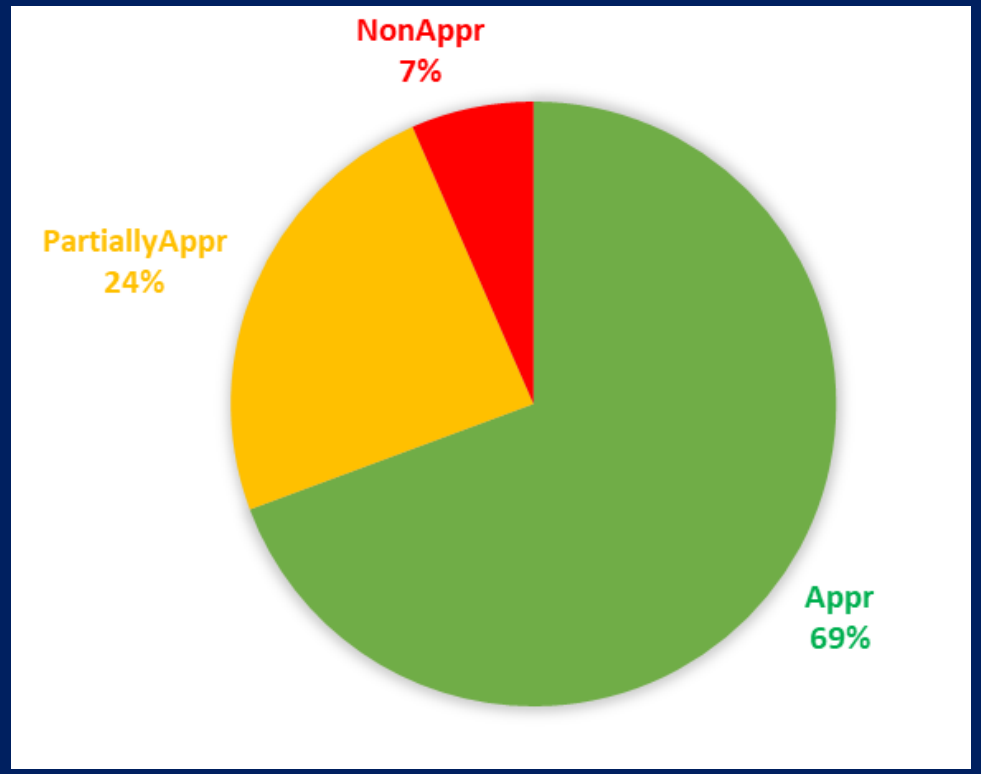
# *Estonia*
# *AR by Referrer Specialty*

- No association between REFERRER SPECIALTY & ESR appropriateness due to the low frequencies in some cells (Exact Chi-square didn't converge).
- **Only 2 GPs in study → No conclusion can be made.**
- **High % of unknown data (n missing=455, 48%).**
  - Highest AR: Oncology doctors (81%), Emergency doctors (78%), & Surgical specialties doctors (72%).
  - Lowest AR: Brain related specialties doctors (37%).



# *Estonia*
# *AR by Referrer Specialty*

**SPECIALIST DOCTOR**




- There were only 2 Family Medicine doctors out of 946 referrals scored.
- Among Medical specialists: AR=69%.

# *Estonia*
# *Conclusions*

- 1,013 records → 6.61% removed → 946 records included in statistical analysis.
- 68.4% of scored population (647 / 946) rated "Fully appropriate" (score 7-9).
- Significant association between degree of appropriateness according to ESR-iGuide:
  - AR was higher in PUBLIC INSTITUTIONS as compared to PRIVATE INSTITUTIONS **(69% vs 39%, p<.0001).**
  - AR was higher in HOSPITALIZATION as compared to AMBULATORY CARE **(73% vs 64%, p=0.0005).**
  - AR was higher in MALE compared to FEMALE patients **(72% vs 65%, p=0.06)**, borderline significant.
  - EXPERTISE of referring physician **(p<0.0001)** for binary variables, with highest AR observed for oncology doctors (81.4%) & emergency medicine doctors (78.3%).

# *Finland*

# *Finland*
# *Sample Overview*

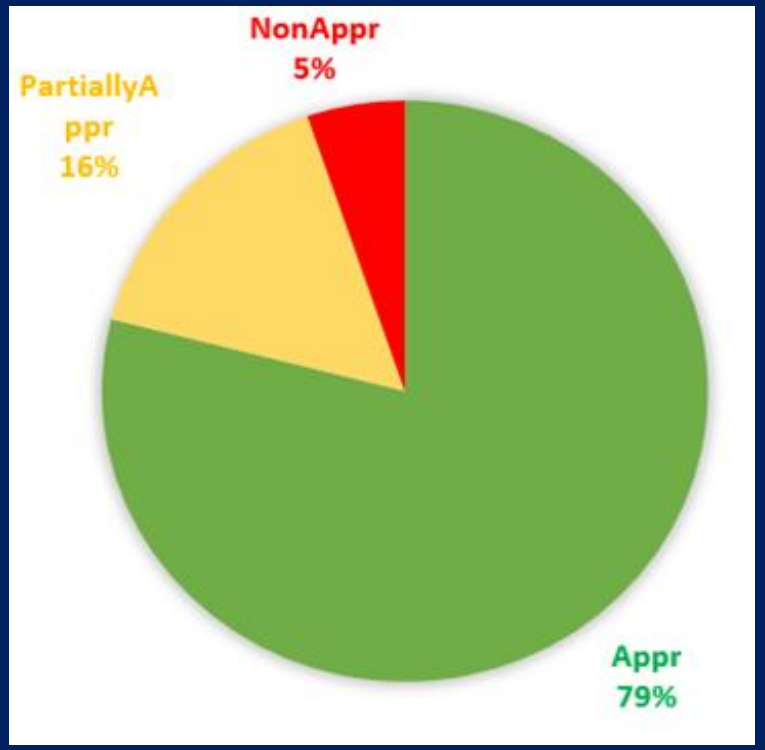
| | N | % Of Total | % Of Scored |
|---|---|---|---|
| Number of audited referrals (Total) | 744 | 100% | |
| Of which removed from analysis (duplicates, invalid data) | 22 | 3.0% | |
| Of which unscored referrals (no/insufficient clinical data) | 2 | 0.3% | |
| Of which scored: | 720 | 96.8% | |
| • Fully appropriate (score 7-9) | • 568 | • 76.3% | • 78.9% |
| • Partially appropriate (score 4-6) | • 113 | • 15.2% | • 15.7% |
| • Inappropriate (score: 1-3) | • 39 | • 5.2% | • 5.4% |

# *Finland*
# *Sample Overview Cont.*

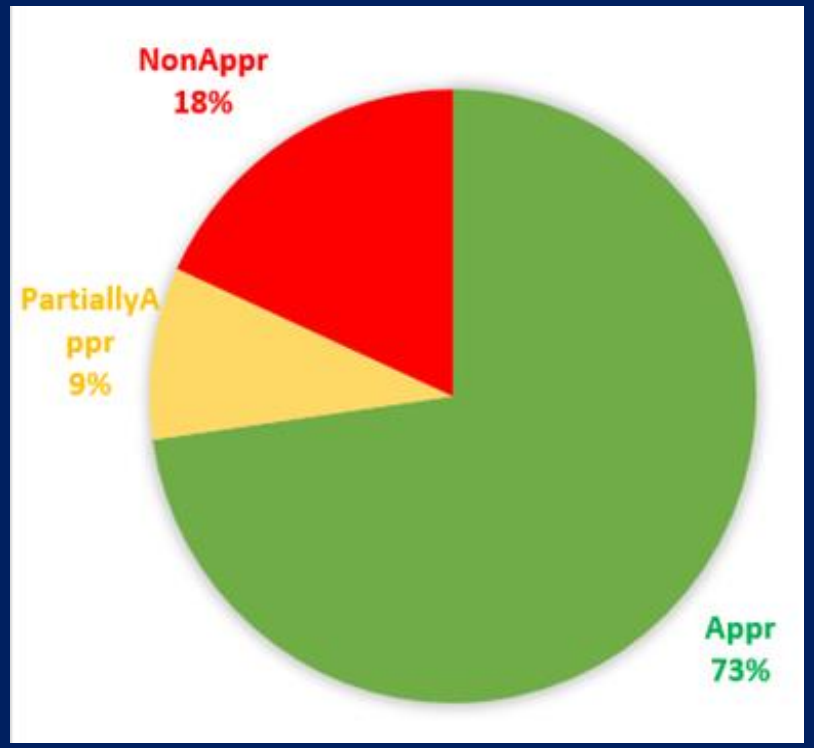
- **Data quality:** relatively excellent with ~97% of referrals scored.
- 3.3% unscored referrals: Of these, 3% (n=22) removed from analysis & 0.3% unscored due to insufficient clinical data (considered as inappropriate).
- **Classification:**
  - 78.9% of scored population (568 / 720) → "Fully appropriate" (score 7-9).
  - 21.1% of scored population (152 / 720) → "Inappropriate" (score <7, when binary). This is relatively high compared to other countries in the study.

# *Finland*
# *AR by Institution Type*

**PUBLIC**



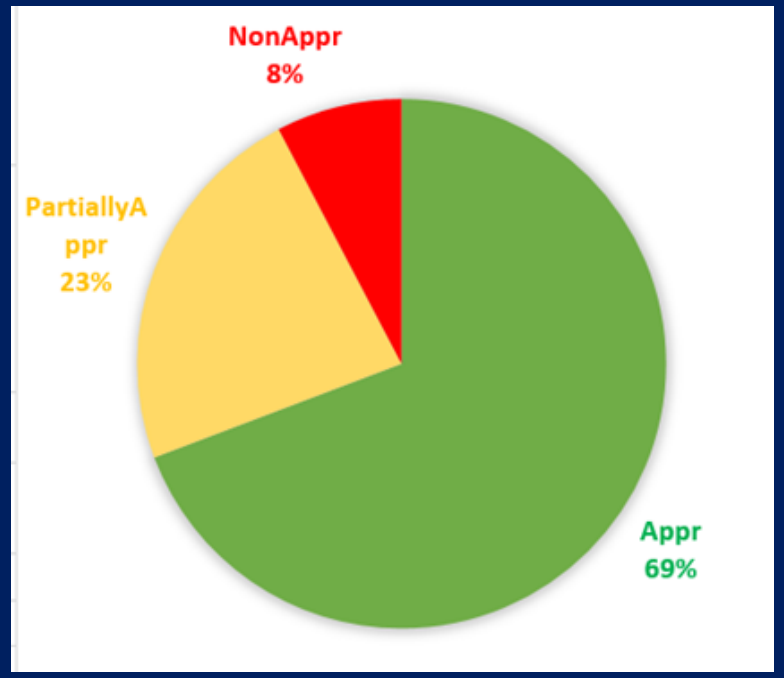

**PRIVATE**



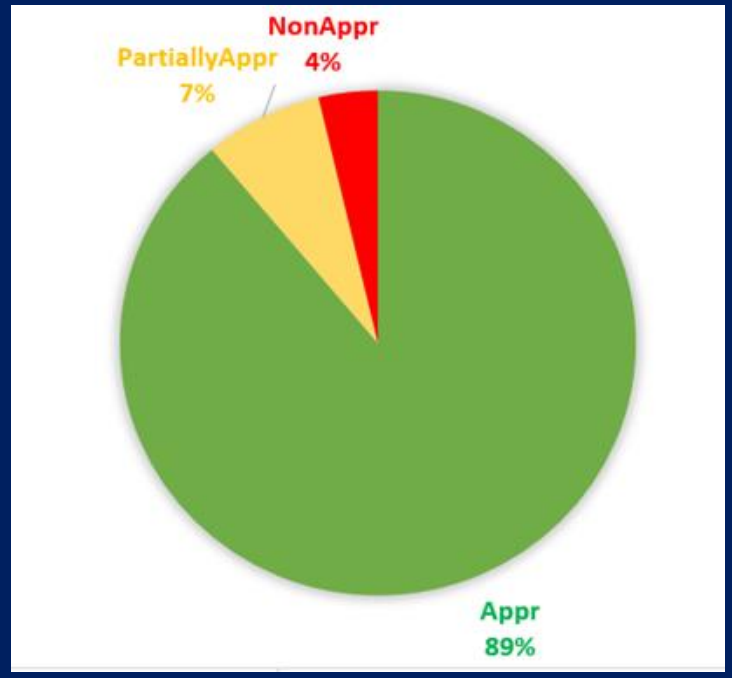

- Most referrals are for a CT in Public institute (98.5%).
- No significant association between degree of appropriateness according to ESR-iGuide & INSTITUTION TYPE **(**Public **79% vs** Private **73%, p=0.15).**

# *Finland*
# *AR by Patient Status*

**EMERGENCY**



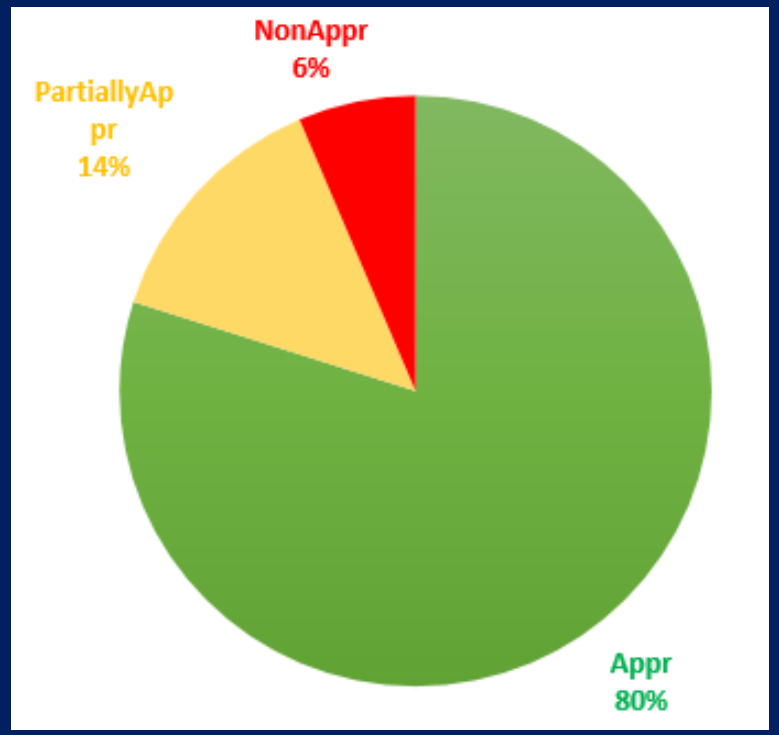

**INPATIENT**



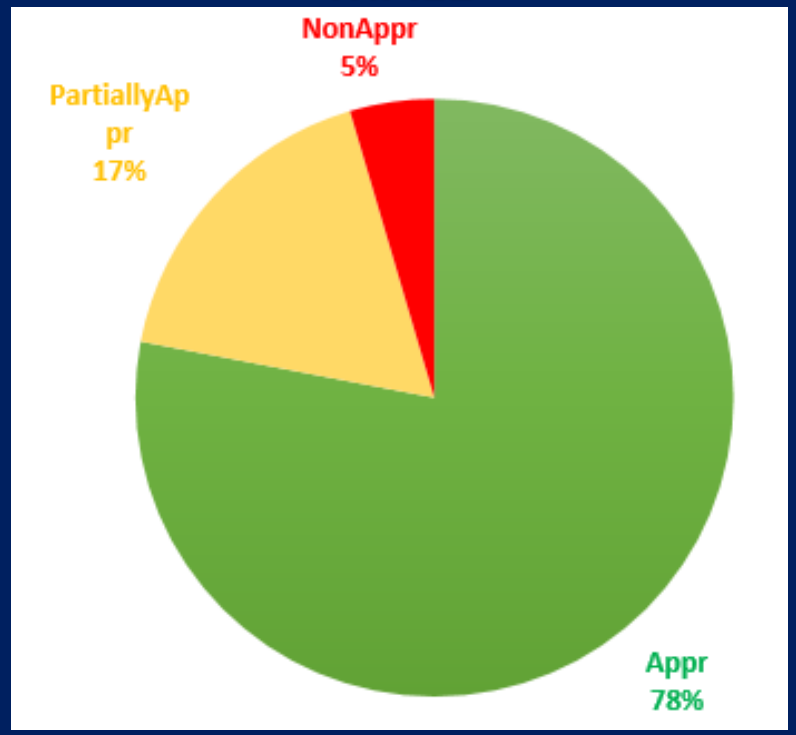

- **92.6% of the data is missing & No representation of ambulatory care.**
- No significant association between degree of appropriateness according to ESR-iGuide & Patient Status.
- AR was lower in EMERGENCY CARE as compared to INPATIENT **(69% vs 89%, p=0.204),** but not significant**.**

# *Finland*
# *AR by Gender*

**FEMALE**



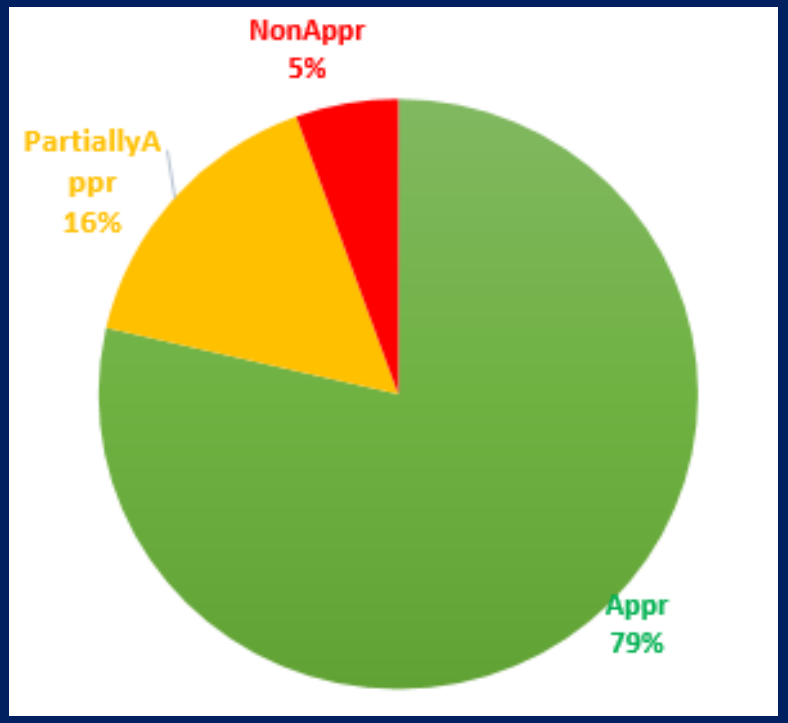

**MALE**



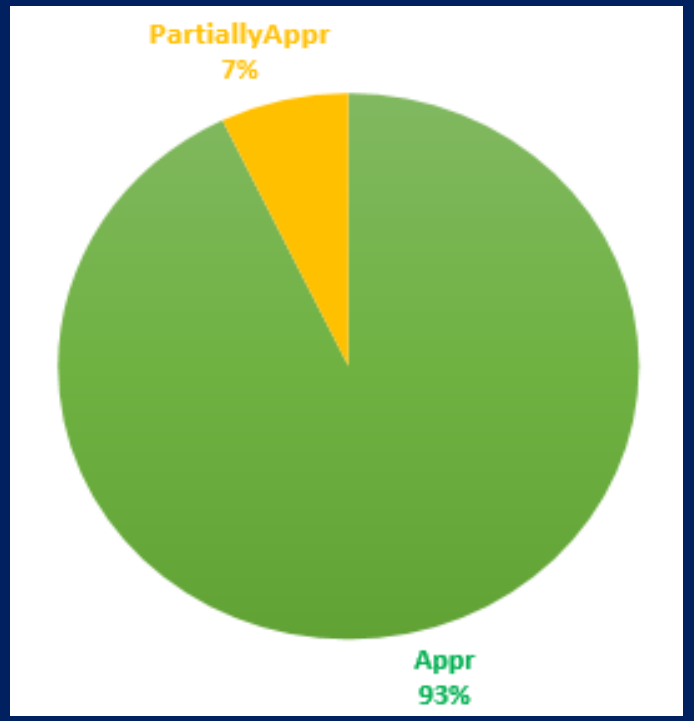

- Men comprised 51.8% of the study sample.
- AR was higher for CT examinations in FEMALE compared to MALE patients **(80% vs 78%, p=0.25),** although this association was not significant.

# *Finland*
# *AR by Age Group*

**ADULT**



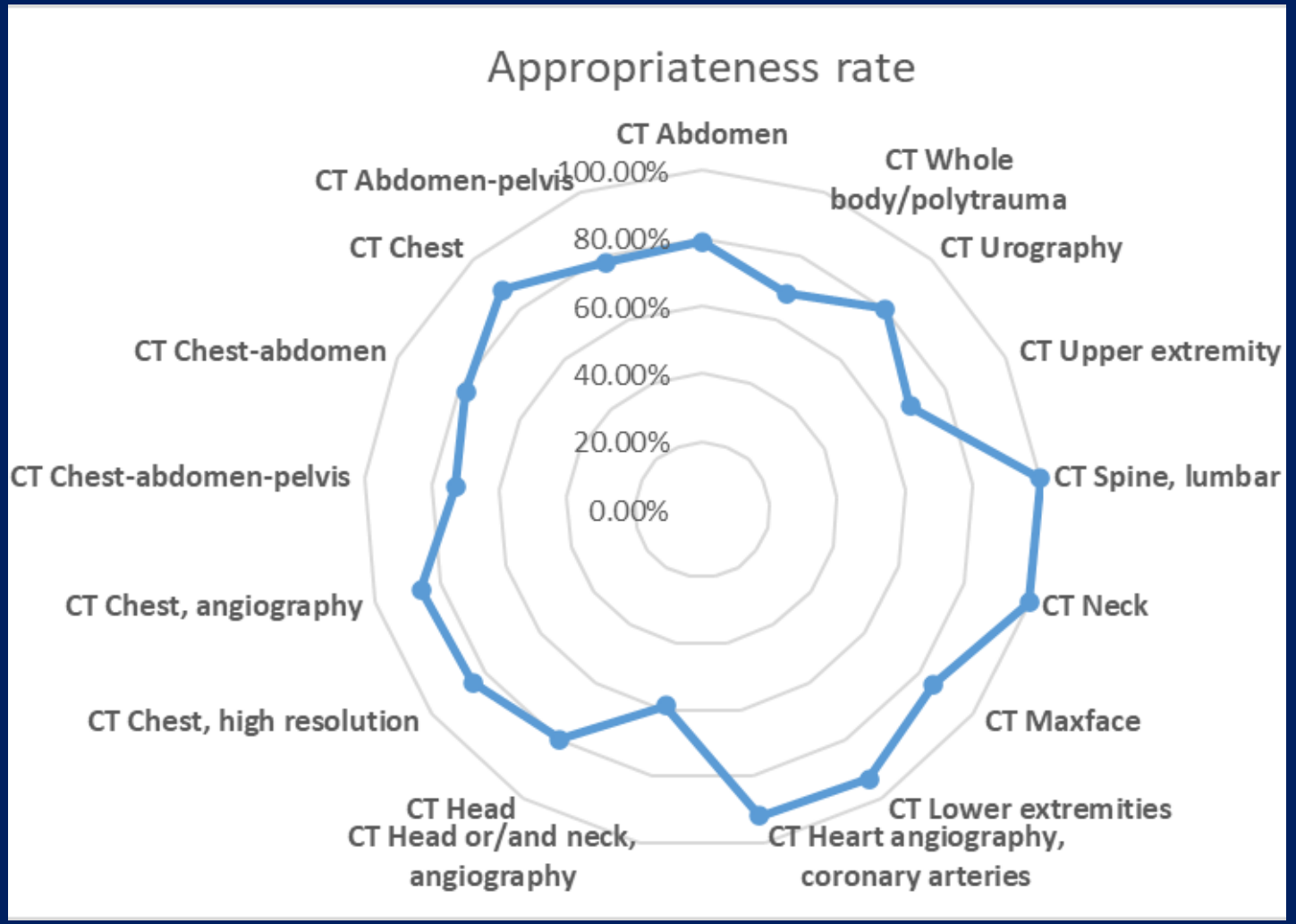

**CHILDREN**




- AR was <u>higher</u> in CHILDREN compared to ADULT **(93% vs 79%, p=0.656),** although association was not significant.
- **Only 14 / 720 referrals scored were in children.**

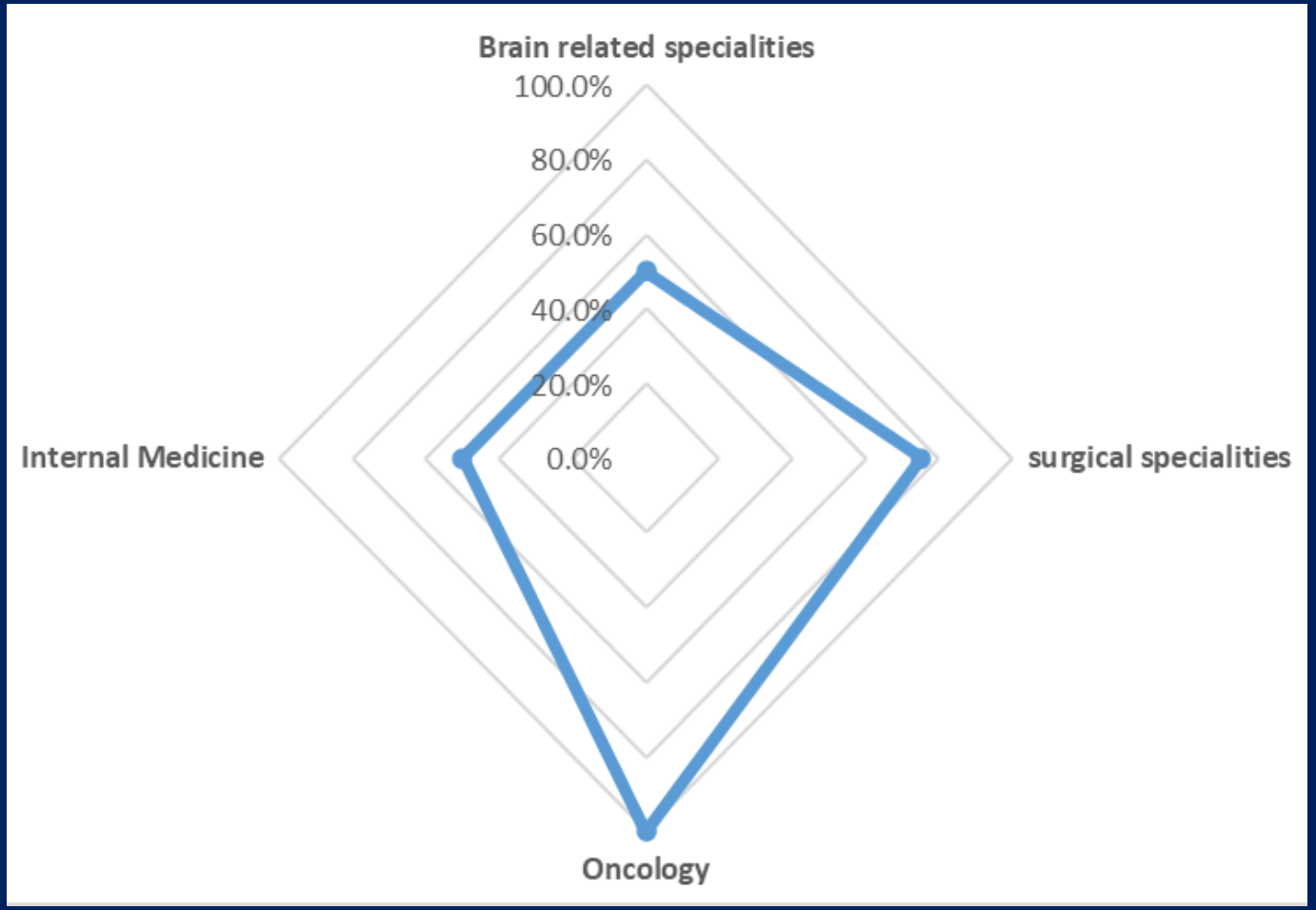
# *Finland*
# *AR by Requested Exam*

- No definitive conclusions could be made about CT TYPE concerning appropriateness (many cells with very low frequency, Chi-square didn't converge).
  - Highest AR: CT Neck & CT Lumbar spine (both AR 100%), CT Lower extremities (93%), CT Heart angiography (92%);
  - AR 80-90%: CT of Maxface (88%), Chest as well as Chest angiography & HRCT (~86%), & CT Urography (80%).
  - AR 70-80%: CT Head (80%), Abdomen (79%), Abdomen-pelvis & Chest-abdomen (78%), & Chest-abdomen-pelvis (73%).
  - Lowest AR: CT Head or/& neck, angiography (59%).



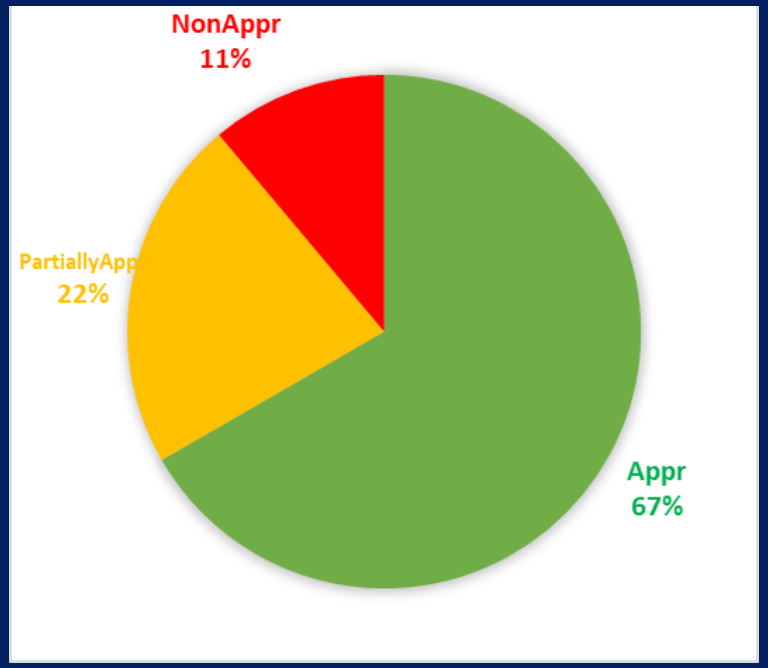
# *Finland*
# *AR by Referrer Specialty*

- No association was found between REFERRER SPECIALTY & CT Appropriateness according to ESR, due to very low frequencies.
- AR was higher for requests referred by Oncologists (100%) & Surgical specialists (75%).



# *Finland*
# *AR by Referrer Specialty*

## SPECIALIST DOCTOR




- Comparison is not relevant, due to high rate of missing data.
- No representation of GPs & only 9 Specialist doctors were included in study (AR = 67%).

# *Finland*
# *Conclusions*

- 744 records → 3.3% removed → 720 records included in statistical analysis.
- 78.9% of scored population (568 / 720) rated "Fully appropriate" (score 7-9).
- No significant associations between degree of appropriateness according to ESR-iGuide & INSTITUTION TYPE, PATIENT STATUS, GENDER, AGE GROUP & ANATOMICAL AREAS.
- **Institution Type:** Only 11 in private institutions.
- **Patient Status:** 92.6% missing & No representation of ambulatory care.
- **Age Group:** only 14 children in study.
- **Referrer Specialty:** 95.6% missing & No representation of GPs.

# *Greece*

# *Greece*
# *Sample Overview*

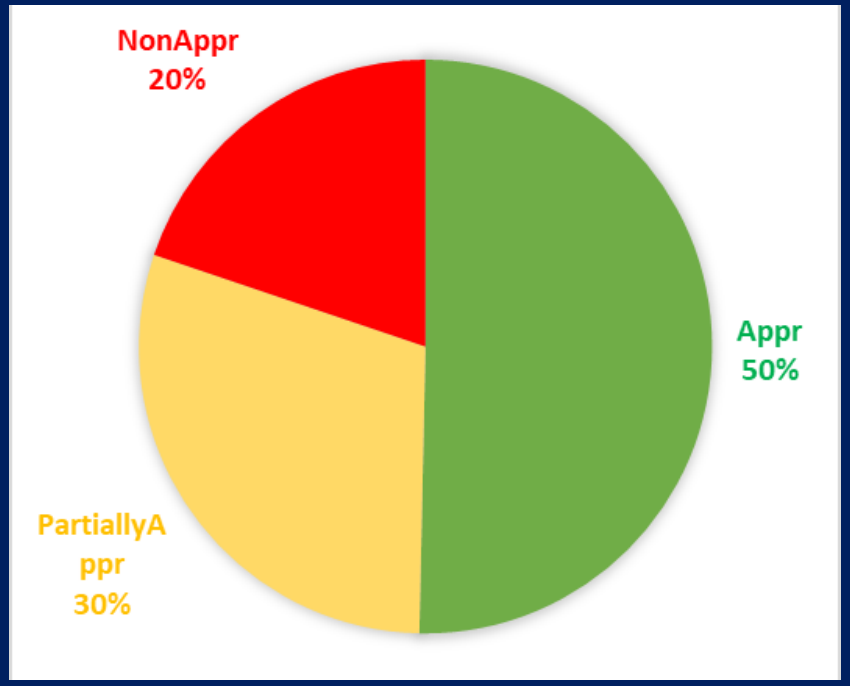
| | N | % Of Total | % Of Scored |
|---|---|---|---|
| Number of audited referrals (Total) | 909 | 100% | |
| Of which removed from analysis (duplicates, invalid data) | 49 | 5.4% | |
| Of which unscored referrals (no/insufficient clinical data) | 193 | 21.2% | |
| Of which scored | 667 | 73.4% | |
| • Fully appropriate (score 7-9) | • 386 | • 42.5% | • 57.9% |
| • Partially appropriate (score 4-6) | • 177 | • 19.5% | • 26.5% |
| • Inappropriate (score: 1-3) | • 104 | • 11.4% | • 15.6% |

# *Greece*
# *Sample Overview Cont.*

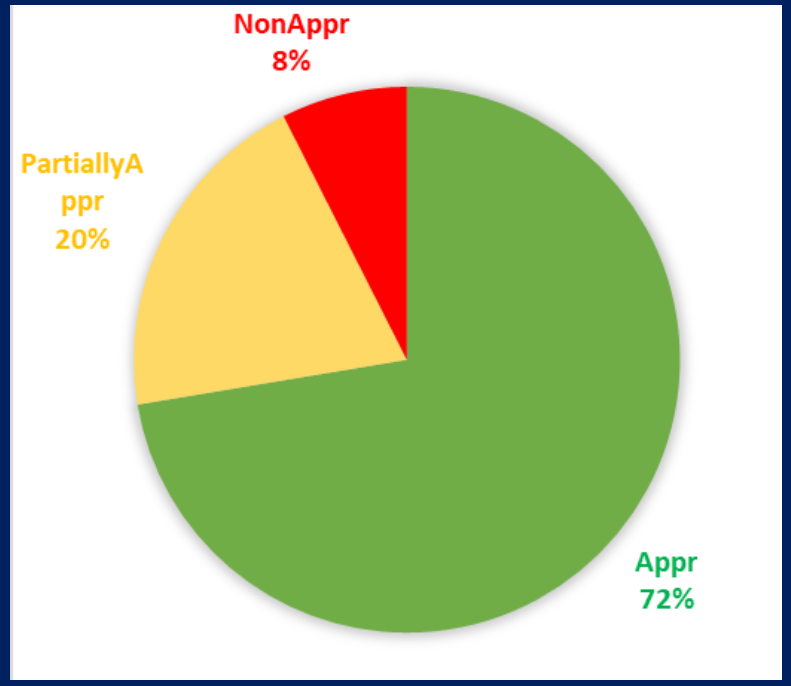
- **Data quality:** relatively average, with ~73% of referrals scored.
- **Source file:** 909 records. Of these, 26.6% (n=242) removed / unscored due to insufficient clinical data (considered inappropriate) → 667 records in statistical analysis.
- **Classification:**
  - 58% of scored population (386 / 667) → "Fully appropriate" (score 7-9).
  - 42% of scored population (281 / 667) → "Inappropriate" (score <7, when binary).

# *Greece*
# *AR by Institution Type*

**PRIVATE**



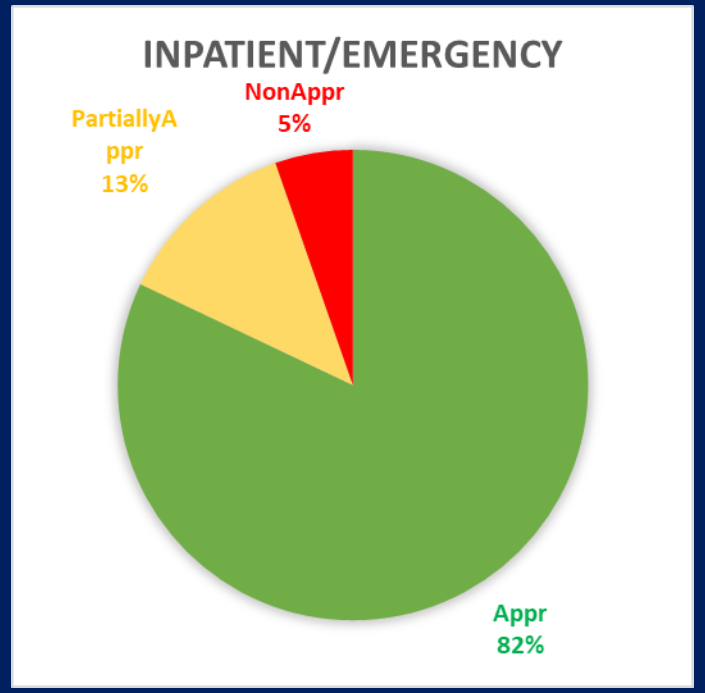

**PUBLIC**



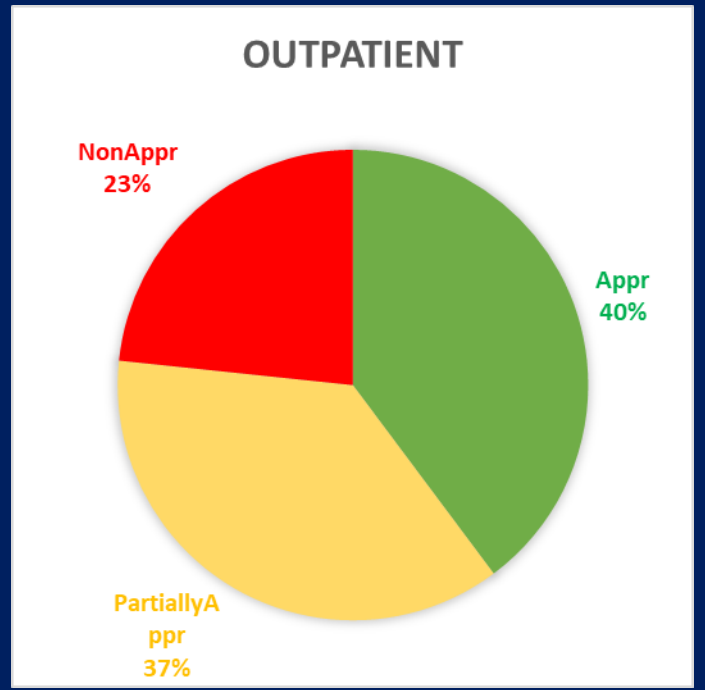

AR was <u>higher</u> in PUBLIC institutions as compared to PRIVATE institutions **(72% vs. 50%, p<0.001).**

# *Greece*
# *AR by Patient Status*

## INTPATIENT / EMERGENCY



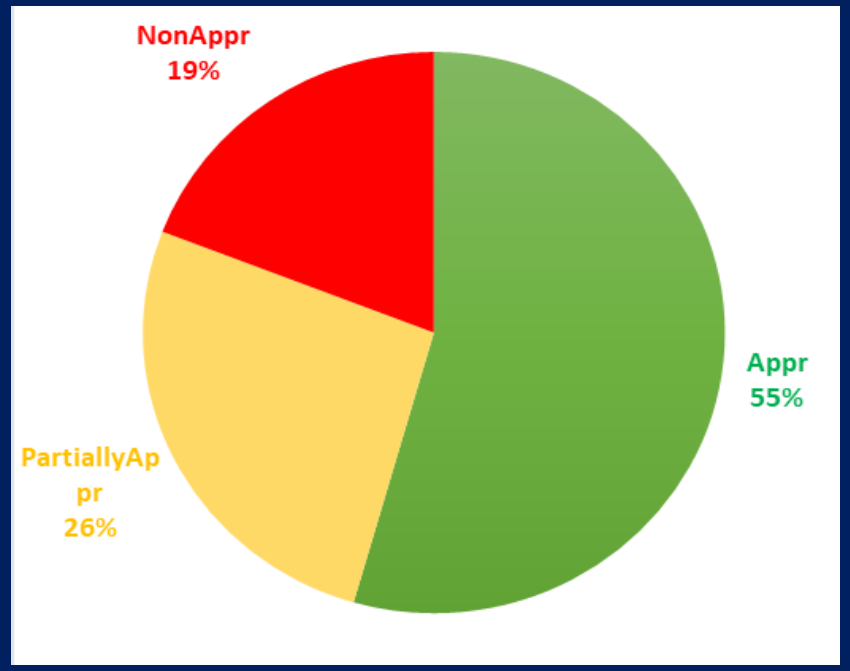

## OUTPATIENT



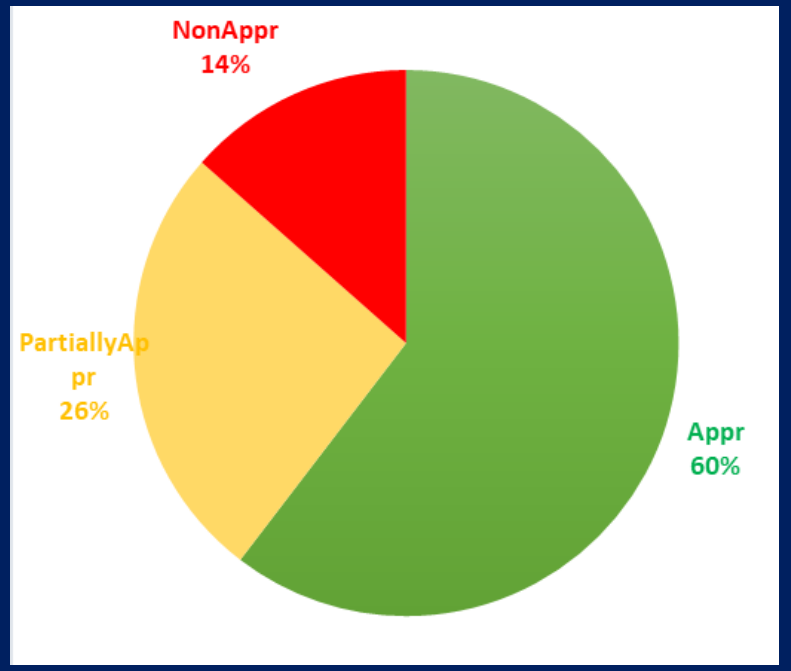

AR was <u>much higher</u> in INPATIENT/EMERGENCY as compared to AMBULATORY CARE **(82% vs 40%, p<0.001).**

# *Greece*
# *AR by Gender*

**FEMALE**



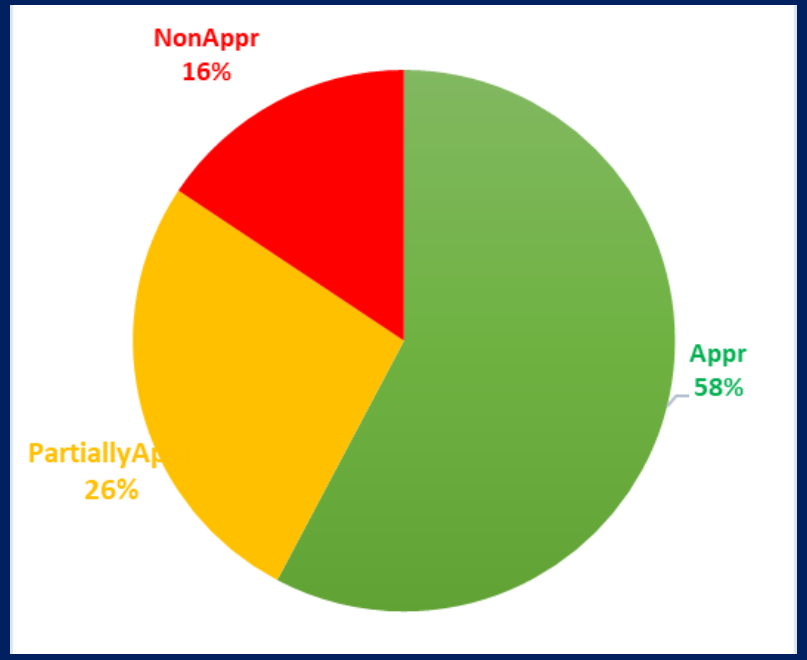

**MALE**




AR was <u>higher</u> when the CT examinations concerned MALE population as compared to FEMALE population, although not statistically significant **(60% vs 55%, p=0.124).**

# *Greece*
# *AR by Age Group*

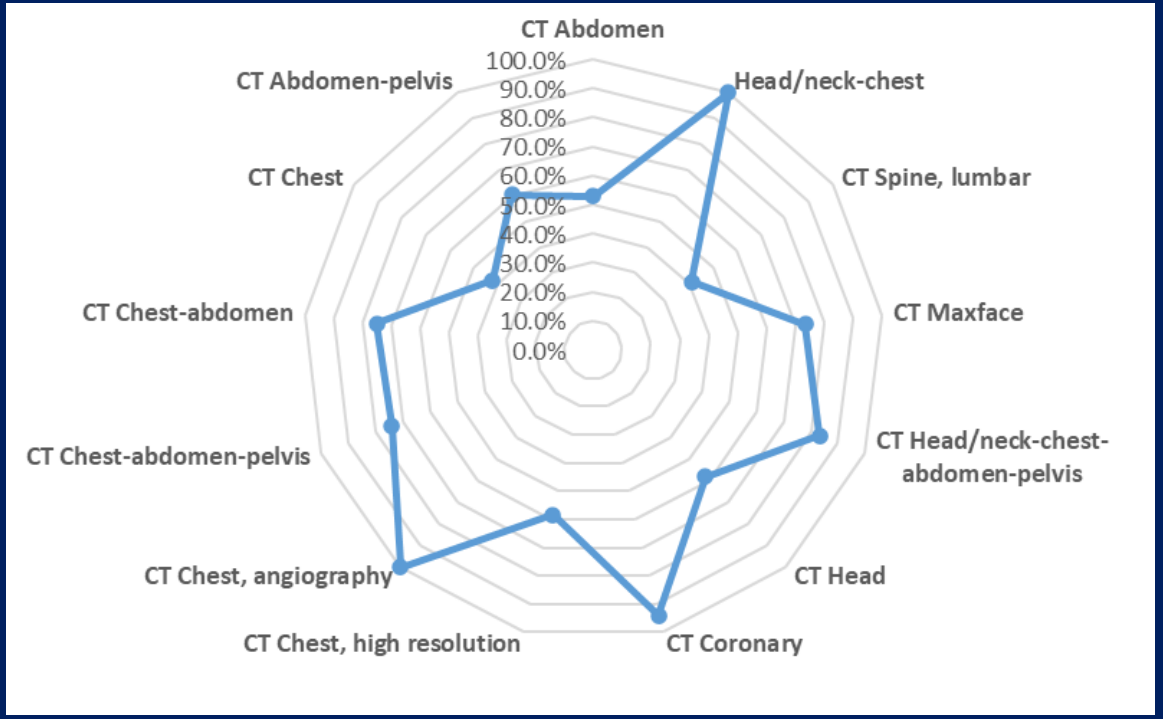
**ADULT**




- No further analysis was done since children (<18 years old) were under-represented in the study (only two Children / 667 referrals scored).
- AR for adults: 58%.

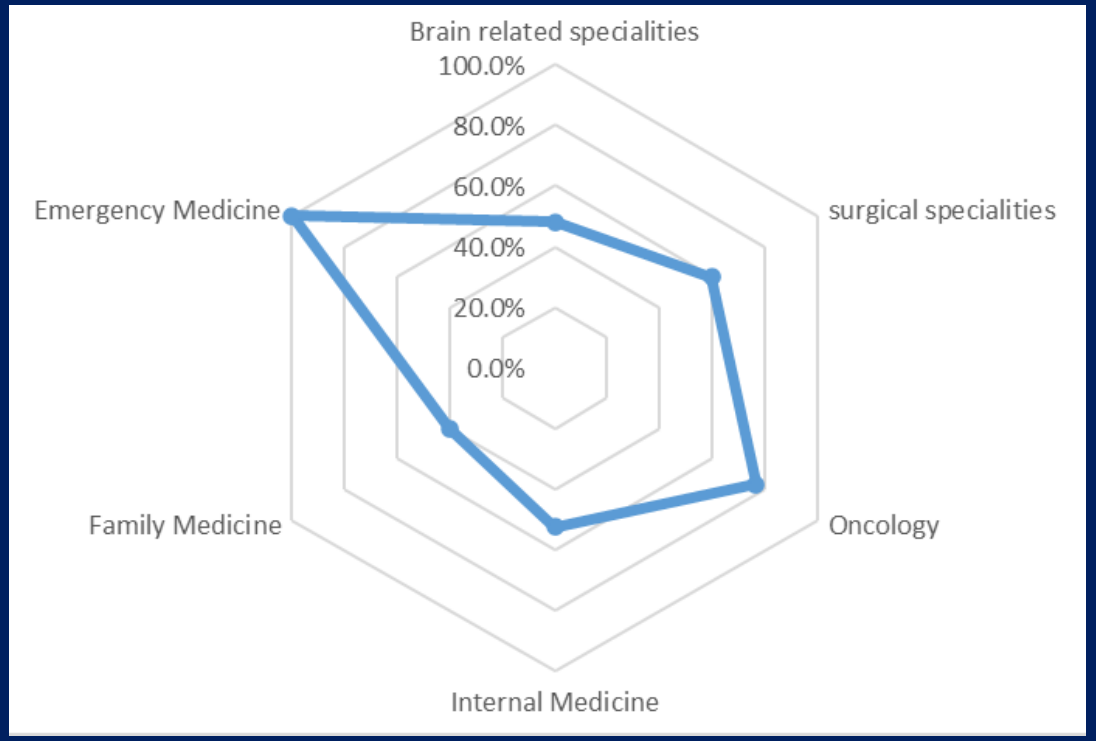
# *Greece*
# *AR by Requested Exam*

- No definitive conclusions about CT TYPE concerning appropriateness (many cells with low expected counts, exact Chi-square didn't converge).
- AR lower than 80%, after omitting cells with n<5 in each category of appropriateness.
- Higher AR for Chest-abdomen-pelvis (74%) & Maxface (73%); rather than CT Abdomen-pelvis (60%), CT Head (58%), CT Abdomen (53%), CT Chest (42%), & CT Lumbar spine (41%).



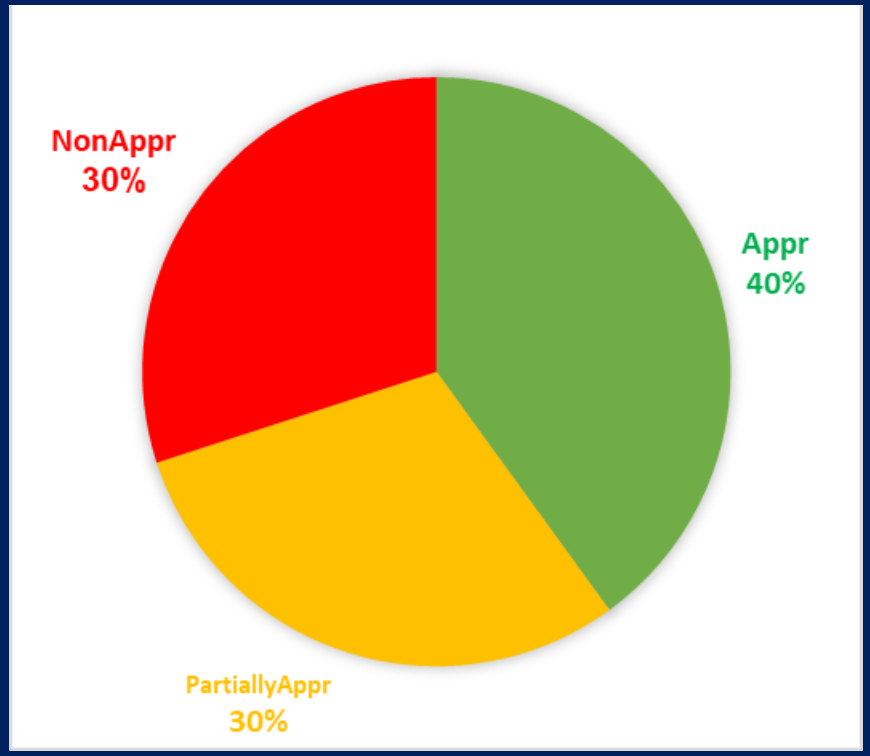
# *Greece*
# *AR by Referrer Specialty*

- No association for REFERRER SPECIALTY & ESR appropriateness due to low frequencies of some cells (Exact Chi-square didn't converge).
- AR was higher in medical specialists (Emergency medicine 100% with 5 cases, Oncology 77%, Surgical specialties 60%, Internal medicine 53%, & Brain related specialties 48%); rather than in GPs (AR 40%).
- **Association was significant when examined in 2 appropriateness categories (app, inapp) instead of 3 categories (app, partially app, inapp).**

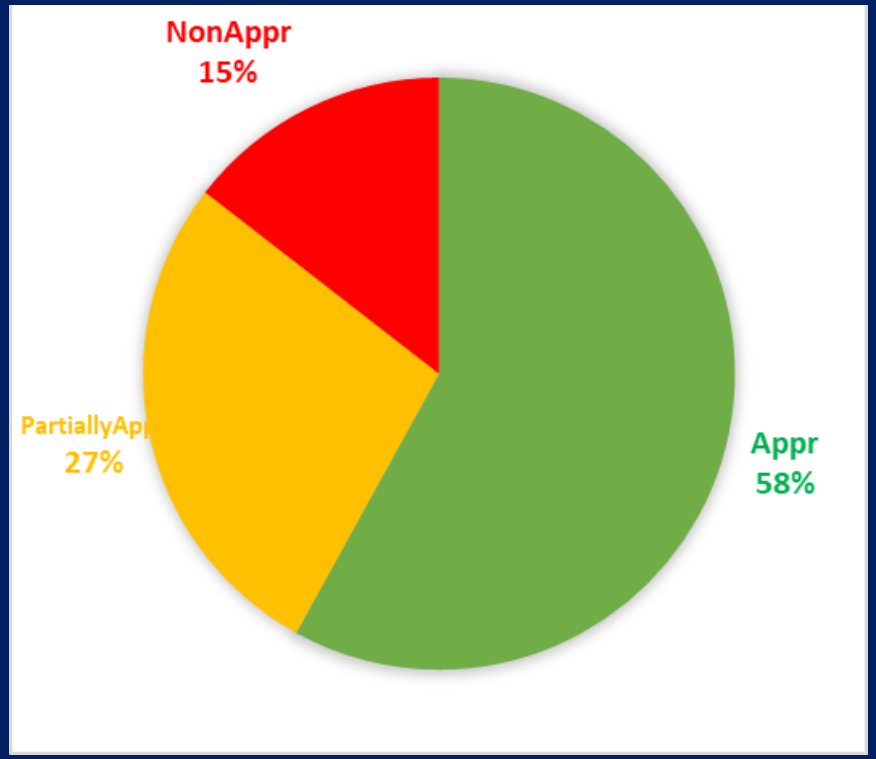


# *Greece*
# *AR by Referrer Specialty*

**FAMILY / GENERAL DOCTOR**




**SPECIALIST DOCTOR**




AR was <u>higher</u> for requests referred by MEDICAL SPECIALISTS rather than by GPs, although association is not statistically significant **(58% vs. 40%, p=0.133).**

# *Greece*
# *Conclusions*

- 909 records → 26.6% removed → 667 records included in statistical analysis.
- 58% of scored population (386 / 667) rated "Fully appropriate" (score 7-9).
- **Significant association between degree of appropriateness according to ESR-iGuide:**
  - AR was higher in PUBLIC institutions as compared to PRIVATE institutions **(72% vs. 50%, p<0.001).**
  - AR was much higher in INPATIENT/EMERGENCY as compared to AMBULATORY CARE **(82% vs 40%, p<0.001).**
  - Referrer specialty for binary variable.
- **Children (<18 years old):** under-represented in study (2 / 667 referrals scored).
- Of note: only 20 referrals from GPs in sample.

# *Hungary*

# *Hungary*
# *Sample Overview*

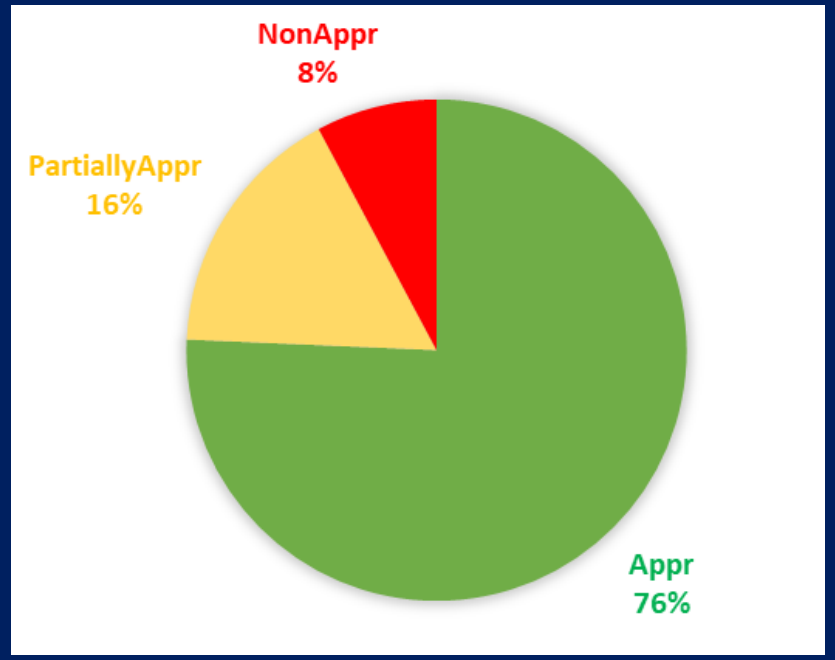
| | N | % Of Total | % Of Scored |
|---|---|---|---|
| Number of audited referrals (Total) | 1,026 | 100% | |
| Of which removed from analysis (duplicates, invalid data) | 19 | 1.85% | |
| Of which unscored referrals (insufficient clinical data) | 86 | 8.38% | |
| Of which scored: | 921 | 89.77% | |
| • Fully appropriate (score 7-9) | • 697 | • 67.93% | • 75.68% |
| • Partially appropriate (score 4-6) | • 152 | • 14.81% | • 16.50% |
| • Inappropriate (score: 1-3) | • 72 | • 7.02% | • 7.82% |

# *Hungary*
# *Sample Overview Cont.*

- **Data quality:** relatively good with almost 90% of referrals scored.
- **Source file:** 1,026 records. Of these, 1.9% (n=19) were removed & 8.4% were unscored due to insufficient clinical data → 921 records in statistical analysis.
- **Classification:**
  - 76% of scored population (697 / 921) → "Fully appropriate" (score 7-9).
  - 24% of scored population (224 / 921) → "Inappropriate" (score <7, when binary).

# *Hungary*
# *AR by Institution Type*

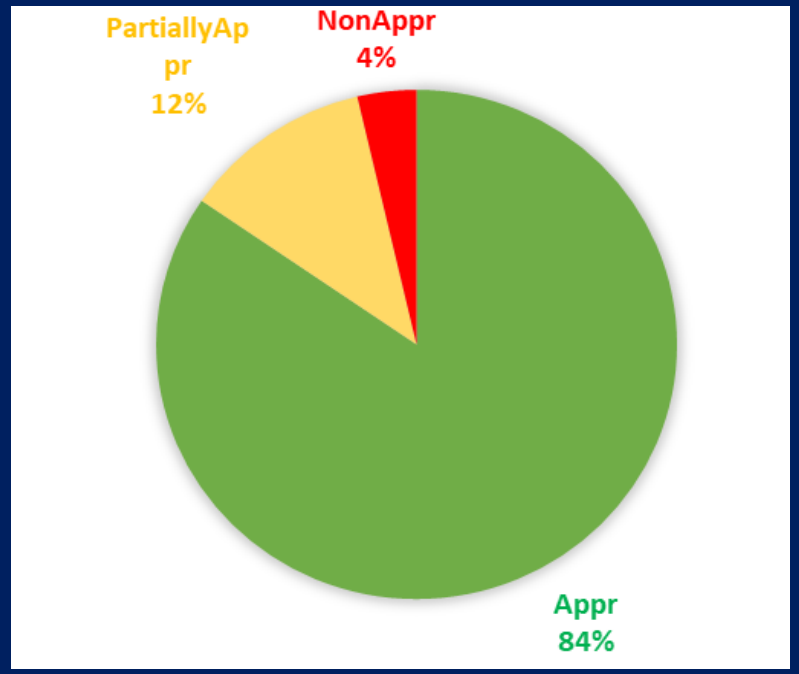
**PUBLIC**



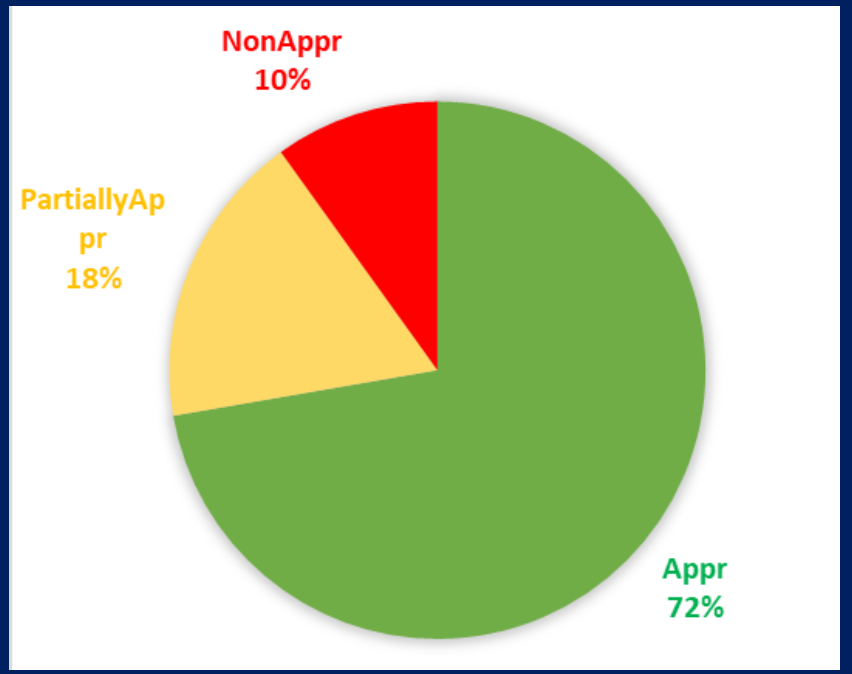

- **All 921 scored referrals belonged to public institutions.** No further analysis was done.
- AR for public institutions: 76%.

# *Hungary*
# *AR by Patient Status*

**EMERGENCY / INPATIENT**



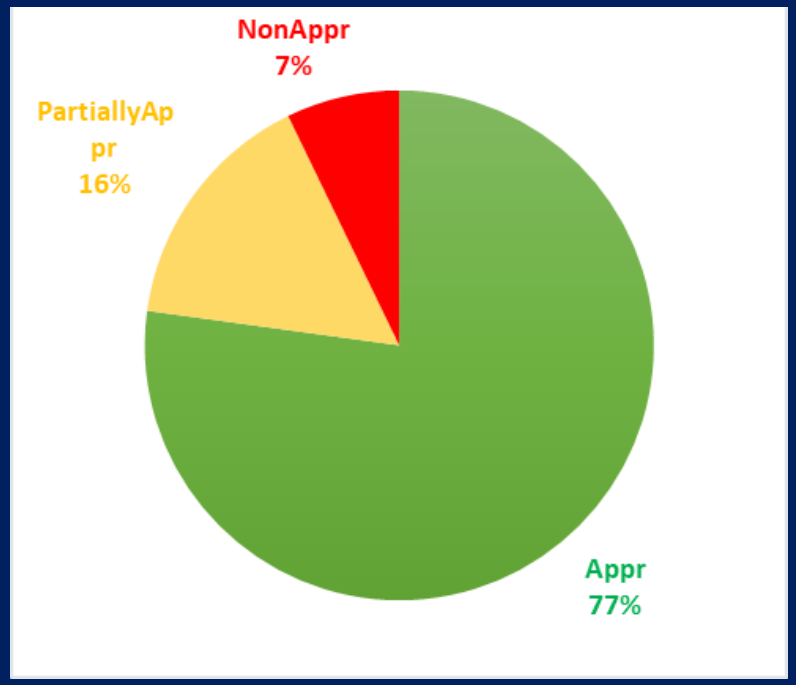

**OUTPATIENT**



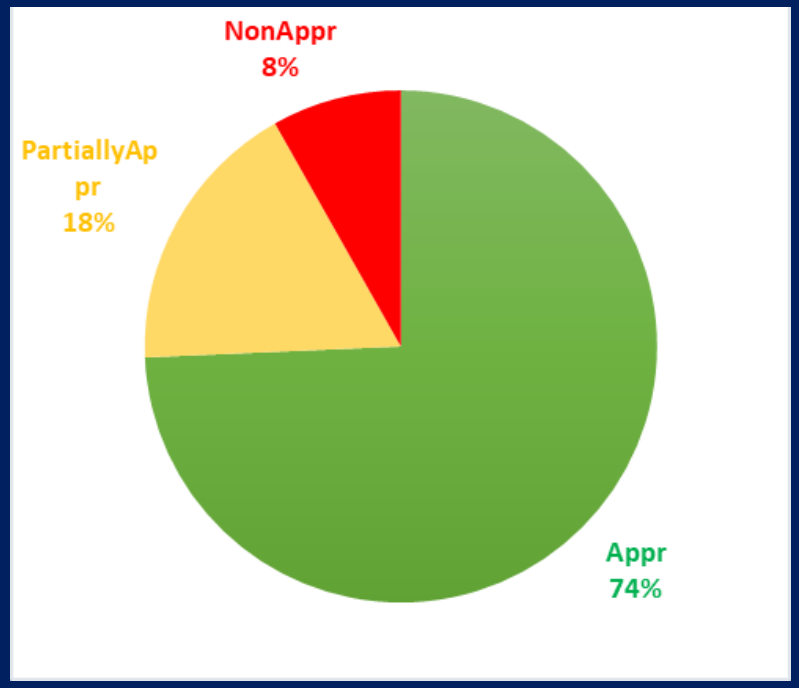

AR was higher in HOSPITALIZATION as compared to AMBULATORY CARE **(85% vs 72%, p=0.0004).**

# *Hungary*
# *AR by Gender*

**FEMALE**



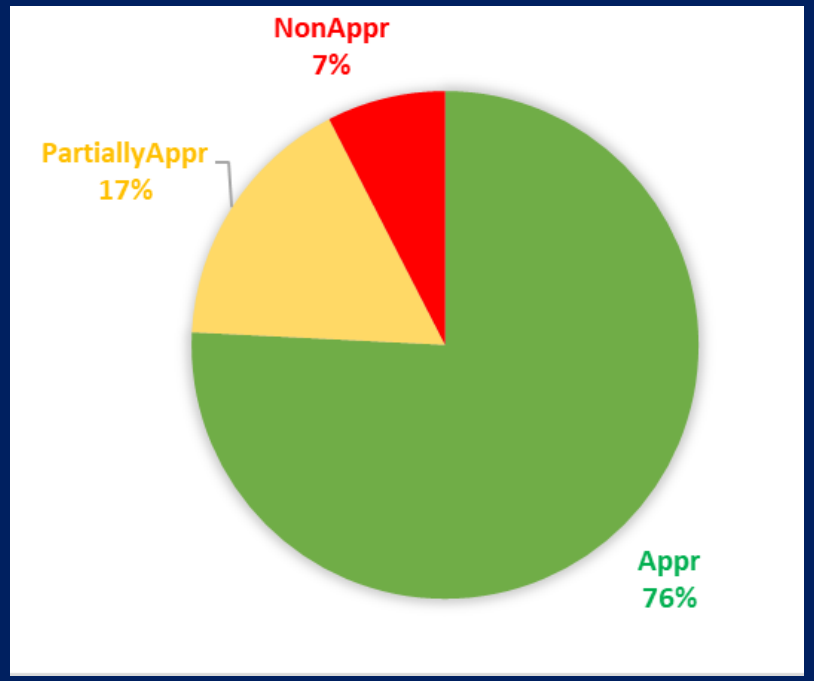

**MALE**




No significant association was found between degree of appropriateness according to ESR-iGuide & PATIENT'S GENDER **(77% vs 74%; p=0.6).**

# *Hungary*
# *AR by Age Group*

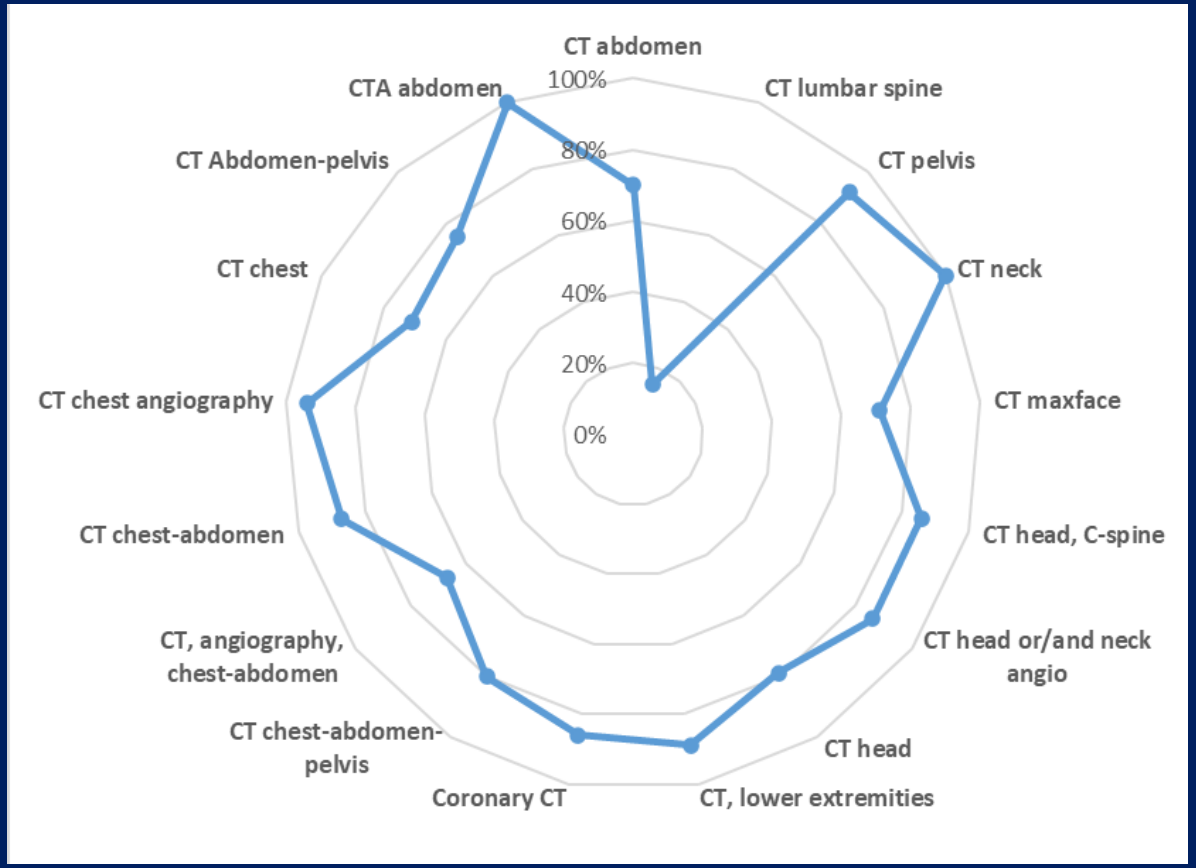
**ADULT**



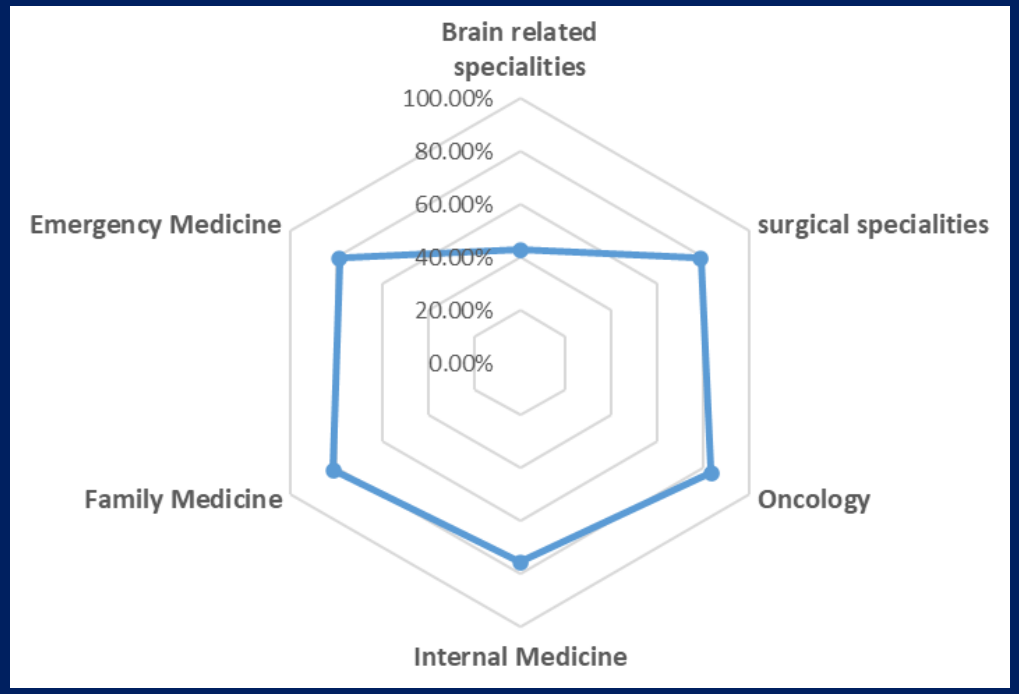

- No further analysis was done since children (<18 years old) were under-represented. There were only 5 Children / 921 referrals scored (4 appropriate, 1 non-appropriate).
- AR for Adults: 76%.

# *Hungary*
# *AR by Requested Exam*

- No definitive conclusions could be made about CT TYPE concerning appropriateness (many cells with very low expected counts, Chi-square didn't converge).
- AR was <u>higher</u> for: CT Neck (100%), CT Chest angiography (94%), CT pelvis (92%), CT Chest-abdomen (87%), CT Coronary (86%), & CT Head or/and neck angio (86%).



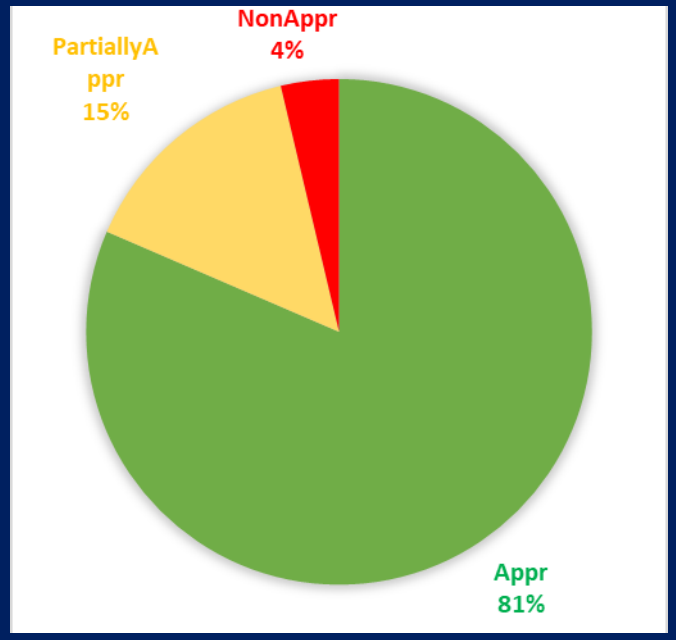
# *Hungary*
# *AR by Referrer Specialty*



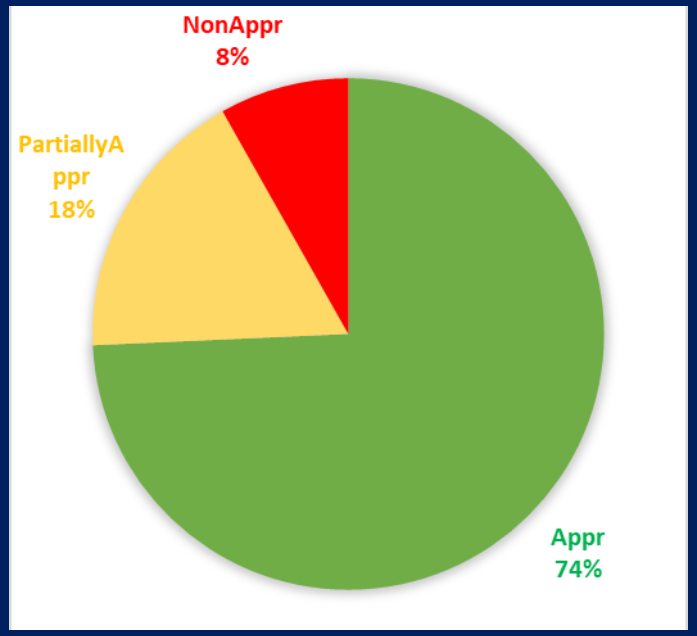

- Significant association was found between degree of appropriateness according to ESR-iGuide & EXPERTISE OF REFERRING PHYSICIAN ($p<0.0001$).
- Highest AR: Oncology doctors (84%) & Family medicine doctors (81.5%).
- Lowest AR: Brain related specialists (43%).

# *Hungary*
# *AR by Referrer Specialty*

**FAMILY / GENERAL DR**




**SPECIALIST DOCTOR**

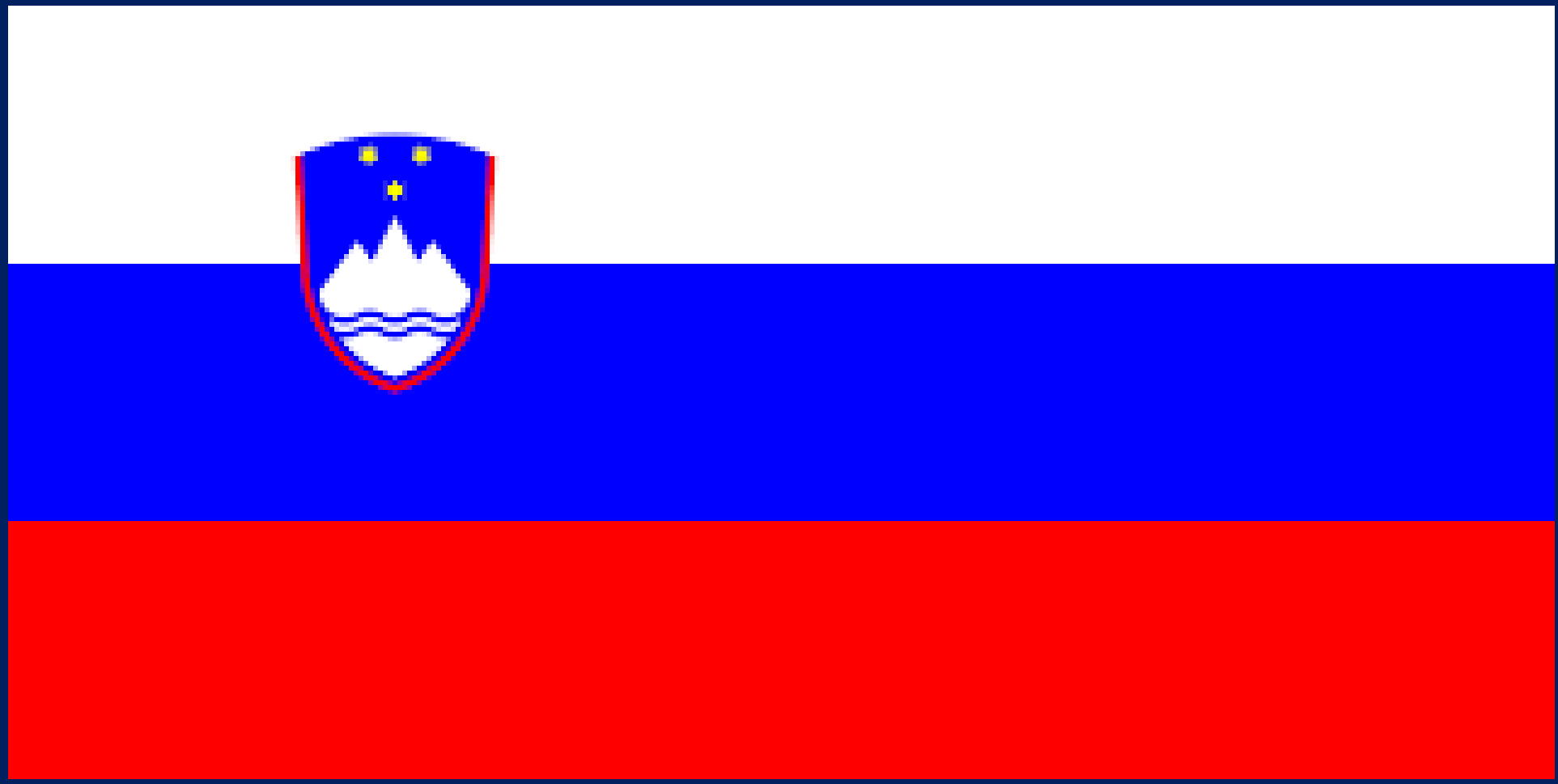



- No significant association was found between degree of appropriateness according to ESR-iGuide & REFERRER SPECIALTY – grouped variable (GP vs Medical specialist).
- In contrast to other countries, AR was higher in GPs compared to MEDICAL SPECIALISTS **(81% vs 74%; p=0.26),** although not statistically significant.

# *Hungary*
# *Conclusions*

- 1,026 records → 10% removed → 921 records included in statistical analysis.
- 75.7% of scored population (697 / 921) rated "Fully appropriate" (score 7-9).
- **Significant association between degree of appropriateness according to ESR-iGuide:**
  - AR was higher in HOSPITALIZATION as compared to AMBULATORY CARE **(85% vs 72%, p=0.0004).**
  - REFERRER SPECIALTY was found to be associated with AR **(p<0.0001).** For 2-categories variable, AR was higher in GPs as compared to SPECIALIST, but not significant.
- No PRIVATE SECTOR.
- children (<18 years old): under-represented in study (5 / 921 referrals scored).

# *Slovenia*



# *Slovenia*
# *Sample Overview*

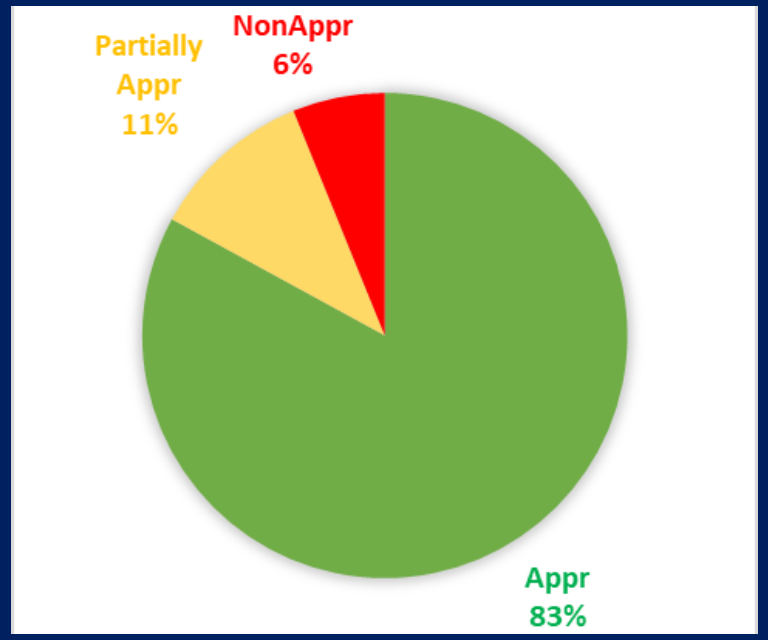
| | N | % Of Total | % Of Scored |
|---|---|---|---|
| Number of audited referrals (Total) | 1,024 | 100% | |
| Of which removed from analysis (duplicates, invalid data) | 9 | 0.88% | |
| Of which unscored referrals (no/insufficient clinical data + not applicable to ESR) | 266 | 26.86% | |
| Of which scored: | 749 | 73.14% | |
| • Fully appropriate (score 7-9) | • 594 | • 58.01% | • 79.3% |
| • Partially appropriate (score 4-6) | • 96 | • 9.38% | • 12.8% |
| • Inappropriate (score: 1-3) | • 59 | • 5.76% | • 7.9% |

# *Slovenia*
# *Sample Overview Cont.*

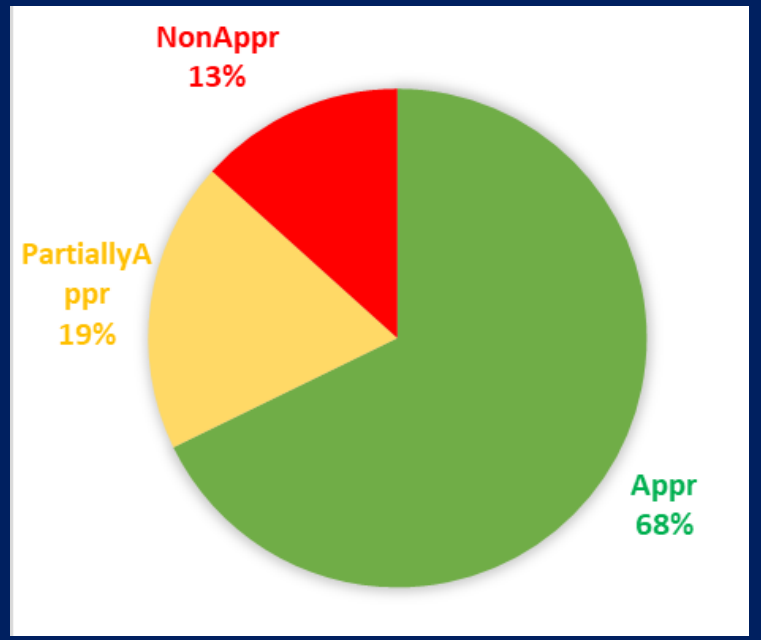
- **Data quality:** relatively average with ~27% referrals unscored due to insufficient clinical data (we couldn’t differentiate between *"insufficient data"* & *"clinical reasons not found in iGUIDE"* due to deficiency of data as was also remarked by both auditors).
- **Classification:**
  - 79% of scored population (594 / 749) → "Fully appropriate" (score 7-9).
  - 21% of scored population (155 / 749) → "Inappropriate" (score <7, when binary).

# *Slovenia*
# *AR by Institution Type*

**PUBLIC**



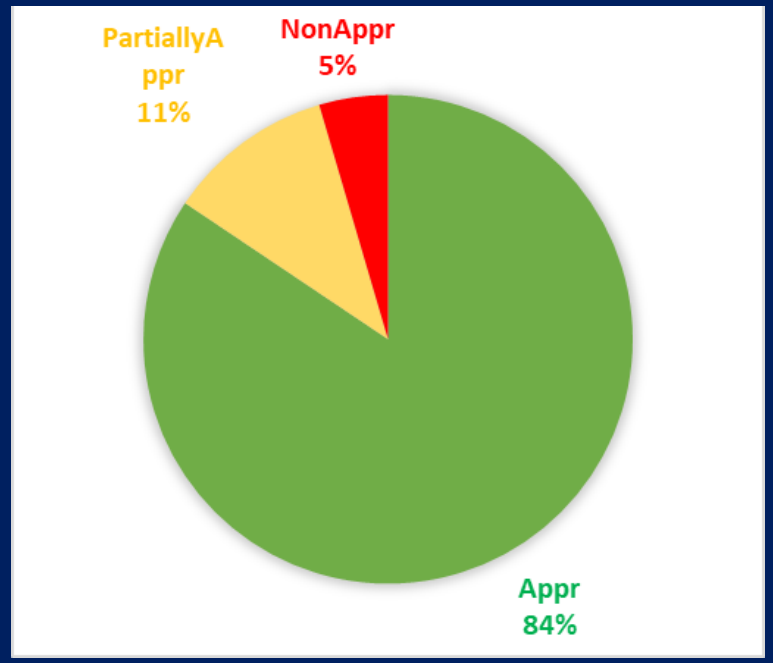

**PRIVATE**



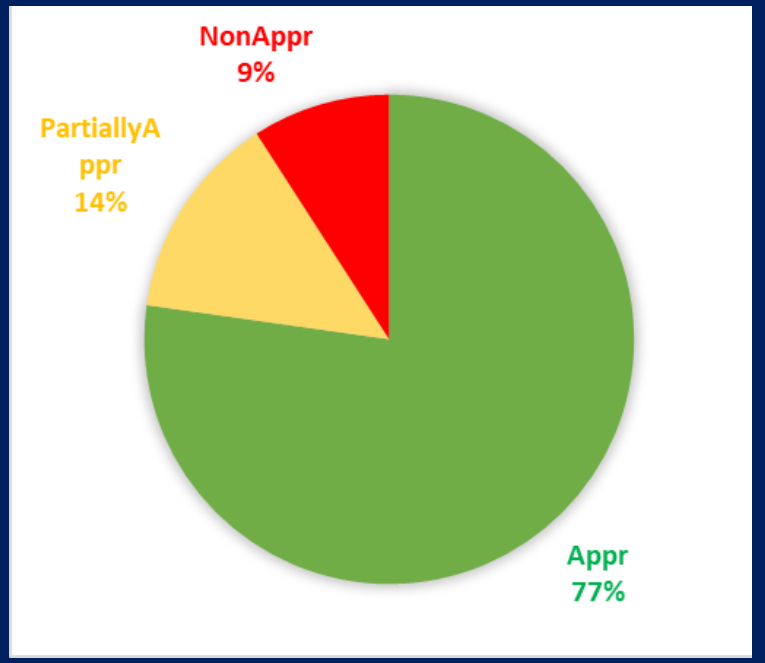

AR was <u>higher</u> when CT examinations occurred in public institutions as compared to PRIVATE INSTITUTIONS **(83% vs 68%; p<0.0001).**

# *Slovenia*
# *AR by Patient Status*

**INPATIENT**



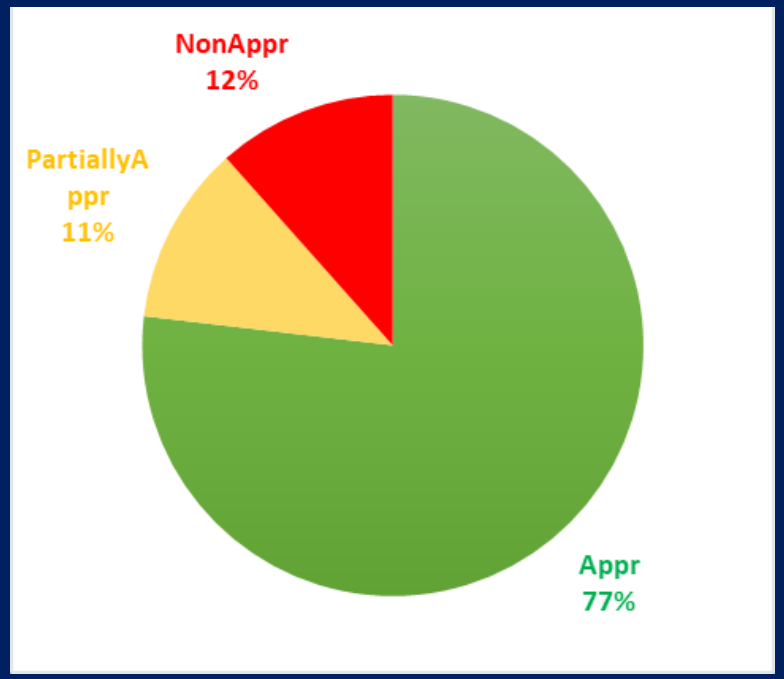

**OUTPATIENT**



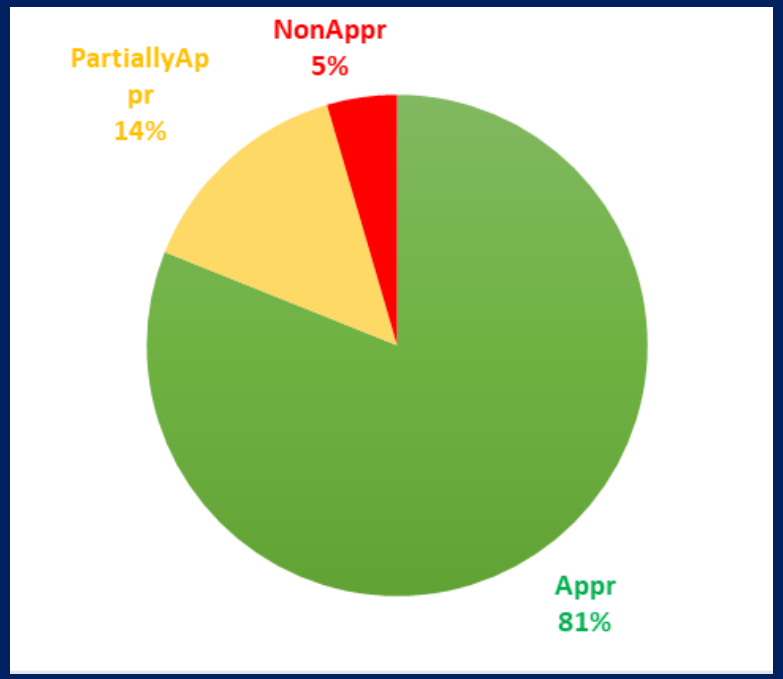

AR was <u>higher</u> when CT examinations were done during HOSPITALIZATION as compared to AMBULATORY CARE **(84% vs 77%, p=0.1038).**

# *Slovenia*
# *AR by Gender*

**FEMALE**




**MALE**



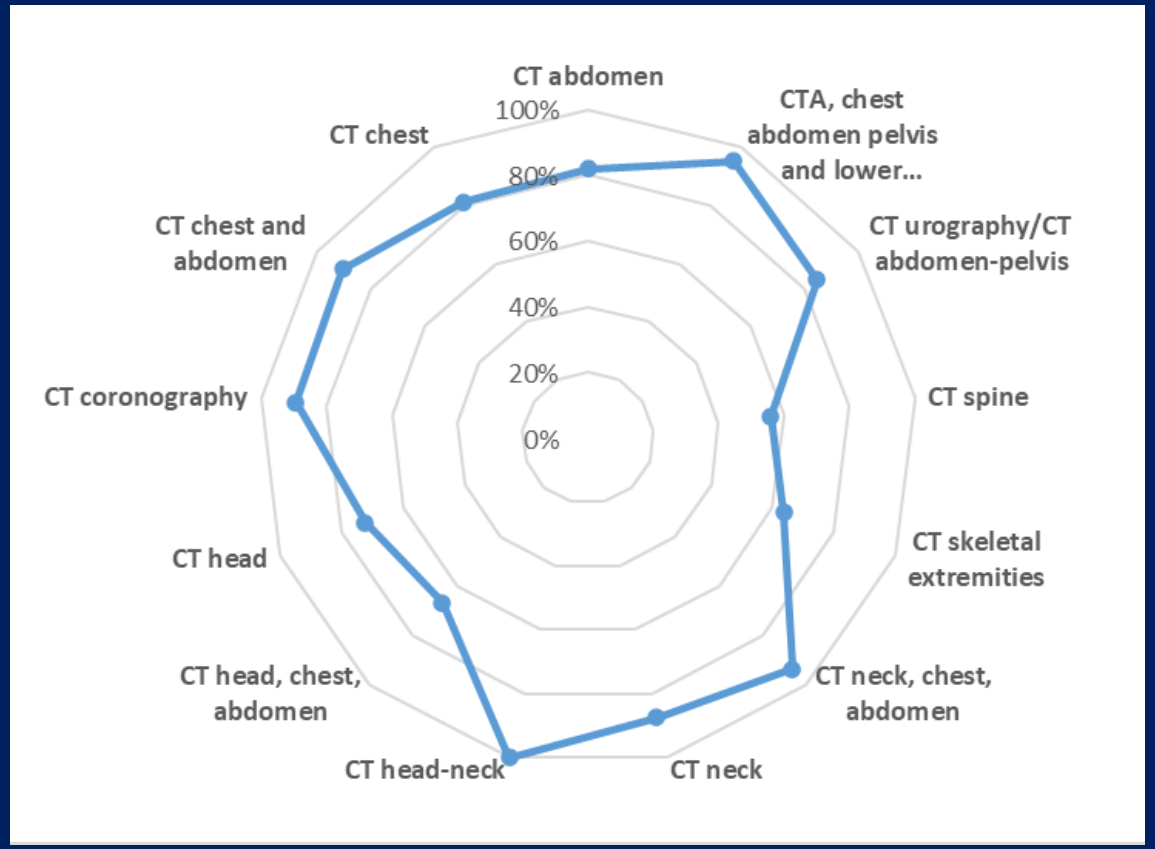

AR was <u>higher</u> when CT examinations concerned MALE population as compared to FEMALE population **(81% vs 77%, p=0.0019**).

# *Slovenia*
# *AR by Age Group*

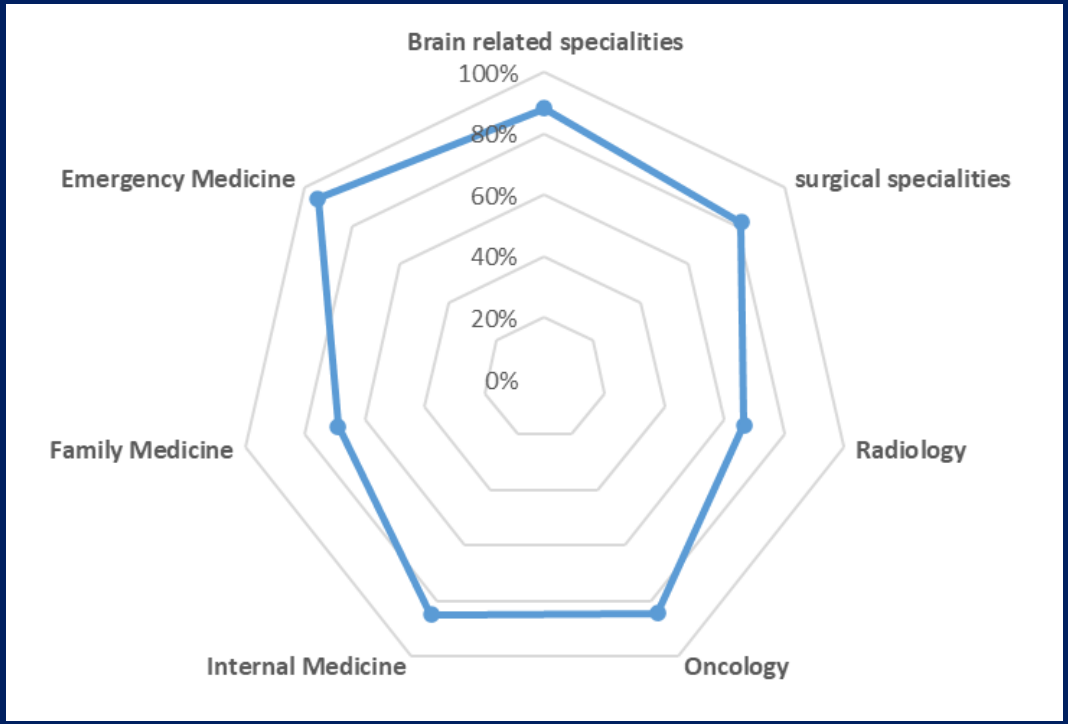
- No further analysis was done since children (<18 years old) were under-represented. Only 5 Children out of 749 referrals scored.

# *Slovenia*
# *AR by Requested Exam*

- No definitive conclusions can be made about CT TYPE concerning appropriateness (many cells with very low frequency, Chi-square didn't converge).
- AR was <u>higher</u> for: CTA, Chest abdomen pelvis & lower extremities (95%); CT Neck, chest, abdomen (94%), CT Chest & abdomen (90.5%), CT Coronography (89.5%), CT Urography/CT Abdomen-pelvis (85%) rather than CT Head (72.5%), CT Skeletal extremities (63.7%) & CT Spine (56%).



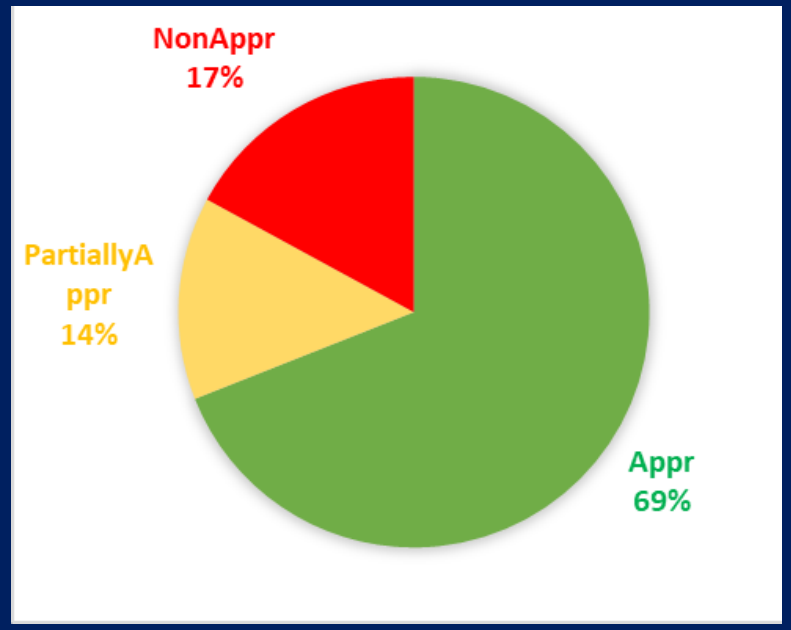
# *Slovenia*
# *AR by Referrer Specialty*



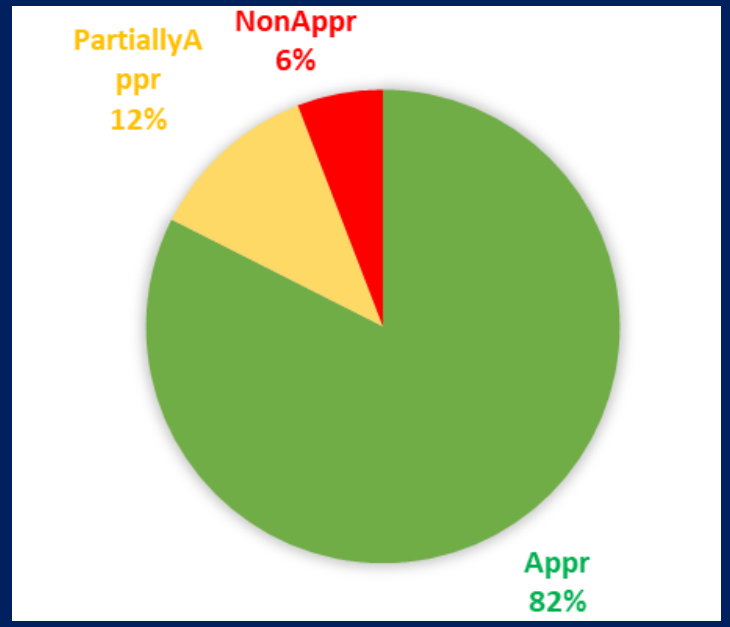

AR was <u>higher</u> for requests referred by MEDICAL SPECIALISTS (Emergency medicine 94%, Brain related specialties 88%, Internal medicine 85%, Oncology 85%, & Surgical specialties 82%) rather than by GPs (AR=69%), p=0.0006. Radiology specialists showed a relatively low AR (67%).

# *Slovenia*
# *AR by Referrer Specialty*

**FAMILY / GENERAL DR**

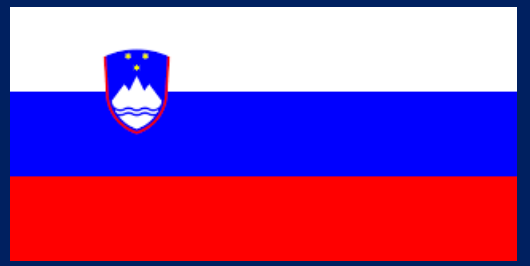



**SPECIALIST DOCTOR**




AR was higher for requests referred by MEDICAL SPECIALISTS rather than by GPs **(82% vs 69%, p < 0.0001).**

# *Slovenia*
# *Conclusions*



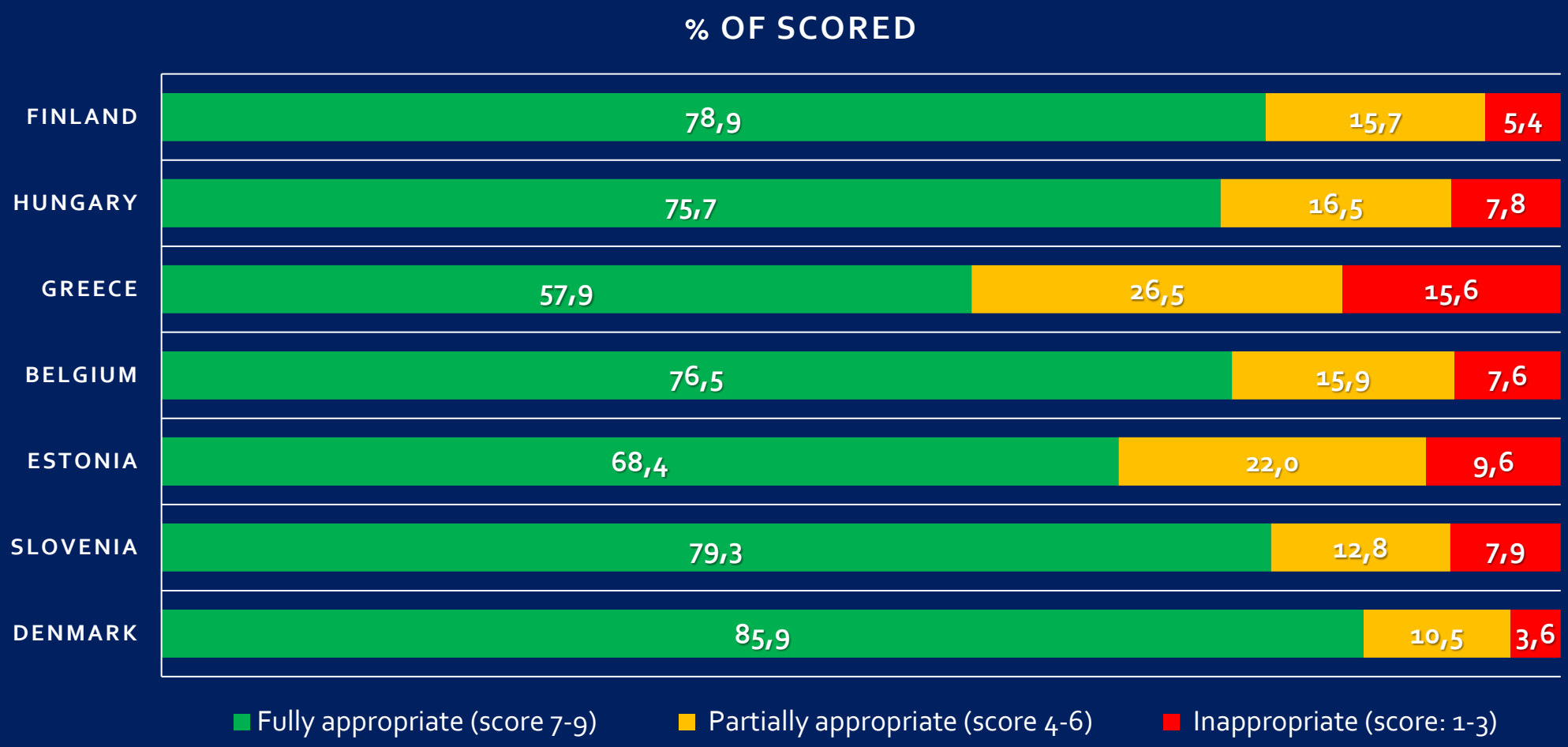
- **~27% referrals unscored due to insufficient clinical data.**
- 79.3% of scored population (594 / 749) → "Fully appropriate" (score 7-9).
- **Significant association between degree of appropriateness according to ESR-iGuide:**
  - AR was higher in PUBLIC institutions as compared to PRIVATE institutions **(83% vs 68%, p < 0.0001).**
  - AR was higher when the CT examinations concerned MALE population as compared to FEMALE population **(81% vs 77%, p=0.0019).**
  - AR was higher in MEDICAL SPECIALISTS as compares to GPs **(82% vs 69%, <0.0001).**
- **Children (<18 years old):** under-represented in study (5/ 749 referrals scored).

# Summary Tables

# *Sample Overview*

| Country | Denmark | | Slovenia | | Estonia | | Belgium | | Greece | | Hungary | | Finland | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | % of Total | N | % of Total | N | % of Total | N | % of Total | N | % of Total | N | % of Total | N | % of Total |
| **Number of audited referrals (Total)** | 1,012 | 100% | 1,024 | 100% | 1,013 | 100% | 1,006 | 100% | 909 | 100% | 1,026 | 100% | 744 | 100% |
| • Of which removed from analysis (duplicates, invalid data) | 71 | 7.02% | 9 | 0.88% | 10 | 0.99% | 22 | 2.19% | 49 | 5.39% | 19 | 1.85% | 22 | 2.96% |
| • Of which unscored referrals (no/insufficient clinical data) | 19 | 1.88% | 266 | 26.86% | 57 | 5.63% | 10 | 0.99% | 193 | 21.23% | 86 | 8.38% | 2 | 0.27% |
| • Of which scored | 922 | 91.11% | 749 | 73.14% | 946 | 93.39% | 974 | 96.80% | 667 | 73.38% | 921 | 89.77% | 720 | 96.77% |

# *Appropriateness according to ESR (%)*



# AR by Institution type & country

| Country (n=missing)<br>Institution type | Appropriate (AR) | Inappropriate | P-value |
|---|---|---|---|
| **Denmark (n=0)** | **N=792** | **N=130** | |
| Private<br>Public | 7/9 (77.8%)<br>785/913 (86%) | 2/9 (22.2%)<br>128/913 (14.02%) | 0.622 |
| **Slovenia (n=0)** | **N=594** | **N=155** | |
| Private<br>Public | 122/180 (67.8%)<br>472/569 (82.9%) | 58/180 (32.2%)<br>97/569 (17.05%) | <0.0001* |
| **Estonia (n=0)** | **N=647** | **N=299** | |
| Private<br>Public | 14/36 (38.9%)<br>633/910 (69. 6%) | 22/36 (61.11%)<br>277/910 (30.44%) | 0.0001* |
| **Belgium (n=0)** | **N=745** | **N=229** | |
| Private<br>Public | 203/290 (70%)<br>542/684 (79.2%) | 87/290 (30.0%)<br>142/684 (20.8%) | 0.002* |
| **Greece (n=0)** | **N=386** | **N=281** | |
| Private<br>Public | 221/439 (50.3%)<br>165/228 (72.4%) | 218/439 (49.7%)<br>63/228 (27.6%) | <0.001* |
| **Hungary (n=0)** | **N=697** | **N=224** | |
| Private<br>Public | -<br>697/921 (75.7%) | -<br>224/921 (24.3%) | -**- ** |
| **Finland (n=0)** | **N=568** | **N=152** | |
| Private<br>Public | 8/11 (72.7%)<br>560/709 (79%) | 3/11 (27.3%)<br>149/709 (21%) | 0.18 |

** Statistically significant at the level of P ≤ 0.05.*

*** No further analysis (no representation of private institutions).*

# AR by Patient Status & country

| Country (n=missing)<br>Patient Status | Appropriate (AR) | Inappropriate | P-value |
|---|---|---|---|
| **Denmark (n=11)** | **N=792** | **N=130** | |
| Inpatient (/emergency)<br>Outpatient | 417/477 (87.4%)<br>365/434 (84.1%) | 60/477(12.6%)<br>69/434 (15.9%) | 0.1511 |
| **Slovenia (n=24)** | **N=594** | **N=155** | |
| Inpatient (/emergency)<br>Outpatient | 130/154 (84.4%)<br>441/571 (77.2%) | 24/154 (15.6%)<br>130/571 (22.8%) | 0.0531 |
| **Estonia (n=11)** | **N=647** | **N=299** | |
| Inpatient (/emergency)<br>Outpatient | 350/480 (72.9%)<br>290/455 (63.7%) | 130/480 (27.1%)<br>165/455 (36.26%) | 0.0025* |
| **Belgium (n=84)** | **N=745** | **N=229** | |
| Inpatient (/emergency)<br>Outpatient | 242/298 (81.2)<br>452/592 (76.4%) | 56/298 (18.8%)<br>140/592 (23.6%) | 0.058 |
| **Greece (n=28)** | **N=386** | **N=281** | |
| Inpatient (/emergency)<br>Outpatient | 215/262 (82.1%)<br>150/377 (39.8%) | 47/262 (17.9%)<br>227/377 (60.2%) | <0.001* |
| **Hungary (n=141)** | **N=697** | **N=224** | |
| Inpatient (/emergency)<br>Outpatient | 208/246 (84.6%)<br>386/534 (72.3%) | 38/246 (15.4%)<br>148/534 (27.7%) | 0.0002* |
| **Finland (n=667)** | **N=568** | **N=152** | |
| Emergency<br>Inpatient | 42/53 (79.2%)<br>24/27 (88.9%) | 11/53 (20.8%)<br>3/27 (11.1%) | 0.26** |

** Statistically significant at the level of P ≤ 0.05.*

*** No representation of outpatient status.*

# AR by Gender & country

| Country (n=missing)<br>Gender | Appropriate (AR) | Inappropriate | P-value |
|---|---|---|---|
| **Denmark (n=4)** | **N=792** | **N=130** | |
| Female<br>Male | 404/458 (88.2%)<br>386/460 (83.9%) | 54/458 (11.8%)<br>74/460 (16.1%) | 0.0602 |
| **Slovenia (n=32)** | **N=594** | **N=155** | |
| Female<br>Male | 279/363 (76.9%)<br>287/354 (81.1%) | 84/363 (23.1%)<br>67/354 (18.9%) | 0.1665 |
| **Estonia (n=2)** | **N=647** | **N=299** | |
| Female<br>Male | 312/480 (65%)<br>333/464 (71.7%) | 168/480 (35%)<br>131/464 (28.2%) | 0.0255* |
| **Belgium (n=4)** | **N=745** | **N=229** | |
| Female<br>Male | 322/452 (71.2%)<br>421/518 (81.3%) | 130/452 (28.8%)<br>97/518 (18.7%) | <0.001* |
| **Greece (n=23)** | **N=386** | **N=281** | |
| Female<br>Male | 165/303 (54.5%)<br>206/341 (60.4%) | 138/303 (45.5%)<br>135/341 (39.6%) | 0.13 |
| **Hungary (n=8)** | **N=697** | **N=224** | |
| Female<br>Male | 365/473 (77.2%)<br>327/440 (74.3%) | 108/473 (22.8%)<br>113/440 (25.7%) | 0.3153 |
| **Finland (n=4)** | **N=568** | **N=152** | |
| Female<br>Male | 274/343 (79.9%)<br>291/373 (78%) | 69/343 (20.1%)<br>82/373 (22%) | 0.24 |

** Statistically significant at the level of P ≤ 0.05.*

# AR by Patient Age Group & country

| Country (n=missing)<br>Patient Age group | Appropriate (AR) | Inappropriate | P-value |
|---|---|---|---|
| **Denmark (n=0)** | **N=792** | **N=130** | |
| Adult<br>Child | 788/917 (85.9%)<br>4/5 (80%) | 129/917 (14.1%)<br>1/5 (20%) | 1.0000 |
| **Slovenia (n=32)** | **N=594** | **N=155** | |
| Adult<br>Child | 561/712 (78.8%)<br>4/5 (80%) | 151/712 (21.2%)<br>1/5 (20%) | 1.0000 |
| **Estonia (n=0)** | **N=647** | **N=299** | |
| Adult<br>Child | 641/939 (68.3%)<br>6/7 (85.7%) | 298/939 (31.7%)<br>1/7 (14.3%) | 0.4425 |
| **Belgium (n=0)** | **N=745** | **N=229** | |
| Adult<br>Child | 729/947 (77.0%)<br>16/27 (59.3%) | 218/947 (23.0%)<br>11/27 (40.7%) | 0.032* |
| **Greece (n=0)** | **N=386** | **N=281** | |
| Adult<br>Child | 384/665 (57.7%)<br>2/2 (100%) | 281/665 (42.3%)<br>0/2 (0%) | 0.51 |
| **Hungary (n=3)** | **N=697** | **N=224** | |
| Adult<br>Child | 692/913 (75.8%)<br>4/5 (80%) | 221/913 (24.2%)<br>1/5 (20%) | 0.8266 |
| **Finland (n=0)** | **N=568** | **N=152** | |
| Adult<br>Child | 555/706 (78.6%)<br>13/14 (92.9%) | 151/706 (21.4%)<br>1/14 (7.1%) | 0.48 |

** Statistically significant at the level of P ≤ 0.05.*

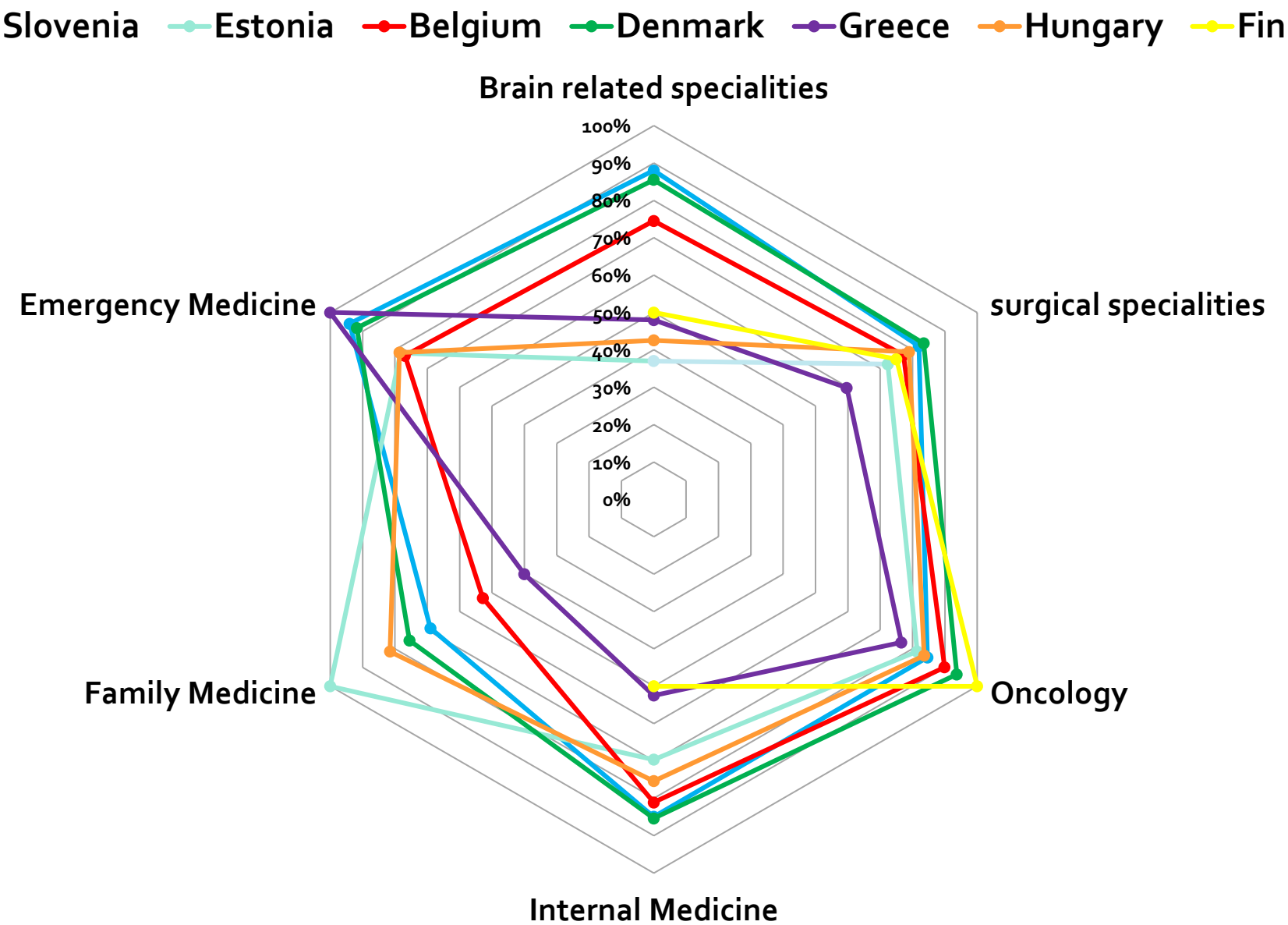
# AR by Referrer Specialty type & country

| Country (n=missing)<br>Referrer Specialty | Appropriate (AR) | Inappropriate | P-value |
|---|---|---|---|
| **Denmark (n=15)** | **N=792** | **N=130** | |
| Family/General Dr<br>Specialist doctor | 77/102 (75.5%)<br>704/ 805(87.5%) | 25/102 (24.5%)<br>101/805 (12.6%) | 0.001* |
| **Slovenia (n=107)** | **N=594** | **N=155** | |
| Family/General Dr<br>Specialist doctor | 89/129 (69%)<br>423/513 (82.5%) | 40/129 (31%)<br>90/513 (17.5%) | 0.0007* |
| **Estonia (n=455)** | **N=647** | **N=299** | |
| Family/General Dr<br>Specialist doctor | 2/2 (100%)<br>339/489 (69.3%) | 0/2 (0%)<br>150/489 (30.7%) | 0.5748 |
| **Belgium (n=46)** | **N=745** | **N=229** | |
| Family/General Dr<br>Specialist doctor | 65/123 (52.8%)<br>641/805 (79.6%) | 58/123 (47.2%)<br>164/805 (20.4%) | <0.001* |
| **Greece (n=192)** | **N=386** | **N=281** | |
| Family/General Dr<br>Specialist doctor | 8/20 (40%)<br>264/455 (58%) | 12/20 (60%)<br>191/455 (42%) | 0.16 |
| **Hungary (n=58)** | **N=697** | **N=224** | |
| Family/General Dr<br>Specialist doctor | 66/81 (81.5%)<br>581/782 (74.3%) | 15/81 (18.5%)<br>201/782 (25.7%) | 0.1553 |
| **Finland (n=711)** | **N=568** | **N=152** | |
| Family/General Dr<br>Specialist doctor | -<br>6/9 (66.7%) | -<br>3/9 (33.3%) | ---** |

** Statistically significant at the level of P ≤ 0.05.*

*** No further analysis (no representation of Family/General Dr.).*

# AR by Referrer Specialty & country

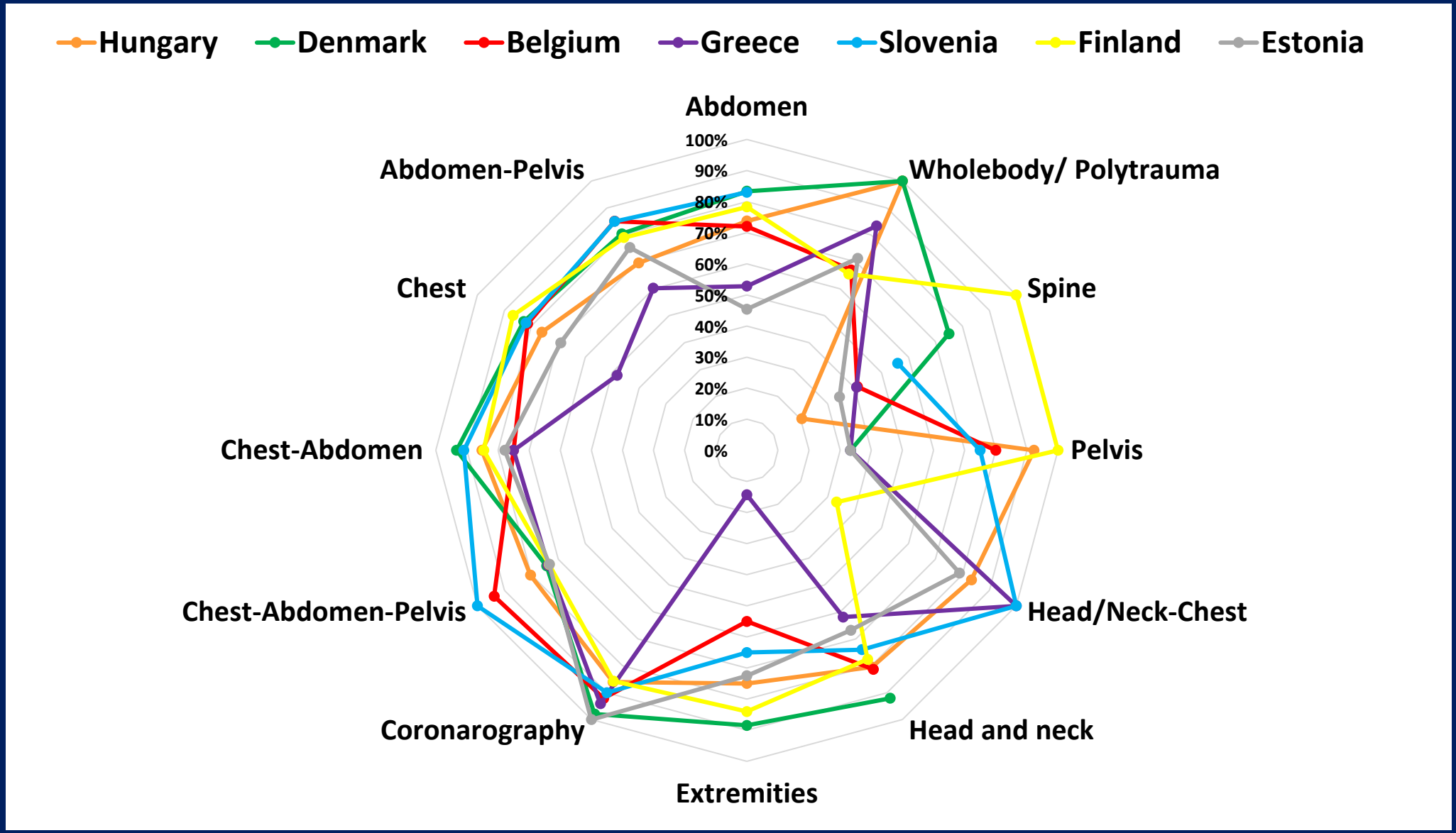


# AR by Anatomical Area & country*

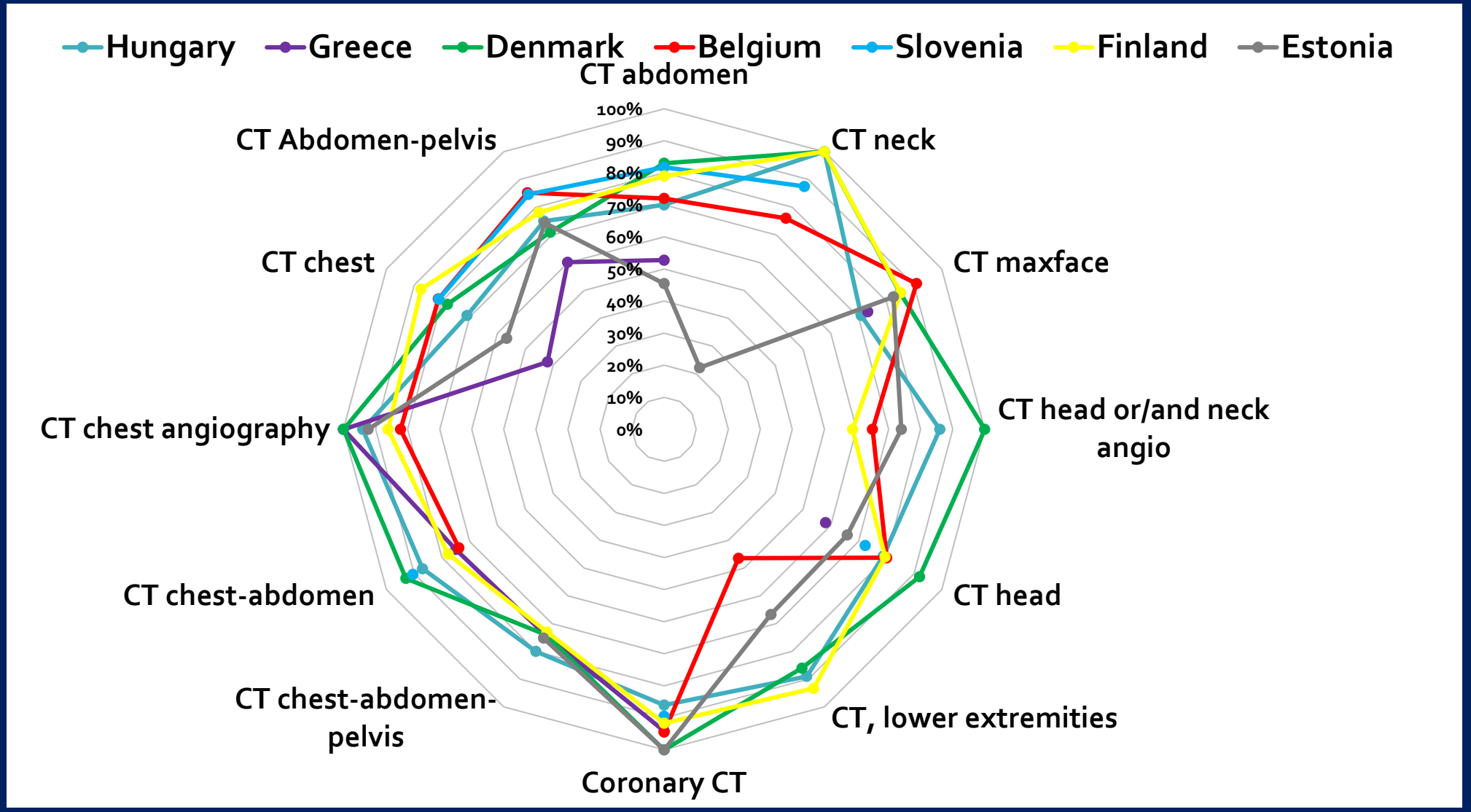
| Anatomical area | Estonia | Finland | Slovenia | Greece | Belgium | Denmark | Hungary |
|---|---|---|---|---|---|---|---|
| Abdomen | 45% | 78% | 83% | 53% | 72% | 83% | 74% |
| Abdomen-Pelvis | 75% | 79% | 85% | 60% | 85% | 80% | 70% |
| Chest | 69% | 87% | 82% | 48% | 81% | 83% | 76% |
| Chest-Abdomen | 78% | 85% | 91% | 75% | 75% | 93% | 85% |
| Chest-Abdomen-Pelvis | 73% | 73% | 100% | 74% | 94% | 74% | 80% |
| Coronarography | 100% | 86% | 90% | 94% | 92% | 98% | 86% |
| Extremities | 73% | 84% | 65% | 14% | 55% | 88% | 75% |
| Head & neck | 67% | 78% | 74% | 62% | 81% | 92% | 80% |
| Head/Neck-Chest | 79% | 33% | 100% | 100% | | | 83% |
| Pelvis | 33% | 100% | 75% | 33% | 80% | 33% | 92% |
| Spine | 34% | 100% | 56% | 41% | 41% | 75% | 20% |
| Whole body / Poly trauma | 71% | 66% | | 83% | 67% | 100% | 100% |

** Based on < **5** observations*

# AR by Anatomical Area & country



# AR by Requested Exam & country



# *Points for Discussion*

- Insufficient information for analysis
- Issues with iGuide & arbitration
- Sampling: Mainly small pediatric population
- In vs. outpatients
- Gender influences AR
- Referrers specialty
- Body areas & AR

# *Issues with iGuide & suggestions*

**Give specific indications in case of multiple tests / combination of tests:**

- Providing guidelines on multiple cases (2+ examinations): Sometimes different / same referral ID, splitting into two rows / one row.
- ESR isn't built for combined tests: difficult comparison between exam requested original referral & exam recommended by ESR iGUIDE.

**Medical specialty of the referrer- Better dropdown from list**

- Defined & standardized categories between auditors (make a short list with broad categories).

**Match found in ESR iGuide exam (main issue concerns ESR scoring)**

- YES MEANS: SAME MODALITY & EXACTLY THE SAME BODY PARTS.
- Defined as "Yes", but: no equivalency in modality (e.g. CT & MRI) & in body parts (e.g. chest-abdominal-pelvis & abdominal-pelvis without chest).
- Defined as "No", but: should be "Yes" when taking into consideration modality & body parts.
- Defined as "No matching", but: still have name of exam in ESR GUIDE & score → Only if "Yes": write name of the ESR's exam & score.
- Add categories to YES/NO: 3. *"No clinical data"* → dropped from analysis, 4. *"Not found in ESR iGUIDE"* (couldn't find reasons) → should be revised by ESR's technician.

# *Special Thanks*

- Prof. Boris Brkljacic
- Dr. Alexandra Karoussou-Schreiner
- Monika Hierath
- Florian Demuth

# Further Analysis