# Benchmarking Breakdown

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# Background

- **Anticoagulation Control - Warfarin**
  - Time in Therapeutic Range (TTR)
    - Assessment of the quality of anticoagulation
    - Rosendaal method
    - TTR of > 66% commonly accepted as benchmark

# Background

- Other Benchmarking areas for anticoagulation
  - Warfarin
    - Variance Growth Rate (VGR)
    - Critical INRs
      - INR ≤ 1.5
      - INR ≥ 4
    - Clinical Outcomes
      - Thrombotic Events
      - Haemorrhagic Events
  - Direct Acting Oral Anticoagulants
    - Clinical Outcomes

# Time in Therapeutic Range

- Patient Populations
  - Overall Population
  - Atrial Fibrillation (AF)
  - Venous Thromboembolism (VTE)
  - Ventricular Assist Device (VAD)

# Overall Population – Benchmark = 66%

Walraven et al. 2006

- Meta-analysis
  - 67 studies; 50,208 patients with 57,155 patient-years of follow-up
  - Vitamin K antagonists included (warfarin, acenocoumarol, dicumarol, ethyl biscoumacetate, and phenprocoumon)
  - Indications included AF, VTE, cardiovascular disease other than AF, peripheral vascular disease, valvular heart disease, and other indications
  - Overall TTR 63.6% of the time (95% CI = 61.6%-65.6%)
  - Study setting significant predictor of TTR
    - **~ 66%** of the TTR in both randomized controlled trials and anticoagulation clinics as compared with 57% for community-based care provided by physician

Walraven et al. Effect of study setting on anticoagulation control: a systematic review and metaregression. Chest. 2006 May;129(5):1155-66

# Atrial Fibrillation – Benchmark = 66%

There is a demonstrated relationship between higher TTR and a lower risk of morbidity and mortality [1-3]

Median TTR ~ 66%

- Connolly et al. 2008 [4]
- Camm et al. 2012 [5]

1. Gallagher AM, Setakis E, Plumb JM, Clemens A, van Staa TP: Risks of stroke and mortality associated with suboptimal anticoagulation in atrial fibrillation patients. *Thromb Haemost* 106:968–977, 2011.

2. Morgan CL, McEwan P, Tukiendorf A, Robinson PA, Clemens A, Plumb JM: Warfarin treatment in patients with atrial fibrillation: observing outcomes associated with varying levels of INR control. *Thromb Res* 124:37–41, 2009.

3. Wan Y, Heneghan C, Perera R, *et al*: Anticoagulation control and prediction of adverse events in patients with atrial fibrillation: a systematic review. *Circ Cardiovasc Qual Outcomes* 1:84–91, 2008.

4. Connolly SJ, Pogue J, Eikelboom J, *et al*; ACTIVE W Investigators: Benefit of oral anticoagulant over antiplatelet therapy in atrial fibrillation depends on the quality of international normalized ratio control achieved by centers and countries as measured by time in therapeutic range. *Circulation* 118:2029–2037, 2008.

5. Camm AJ, Lip GY, De Caterina R, *et al*; ESC Committee for Practice Guidelines (CPG): 2012 focused update of the ESC Guidelines for the management of atrial fibrillation: an update of the 2010 ESC Guidelines for the management of atrial fibrillation. Developed with the special contribution of the European Heart Rhythm Association. *Eur Heart J* 33:2719–2747, 2012.

# Atrial Fibrillation – Benchmark = 66%

## Pokorney et al. 2005

- 5,210 AF patients with 119,842 INRs over a median of 18 months of follow-up
- 59% of all measured INR values were in the therapeutic range
- The mean and median patient-level TTRs were **65%** ± 20% and **68%** (IQR 53%-79%)
- Patients followed at anticoagulation clinics had higher median TTR (**69%**, IQR 55%-80%) than those patients not followed at anticoagulation clinics (**66%**, IQR 51%-78%) ($P < 0.0001$)
- Patients within the lowest quartile TTR (i.e., TTR ≤53) were more often female, nonwhite, and had less college education than those with higher TTRs
- Patients with comorbidities, including diabetes, CKD, and heart failure, were also less likely to have high TTR

S.D. Pokorney, D.N. Simon, L. Thomas, *et al.* Patients' time in therapeutic range on warfarin among US patients with atrial fibrillation: Results from ORBIT-AF registry. Am Heart J, 170 (2015), pp. 141-148:48.e1

# Atrial Fibrillation – Aiming for a Higher TTR

- Well controlled patients – TTRs > 70%
- Many US based anticoagulation management services are reporting these numbers currently

- Impact on TTR since DOAC introduction
  - More comorbidities ?
  - Higher $CHADS_2$-VASc ? Also higher HAS-BLED ?

# Atrial Fibrillation – DOAC Trials

| | Trial | Average $CHADS_2$-VASc | TTR in Warfarin Group |
|---|---|---|---|
| Apixaban | Artistotle | 2.1 | 62% |
| Rivaroxaban | Rocket AF | 3.5 | 55% |
| Edoxaban | Engage AF TIMI 48 | 2.8 | 68.4% |
| Dabigatran | Rely | 2.1 | 64% |

# Venous Thromboembolism

TTR benchmark depends on time period from start of treatment

Erkens et al. 2012

- Meta Analysis
  - 40 studies reporting TTR in 26064 patients treated with a Vitamin K antagonist for VTE
  - Mean TTR = **54.0%** in the first month since the start of treatment
  - **55.6%** in months 1 to 3
  - **60.0%** in months 2 to 3
  - **60.0%** in the months 1 to 6+
  - **75.2%** in months 4 to 12+

Erkens PM, Ten Cate H, Buller HR et al (2012) Benchmark for time in therapeutic range in venous thromboembolism: a systematic review and meta-analysis. PLoS One 7:e42269

# Venous Thromboembolism – DOAC Trials

| | Trial | TTR in Warfarin Group |
|---|---|---|
| Apixaban | Amplify | 51% |
| Rivaroxaban | Einstein PE | 62.7% |
| Rivaroxaban | Einstein DVT | 57.7% |
| Edoxaban | Hokusai - VTE | 63.5% |
| Dabigatran | Recover I | 60% |
| Dabigatran | Recover II | 57% |

# Ventricular Assist Device – Benchmark = 50%

- Halder et al. 2017
  - Overall TTR of **52%**

- Jennings et al. 2011
  - HeartMate 2 TTR = **51%**

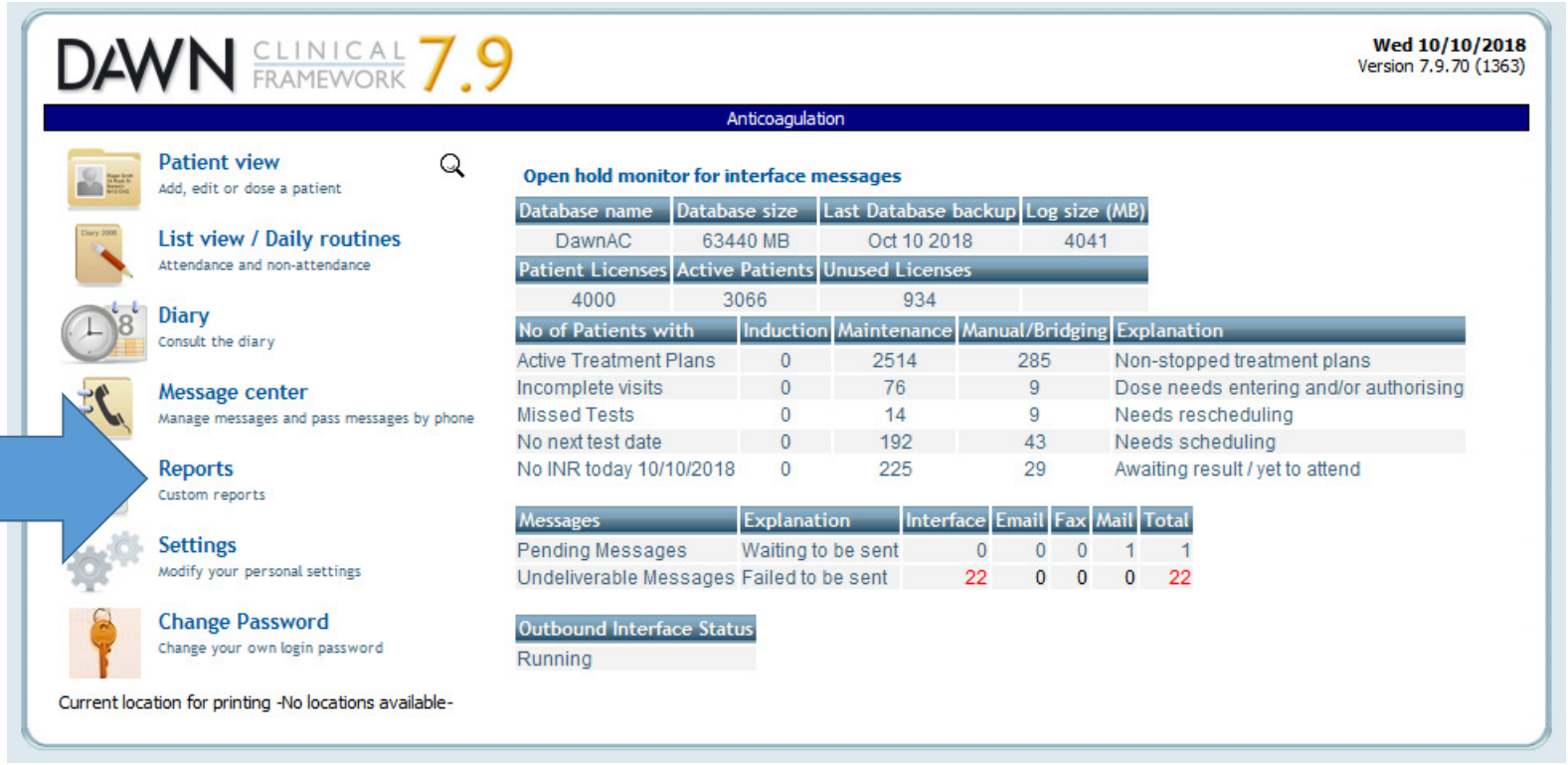
Halder LC, Richardson LB, Garbeich RF, Zimbwa P, Bennett MK. Time in therapeutic range of left ventricular assist device patients anticoagulated with warfarin: a correlation of clinical outcomes. ASAIO J 2017;63: 37–40.

Jennings D, McDonnell J, Schillig J: Assessment of long-term anticoagulation in patients with a continuous-flow left-ventricular assist device: a pilot study. *J Thorac Cardiovasc Surg* 142: e1–e2, 2011.

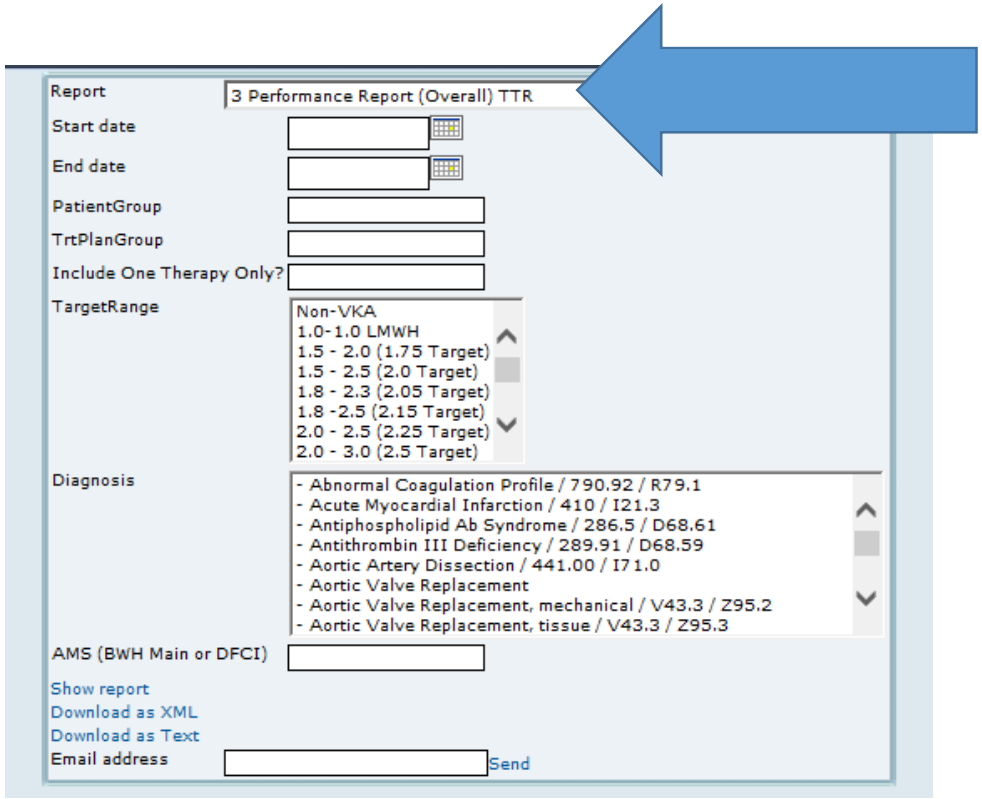
# Reporting of Time in Therapeutic Range

- Consider Patient Population
- Consider different INR Ranges
  - 2.0 – 3.0
  - 2.5 – 3.5
- TTRs should be calculated over a maintenance period of 6 months, excluding the first 6 weeks following initiation
- DAWN AC may be used to assist in TTR reporting & benchmarking

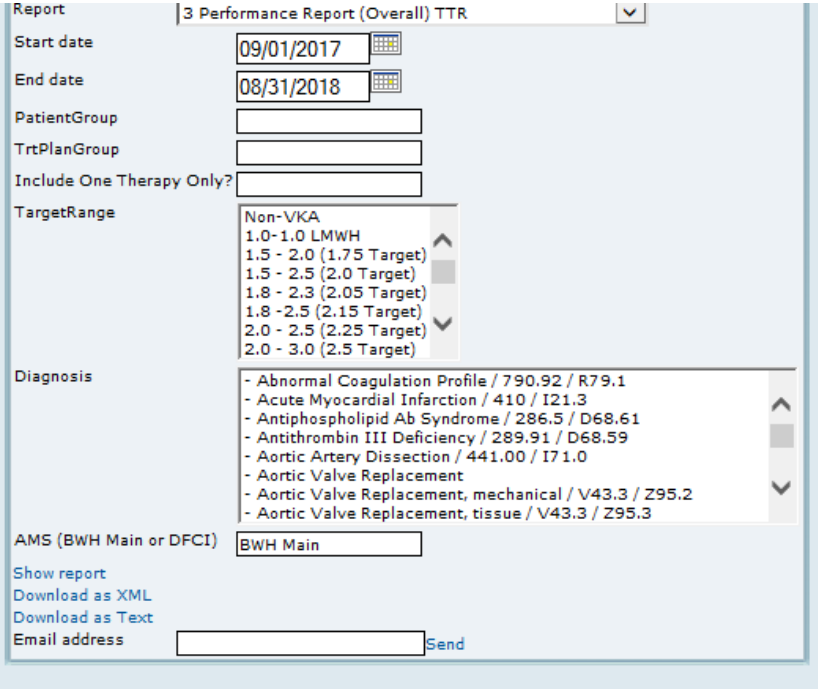
# DAWN AC - Reports



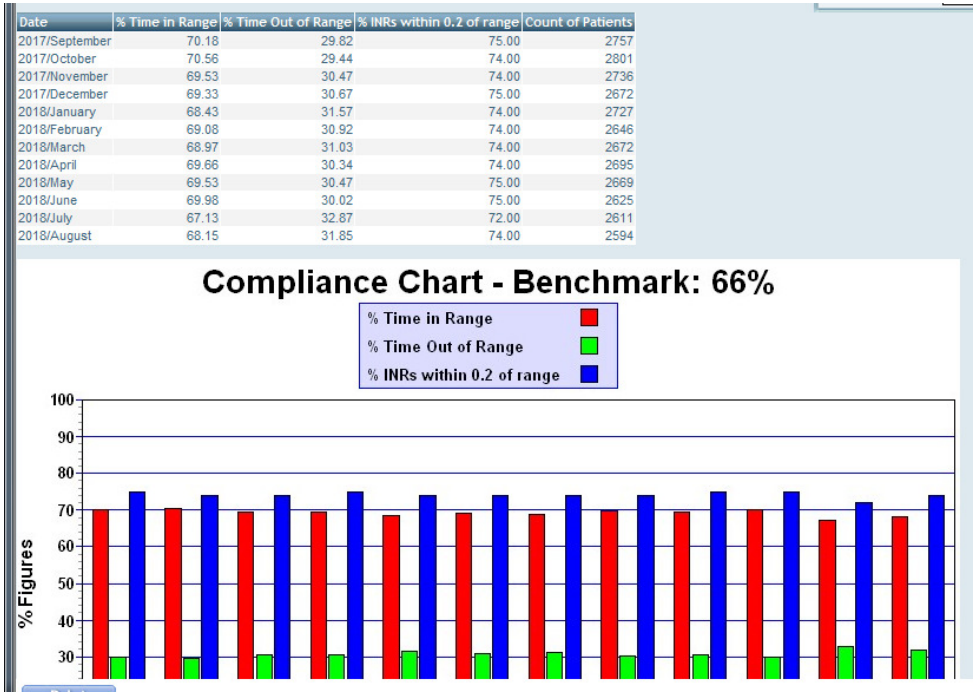
# Performance Measure – Overall TTR



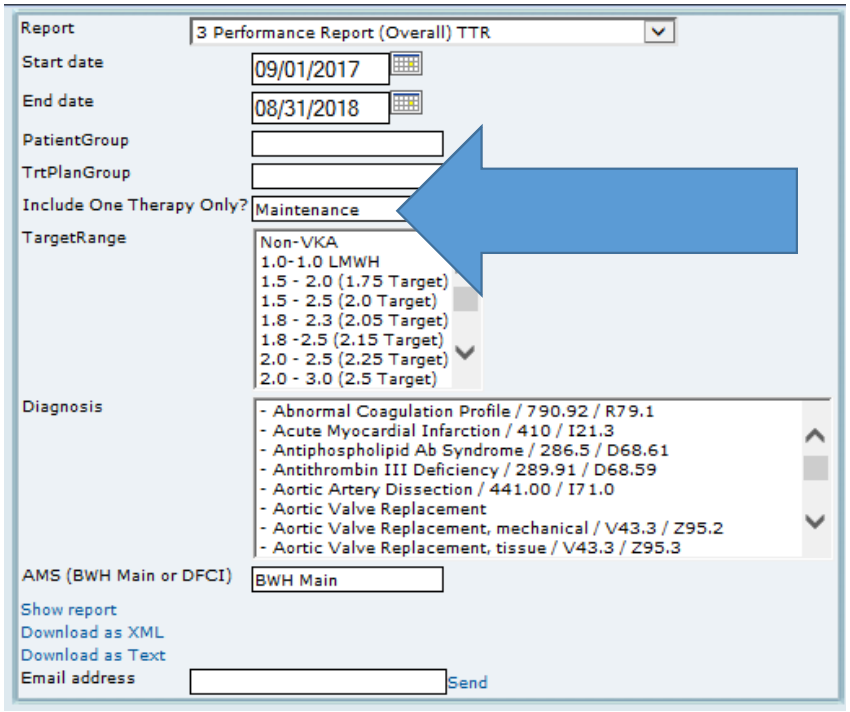
# Performance Measure – Overall TTR



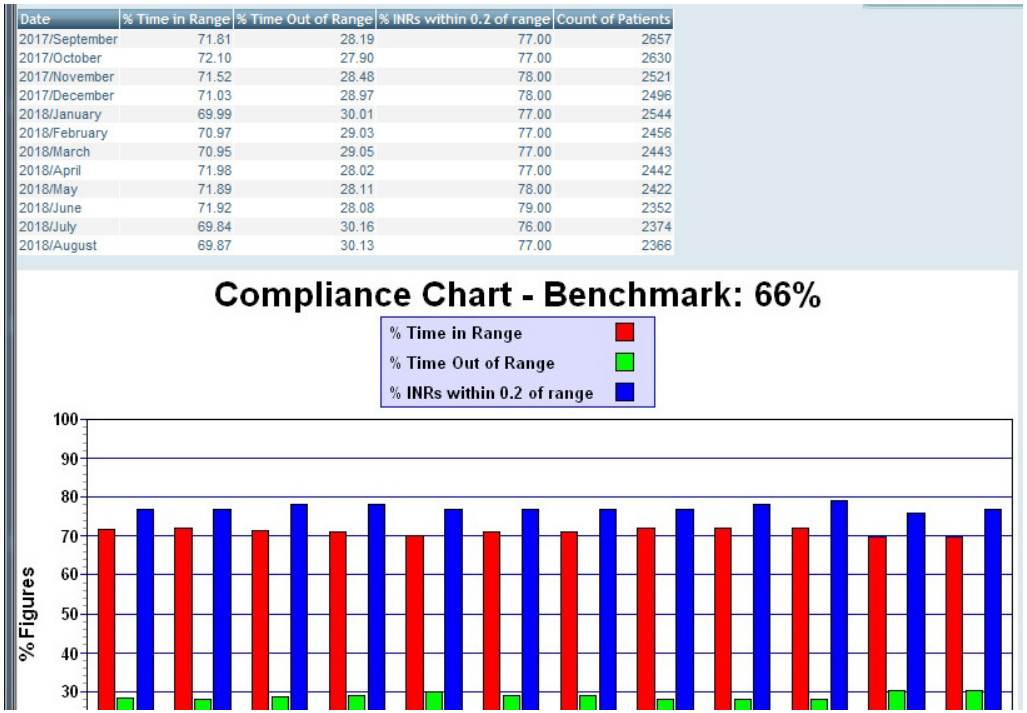

| Date | % Time in Range | % Time Out of Range | % INRs within 0.2 of range | Count of Patients |
|---|---|---|---|---|
| 2017/September | 70.18 | 29.82 | 75.00 | 2757 |
| 2017/October | 70.56 | 29.44 | 74.00 | 2801 |
| 2017/November | 69.53 | 30.47 | 74.00 | 2736 |
| 2017/December | 69.33 | 30.67 | 75.00 | 2672 |
| 2018/January | 68.43 | 31.57 | 74.00 | 2727 |
| 2018/February | 69.08 | 30.92 | 74.00 | 2646 |
| 2018/March | 68.97 | 31.03 | 74.00 | 2672 |
| 2018/April | 69.66 | 30.34 | 74.00 | 2695 |
| 2018/May | 69.53 | 30.47 | 75.00 | 2669 |
| 2018/June | 69.98 | 30.02 | 75.00 | 2625 |
| 2018/July | 67.13 | 32.87 | 72.00 | 2611 |
| 2018/August | 68.15 | 31.85 | 74.00 | 2594 |



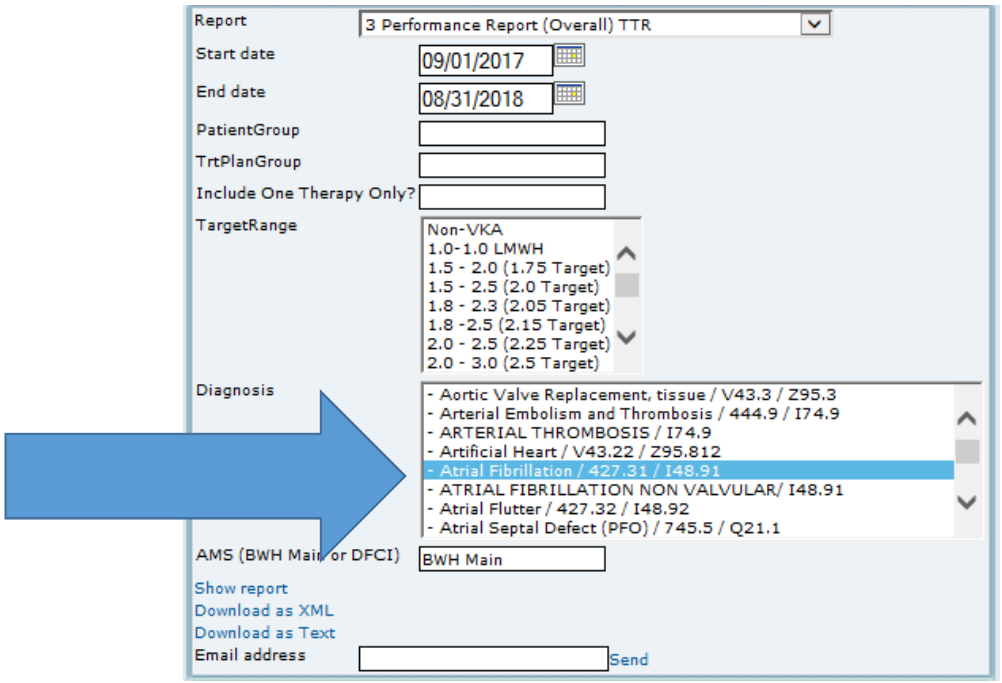
# Performance Measure – Overall TTR



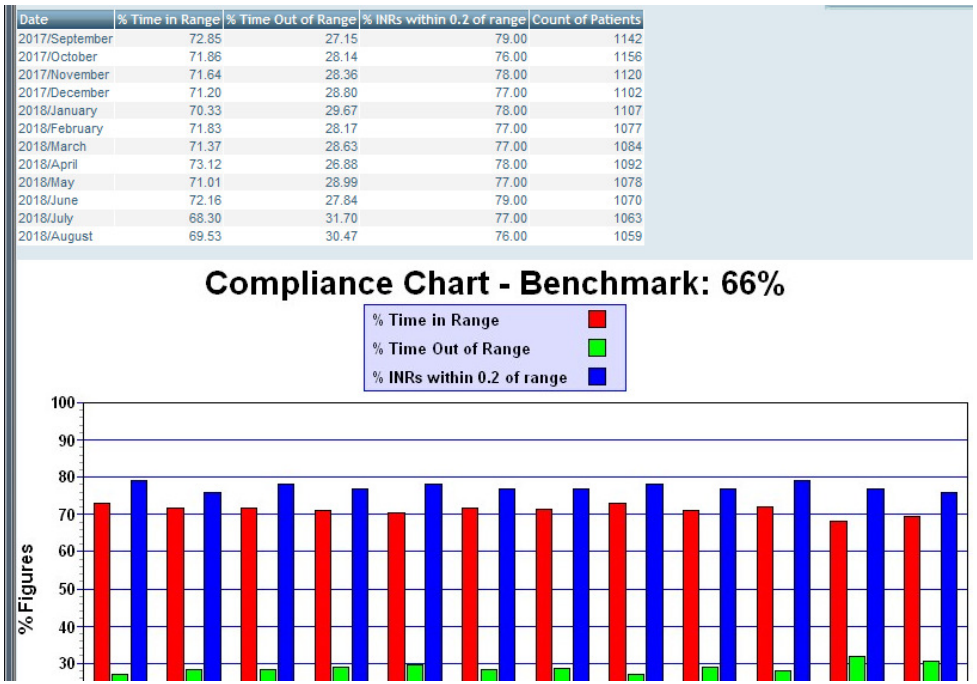

| Date | % Time in Range | % Time Out of Range | % INRs within 0.2 of range | Count of Patients |
|---|---|---|---|---|
| 2017/September | 71.81 | 28.19 | 77.00 | 2657 |
| 2017/October | 72.10 | 27.90 | 77.00 | 2630 |
| 2017/November | 71.52 | 28.48 | 78.00 | 2521 |
| 2017/December | 71.03 | 28.97 | 78.00 | 2496 |
| 2018/January | 69.99 | 30.01 | 77.00 | 2544 |
| 2018/February | 70.97 | 29.03 | 77.00 | 2456 |
| 2018/March | 70.95 | 29.05 | 77.00 | 2443 |
| 2018/April | 71.98 | 28.02 | 77.00 | 2442 |
| 2018/May | 71.89 | 28.11 | 78.00 | 2422 |
| 2018/June | 71.92 | 28.08 | 79.00 | 2352 |
| 2018/July | 69.84 | 30.16 | 76.00 | 2374 |
| 2018/August | 69.87 | 30.13 | 77.00 | 2366 |



# Performance Measure – Overall TTR




| Date | % Time in Range | % Time Out of Range | % INRs within 0.2 of range | Count of Patients |
|---|---|---|---|---|
| 2017/September | 72.85 | 27.15 | 79.00 | 1142 |
| 2017/October | 71.86 | 28.14 | 76.00 | 1156 |
| 2017/November | 71.64 | 28.36 | 78.00 | 1120 |
| 2017/December | 71.20 | 28.80 | 77.00 | 1102 |
| 2018/January | 70.33 | 29.67 | 78.00 | 1107 |
| 2018/February | 71.83 | 28.17 | 77.00 | 1077 |
| 2018/March | 71.37 | 28.63 | 77.00 | 1084 |
| 2018/April | 73.12 | 26.88 | 78.00 | 1092 |
| 2018/May | 71.01 | 28.99 | 77.00 | 1078 |
| 2018/June | 72.16 | 27.84 | 79.00 | 1070 |
| 2018/July | 68.30 | 31.70 | 77.00 | 1063 |
| 2018/August | 69.53 | 30.47 | 76.00 | 1059 |



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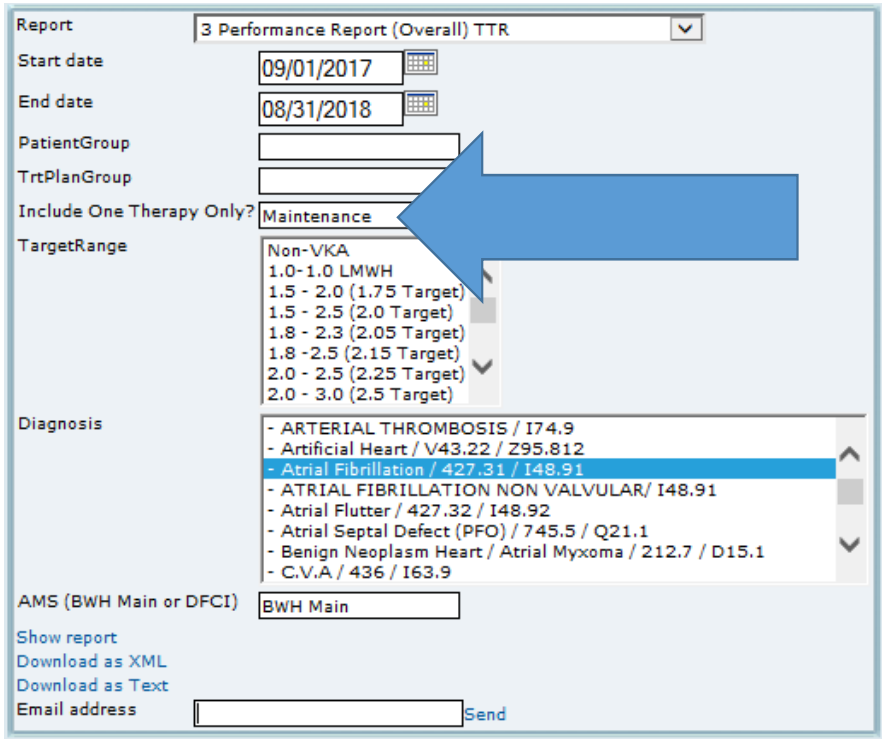
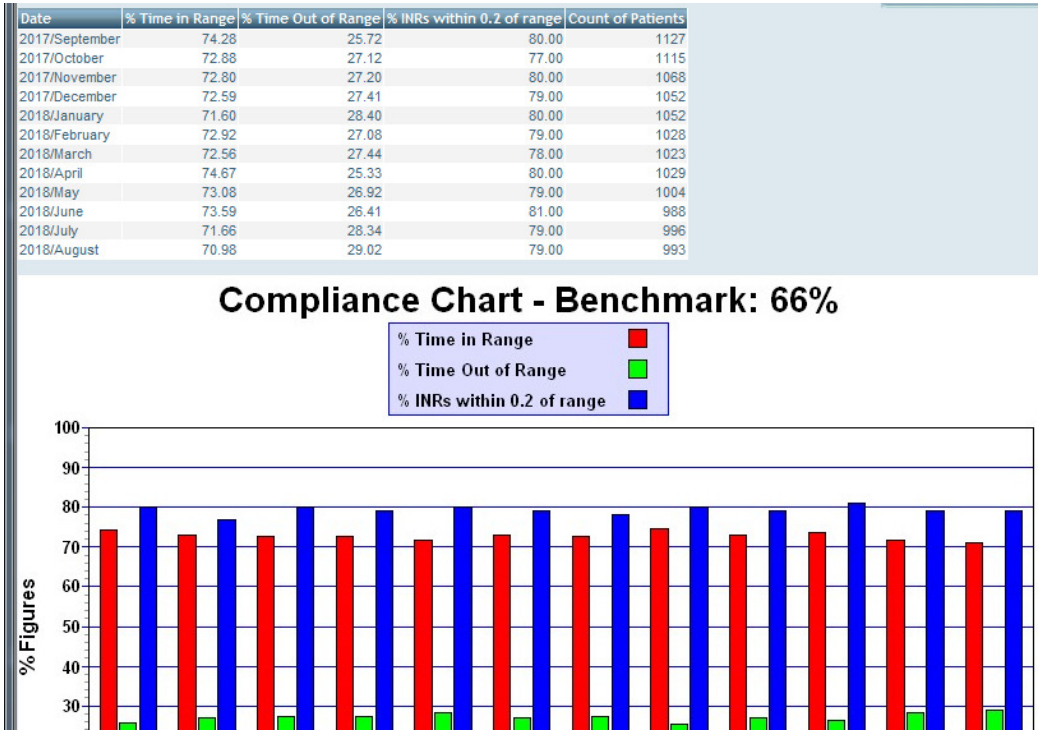
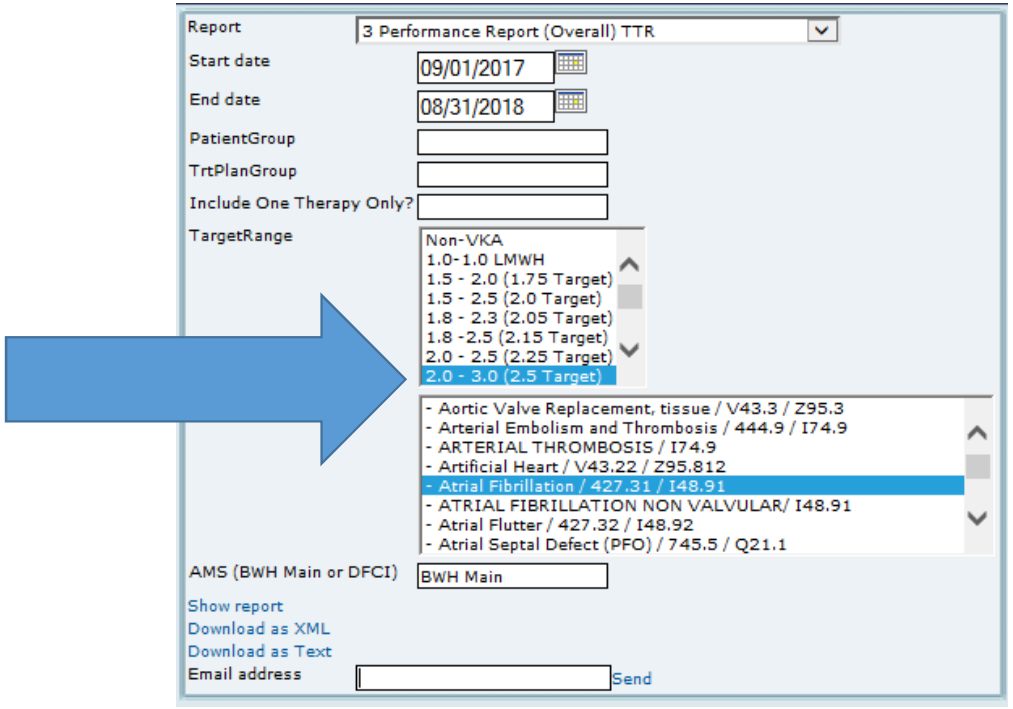


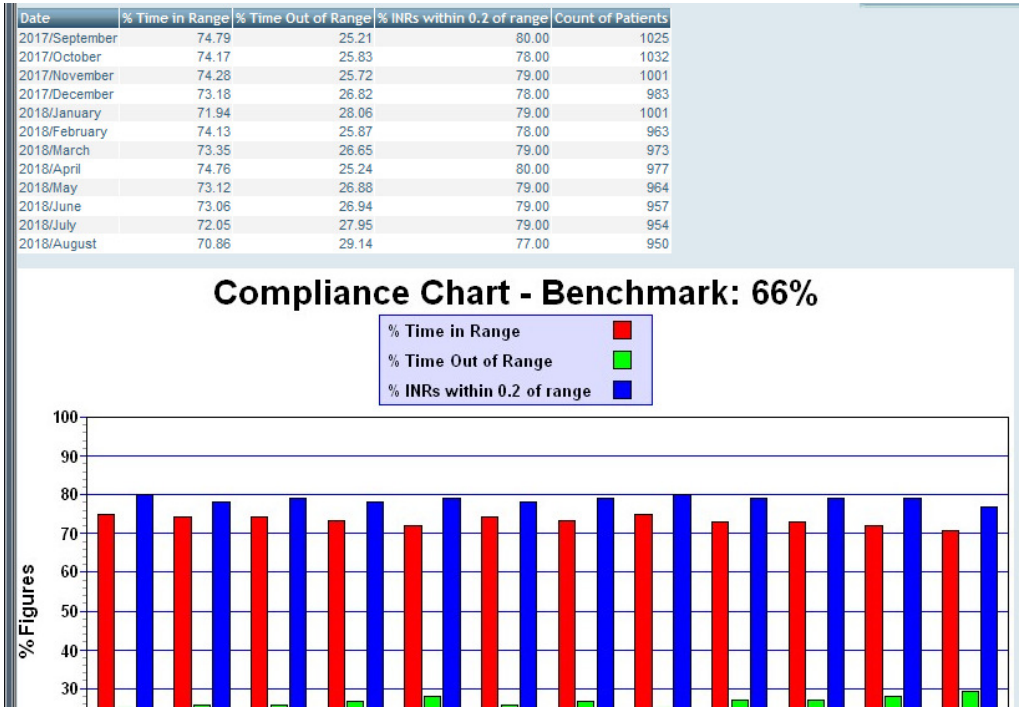

| Date | % Time in Range | % Time Out of Range | % INRs within 0.2 of range | Count of Patients |
|---|---|---|---|---|
| 2017/September | 74.28 | 25.72 | 80.00 | 1127 |
| 2017/October | 72.88 | 27.12 | 77.00 | 1115 |
| 2017/November | 72.80 | 27.20 | 80.00 | 1068 |
| 2017/December | 72.59 | 27.41 | 79.00 | 1052 |
| 2018/January | 71.60 | 28.40 | 80.00 | 1052 |
| 2018/February | 72.92 | 27.08 | 79.00 | 1028 |
| 2018/March | 72.56 | 27.44 | 78.00 | 1023 |
| 2018/April | 74.67 | 25.33 | 80.00 | 1029 |
| 2018/May | 73.08 | 26.92 | 79.00 | 1004 |
| 2018/June | 73.59 | 26.41 | 81.00 | 988 |
| 2018/July | 71.66 | 28.34 | 79.00 | 996 |
| 2018/August | 70.98 | 29.02 | 79.00 | 993 |



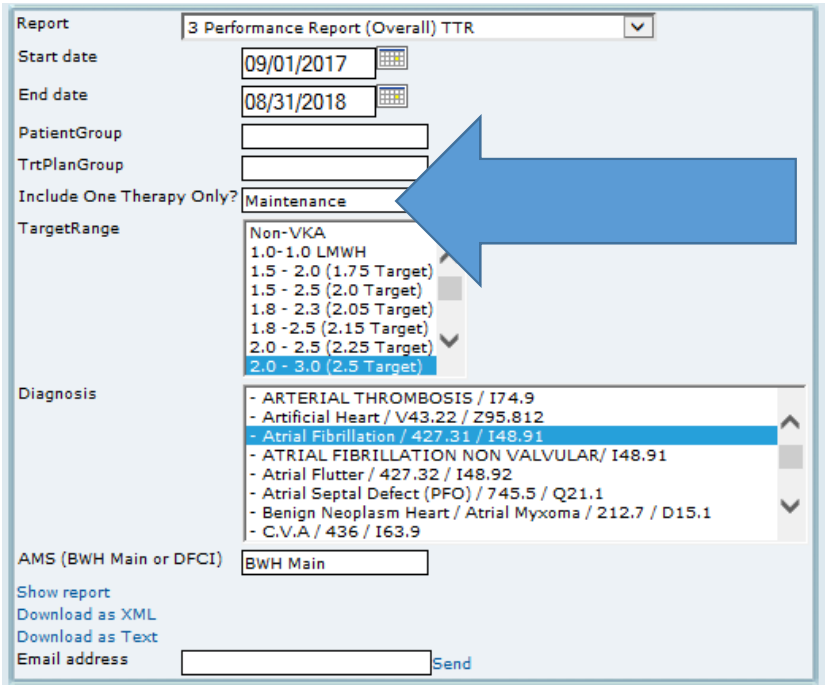
# Performance Measure – Overall TTR



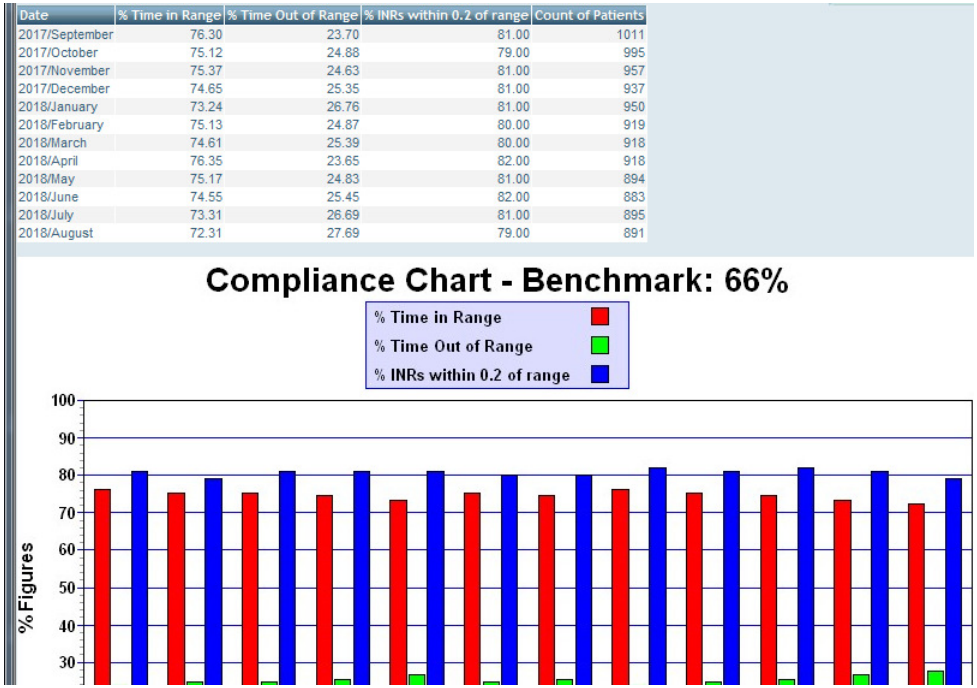

| Date | % Time in Range | % Time Out of Range | % INRs within 0.2 of range | Count of Patients |
|---|---|---|---|---|
| 2017/September | 74.79 | 25.21 | 80.00 | 1025 |
| 2017/October | 74.17 | 25.83 | 78.00 | 1032 |
| 2017/November | 74.28 | 25.72 | 79.00 | 1001 |
| 2017/December | 73.18 | 26.82 | 78.00 | 983 |
| 2018/January | 71.94 | 28.06 | 79.00 | 1001 |
| 2018/February | 74.13 | 25.87 | 78.00 | 963 |
| 2018/March | 73.35 | 26.65 | 79.00 | 973 |
| 2018/April | 74.76 | 25.24 | 80.00 | 977 |
| 2018/May | 73.12 | 26.88 | 79.00 | 964 |
| 2018/June | 73.06 | 26.94 | 79.00 | 957 |
| 2018/July | 72.05 | 27.95 | 79.00 | 954 |
| 2018/August | 70.86 | 29.14 | 77.00 | 950 |



# Performance Measure – Overall TTR



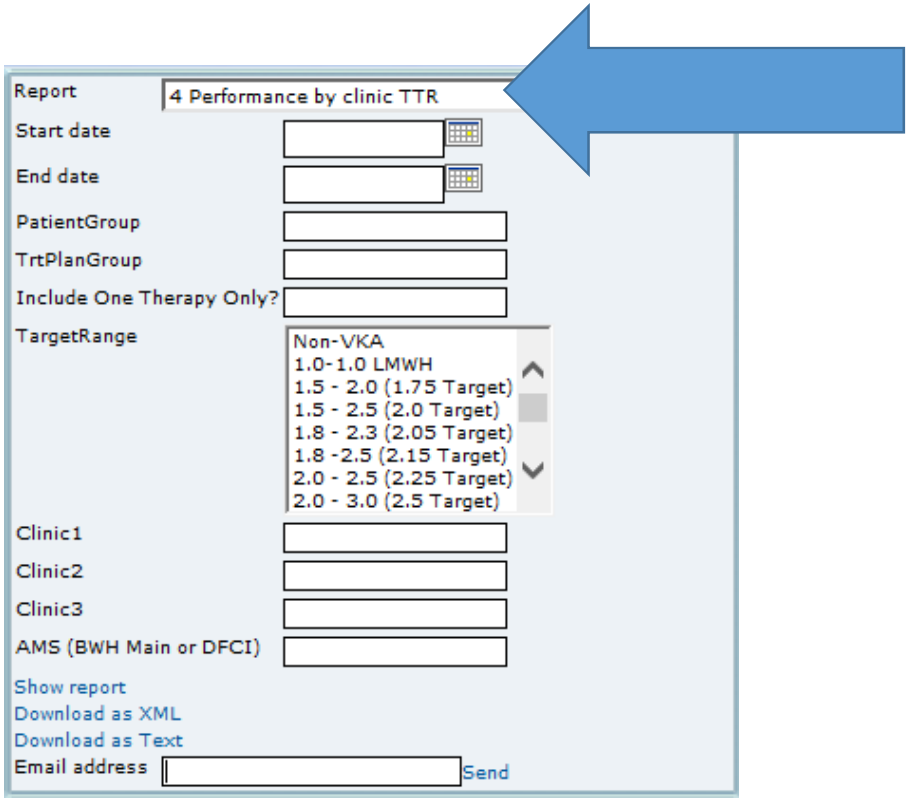

| Date | % Time in Range | % Time Out of Range | % INRs within 0.2 of range | Count of Patients |
|---|---|---|---|---|
| 2017/September | 76.30 | 23.70 | 81.00 | 1011 |
| 2017/October | 75.12 | 24.88 | 79.00 | 995 |
| 2017/November | 75.37 | 24.63 | 81.00 | 957 |
| 2017/December | 74.65 | 25.35 | 81.00 | 937 |
| 2018/January | 73.24 | 26.76 | 81.00 | 950 |
| 2018/February | 75.13 | 24.87 | 80.00 | 919 |
| 2018/March | 74.61 | 25.39 | 80.00 | 918 |
| 2018/April | 76.35 | 23.65 | 82.00 | 918 |
| 2018/May | 75.17 | 24.83 | 81.00 | 894 |
| 2018/June | 74.55 | 25.45 | 82.00 | 883 |
| 2018/July | 73.31 | 26.69 | 81.00 | 895 |
| 2018/August | 72.31 | 27.69 | 79.00 | 891 |



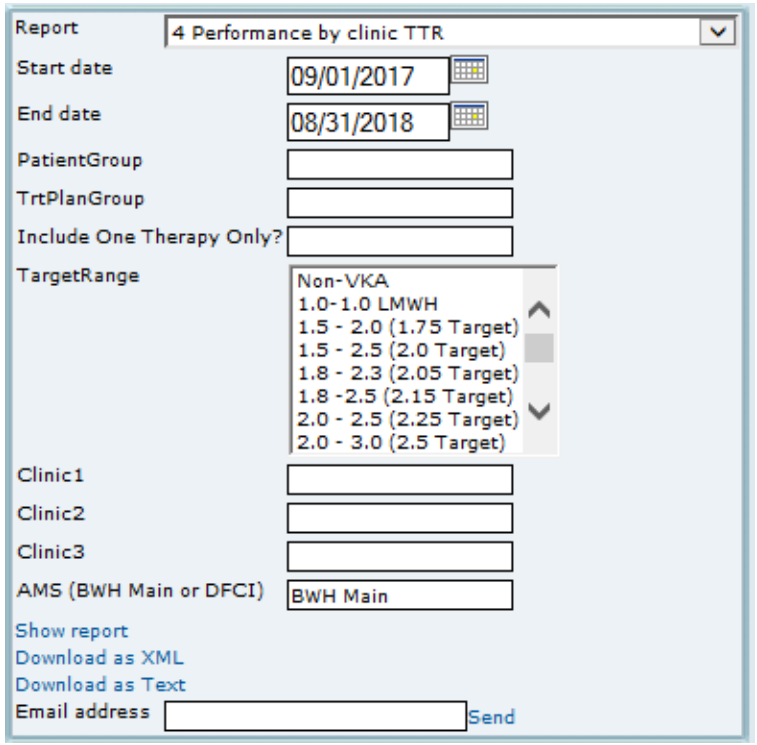
# Overall TTR Calculation Summary

| | TTR (September 2017) |
|---|---|
| Overall Population | 70.18% |
| Overall Population (Maintenance) | 71.81% |
| Atrial Fibrillation Population | 72.85% |
| Atrial Fibrillation Population (Maintenance) | 74.28% |
| Atrial Fibrillation Population (INR Range 2.0 – 3.0) | 74.49% |
| Atrial Fibrillation Population (INR Range 2.0 – 3.0 & Maintenance) | 76.30% |

# Performance by Clinic – TTR

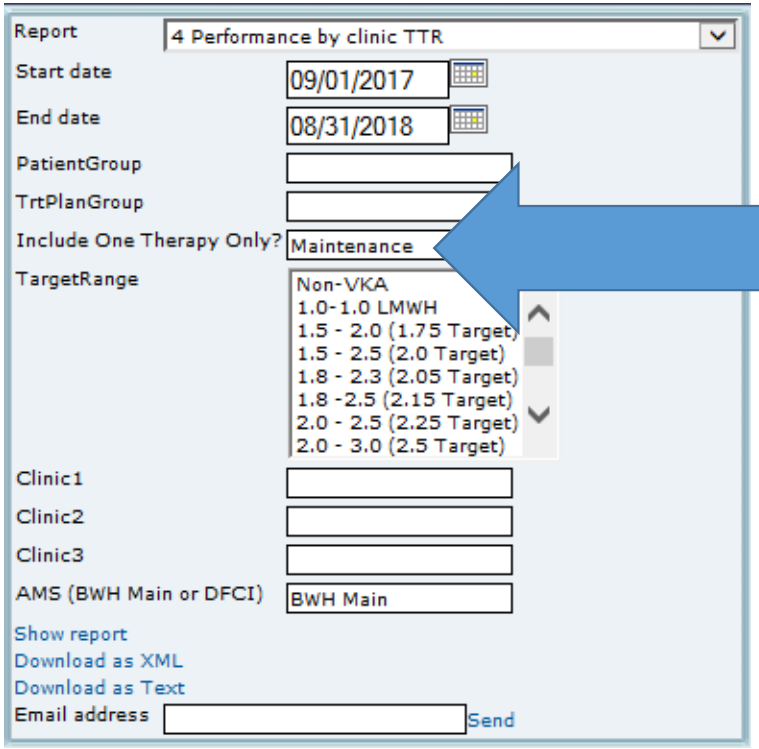


# Performance by Clinic – TTR




| Date | Clinic | % Time in Range | % Time Out of Range | % INRs within 0.2 of range | Count of Patients |
|---|---|---|---|---|---|
| 2017/September | Amy Levesque | 70.06 | 29.94 | 72.00 | 333 |
| 2017/September | Magie Pham | 68.54 | 31.46 | 72.00 | 330 |
| 2017/September | Peter Collins | 67.25 | 32.75 | 73.00 | 334 |
| 2017/September | Sarra Ben Ghorbal | 72.79 | 27.21 | 76.00 | 196 |
| 2017/September | Themio Papadopoulos | 69.75 | 30.25 | 75.00 | 334 |
| 2017/September | David Appel | 73.30 | 26.70 | 78.00 | 342 |
| 2017/September | Andrea Lewin | 71.56 | 28.44 | 77.00 | 269 |
| 2017/September | Laura Hill | 73.24 | 26.76 | 77.00 | 209 |
| 2017/September | Gina Dube | 67.85 | 32.15 | 73.00 | 333 |
| 2017/September | Magentum | 76.10 | 23.90 | 85.00 | 9 |
| 2017/September | Nicole Vincze Irving | 67.77 | 32.23 | 68.00 | 69 |
| 2017/October | Andrea Lewin | 68.38 | 31.62 | 69.00 | 258 |
| 2017/October | Magentum | 84.18 | 15.82 | 93.00 | 9 |
| 2017/October | Nicole Vincze Irving | 63.09 | 36.91 | 68.00 | 66 |
| 2017/October | Themio Papadopoulos | 69.99 | 30.01 | 74.00 | 335 |
| 2017/October | Laura Hill | 71.34 | 28.66 | 73.00 | 220 |
| 2017/October | David Appel | 74.31 | 25.69 | 77.00 | 353 |
| 2017/October | Amy Levesque | 67.92 | 32.08 | 72.00 | 339 |
| 2017/October | Gina Dube | 69.95 | 30.05 | 73.00 | 332 |
| 2017/October | Magie Pham | 71.43 | 28.57 | 73.00 | 337 |
| 2017/October | Peter Collins | 72.11 | 27.89 | 77.00 | 345 |
| 2017/October | Sarra Ben Ghorbal | 69.73 | 30.27 | 75.00 | 207 |
| 2017/November | Laura Hill | 67.79 | 32.21 | 72.00 | 208 |
| 2017/November | Magentum | 78.78 | 21.22 | 90.00 | 9 |
| 2017/November | Nicole Vincze Irving | 61.61 | 38.39 | 71.00 | 63 |
| 2017/November | Andrea Lewin | 66.14 | 33.86 | 69.00 | 252 |
| 2017/November | Sarra Ben Ghorbal | 70.69 | 29.31 | 78.00 | 207 |
| 2017/November | Amy Levesque | 71.66 | 28.34 | 75.00 | 328 |
| 2017/November | David Appel | 71.82 | 28.18 | 75.00 | 344 |
| 2017/November | Gina Dube | 67.88 | 32.12 | 72.00 | 326 |
| 2017/November | Magie Pham | 68.28 | 31.72 | 73.00 | 341 |
| 2017/November | Peter Collins | 71.26 | 28.74 | 76.00 | 330 |
| 2017/November | Themio Papadopoulos | 70.17 | 29.83 | 73.00 | 330 |
| 2017/December | Amy Levesque | 68.29 | 31.71 | 76.00 | 317 |
| 2017/December | Gina Dube | 67.58 | 32.42 | 74.00 | 328 |
| 2017/December | HAT Stewardship | 5.49 | 94.51 | 0.00 | 1 |
| 2017/December | Magie Pham | 68.03 | 31.97 | 74.00 | 338 |

# Performance by Clinic – TTR

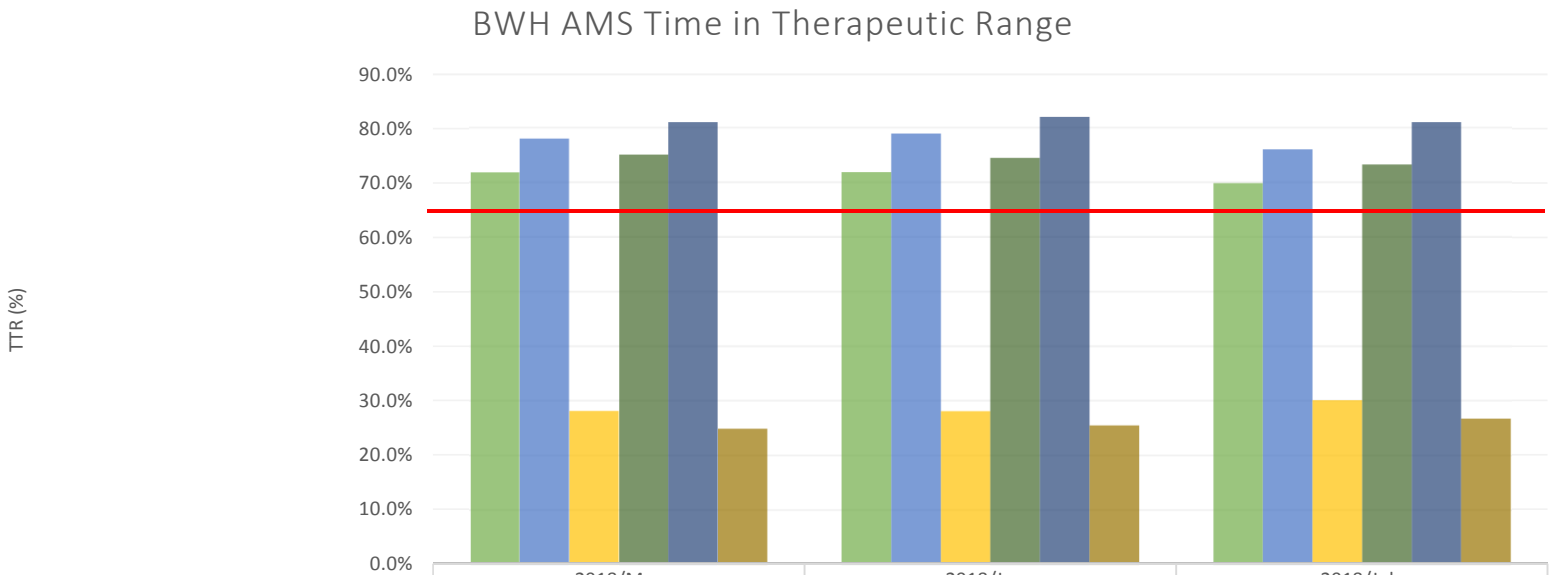



| Date | Clinic | % Time in Range | % Time Out of Range | % INRs within 0.2 of range | Count of Patients |
|---|---|---|---|---|---|
| 2017/September | Amy Levesque | 71.32 | 28.68 | 75.00 | 323 |
| 2017/September | Magie Pham | 70.49 | 29.51 | 76.00 | 319 |
| 2017/September | Peter Collins | 68.11 | 31.89 | 75.00 | 325 |
| 2017/September | Sarra Ben Ghorbal | 74.94 | 25.06 | 77.00 | 194 |
| 2017/September | Themio Papadopoulos | 70.76 | 29.24 | 77.00 | 327 |
| 2017/September | David Appel | 74.54 | 25.46 | 83.00 | 328 |
| 2017/September | Andrea Lewin | 73.47 | 26.53 | 77.00 | 254 |
| 2017/September | Laura Hill | 75.72 | 24.28 | 81.00 | 201 |
| 2017/September | Gina Dube | 69.87 | 30.13 | 76.00 | 318 |
| 017/September | Magentum | 76.10 | 23.90 | 85.00 | 9 |
| 017/September | Nicole Vincze Irving | 72.18 | 27.82 | 74.00 | 59 |
| 017/October | David Appel | 75.40 | 24.60 | 80.00 | 326 |
| 017/October | Amy Levesque | 68.78 | 31.22 | 74.00 | 319 |
| 2017/October | Gina Dube | 71.79 | 28.21 | 78.00 | 306 |
| 2017/October | Magie Pham | 73.30 | 26.70 | 76.00 | 310 |
| 2017/October | Peter Collins | 73.15 | 26.85 | 79.00 | 330 |
| 2017/October | Sarra Ben Ghorbal | 70.77 | 29.23 | 78.00 | 205 |
| 2017/October | Andrea Lewin | 70.65 | 29.35 | 70.00 | 247 |
| 2017/October | Magentum | 84.18 | 15.82 | 93.00 | 9 |
| 2017/October | Nicole Vincze Irving | 65.50 | 34.50 | 70.00 | 55 |
| 2017/October | Themio Papadopoulos | 71.42 | 28.58 | 78.00 | 317 |
| 2017/October | Laura Hill | 73.90 | 26.10 | 77.00 | 206 |
| 2017/November | Andrea Lewin | 67.36 | 32.64 | 71.00 | 234 |
| 2017/November | Sarra Ben Ghorbal | 71.73 | 28.27 | 79.00 | 196 |
| 2017/November | Laura Hill | 70.72 | 29.28 | 77.00 | 197 |
| 2017/November | Magentum | 78.78 | 21.22 | 90.00 | 9 |
| 2017/November | Nicole Vincze Irving | 66.13 | 33.87 | 75.00 | 49 |
| 2017/November | Amy Levesque | 73.87 | 26.13 | 78.00 | 301 |
| 2017/November | David Appel | 73.70 | 26.30 | 80.00 | 318 |
| 2017/November | Gina Dube | 70.75 | 29.25 | 77.00 | 288 |
| 2017/November | Magie Pham | 70.27 | 29.73 | 77.00 | 316 |
| 2017/November | Peter Collins | 72.14 | 27.86 | 77.00 | 317 |
| 2017/November | Themio Papadopoulos | 72.49 | 27.51 | 80.00 | 296 |
| 2017/December | Andrea Lewin | 68.05 | 31.95 | 76.00 | 243 |
| 2017/December | Magentum | 74.58 | 25.42 | 91.00 | 9 |
| 2017/December | Sarra Ben Ghorbal | 72.62 | 27.38 | 78.00 | 195 |
| 2017/December | Laura Hill | 73.55 | 26.45 | 80.00 | 191 |

# BWH AMS TTR Benchmarking Report

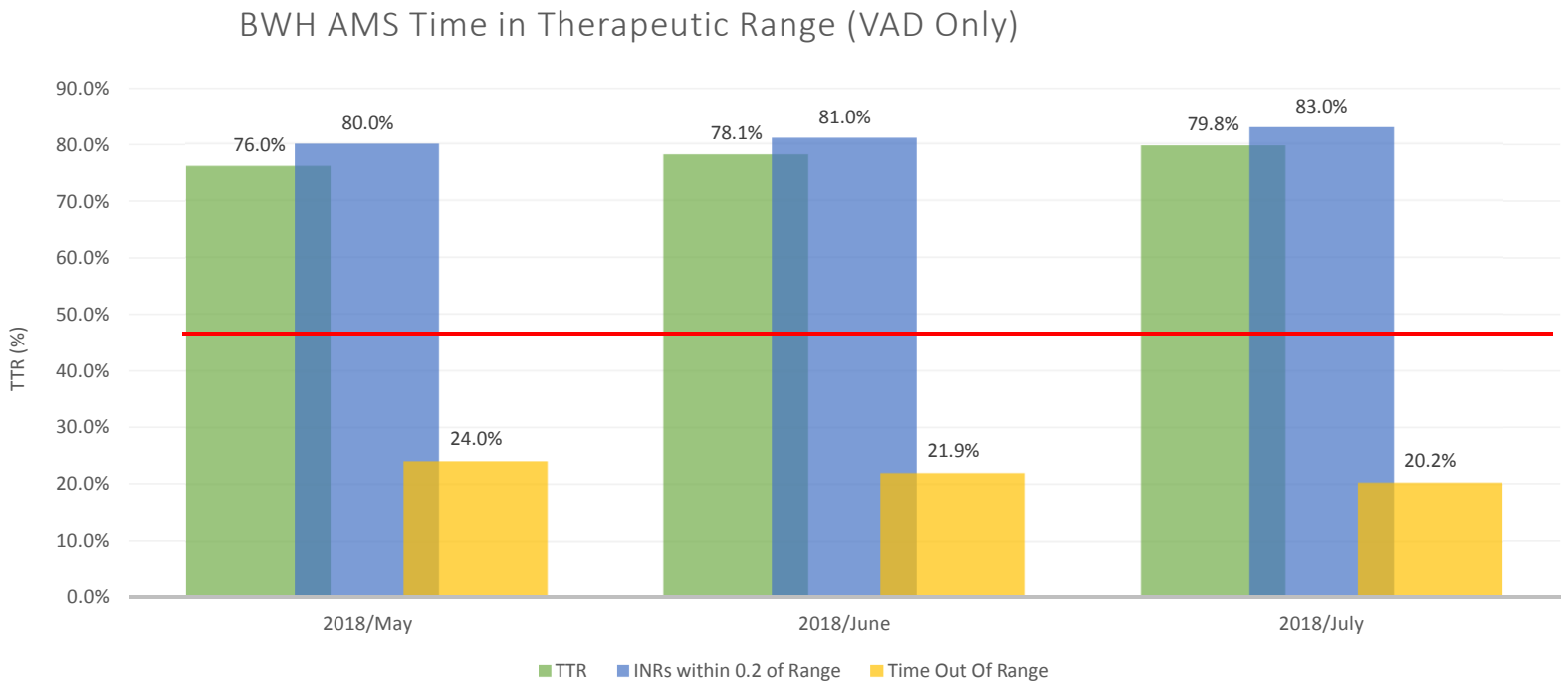
- Reported to AMS leadership monthly & P&T yearly
- Using data from DAWN input into Microsoft Excel
  - TTR – Overall Population (Maintenance)
  - TTR – AF Population (INR Range 2.0 – 3.0 & Maintenance)
  - TTR – VAD (Maintenance)
  - TTR by Clinician – Overall Population (Maintenance)

# BWH AMS TTR Benchmarking Report




| | 2018/May | 2018/June | 2018/July |
|---|---|---|---|
| All Patients TTR | 71.9% | 71.9% | 69.9% |
| All Patients TTR within 0.2 of Range | 78.0% | 79.0% | 76.0% |
| All Patients Time Out Of Range | 28.1% | 28.1% | 30.2% |
| AF (2.0 - 3.0) Patients | 75.1% | 74.5% | 73.3% |
| AF (2.0 - 3.0) Patients TTR within 0.2 of Range | 81.0% | 82.0% | 81.0% |
| AF (2.0 - 3.0) Patients Time Out Of Range | 24.9% | 25.5% | 26.7% |

# BWH AMS TTR Benchmarking Report

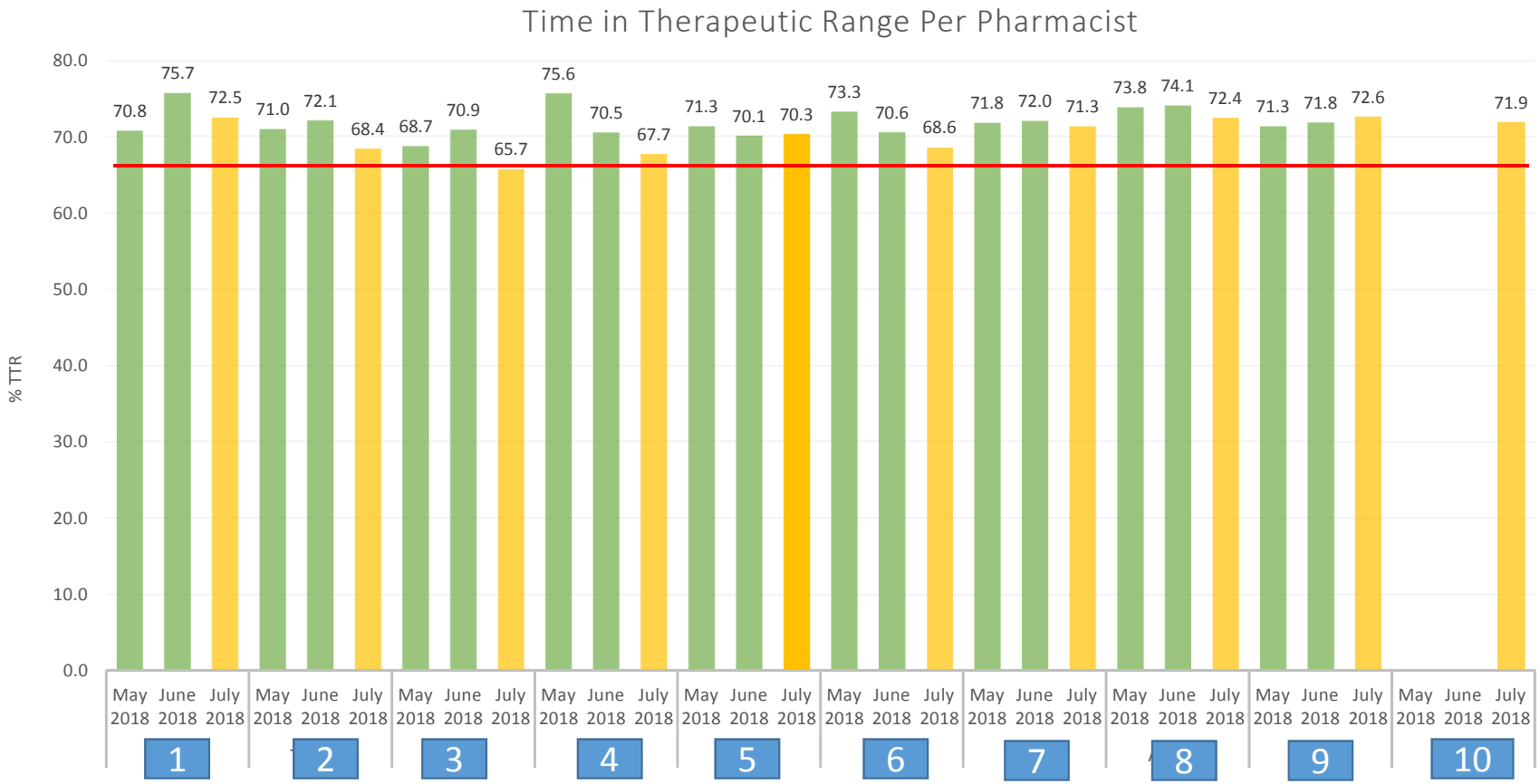


BRIGHAM HEALTH
BRIGHAM AND WOMEN'S HOSPITAL

MAGNET RECOGNIZED
AMERICAN NURSES CREDENTIALING CENTER

HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

# BWH AMS TTR Benchmarking Report



# What to do with TTR Benchmarking Data

- Look at the AMS as a whole
- Look at TTR by individual clinicians
  - Helps us to better manage our patients
  - Example: Can identify trends as clinicians go on maternity leave
    - BWH AMS has looked at splitting up a patient load versus daily assignment of patient load coverage
      - Splitting up yields higher TTRs
  - Compare month to month data
    - Comparing against yourself
  - Compare individual clinician's data to their peers
    - Identify need for more dosing training with continuous low TTRs
- Use low TTR to target patients for DOAC candidacy

# Audience Poll

- Across various clinics, how is TTR being reported?
  - Patient Populations/ Indications?
  - INR Ranges?
  - Who do you exclude in this calculation?

# Audience Poll

- With lack of DAWN AC INRs integrating into EHR, do any clinics have problems with they way upper level management may calculate TTRs?
  - Ex: Only include EHR INRs and don't consider time interval between tests when calculating TTR, causing a false low TTR to be reported

# Conclusions

- TTR Benchmark
  - Overall – 66%
  - AF – 66%, well controlled patients >70%
  - VTE - >60% after first month
  - VAD – 50%
- DAWN AC reporting
  - By Population/ Indication
  - By INR Range
  - Maintenance mode calculation
  - By individual clinicians
- Use this data to improve the quality of anticoagulation therapy patients receive

# Questions?