

Welcome to Medistim ASA's Interim report Q3 2021

The webinar will begin shortly

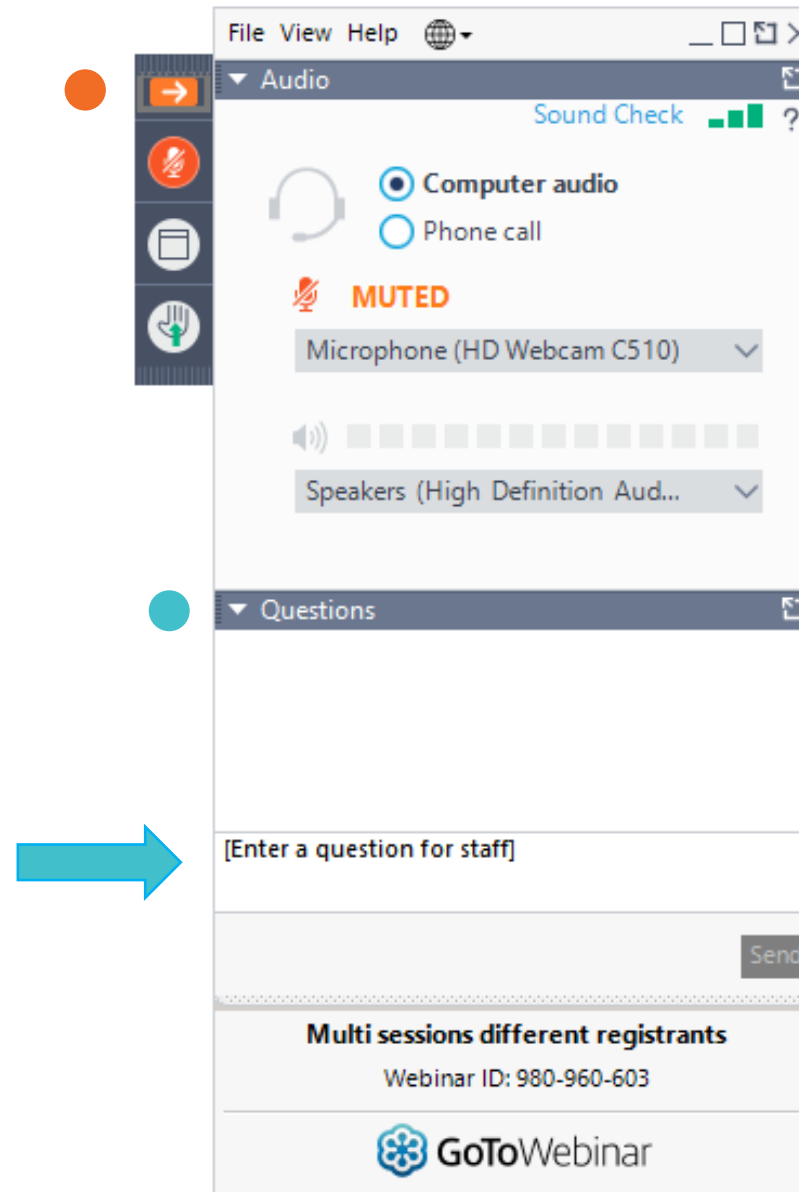


Before we start

You will be kept on mute during the presentation.

All questions will be answered at the end of the presentation

- Click on this arrow to expand or minimize your GoToMeeting panel
- Add any questions here in the **questions** panel and we will answer them at the end of the presentation



Medistim ASA Q3 2021

October 22nd 2021



Kari E. Krogstad

PRESIDENT & CEO

Thomas Jakobsen

CFO



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01 Highlights

Highlights 3rd Quarter

	Q3 2021	Q o Q
Revenue	MNOK 102.1 (83.4)	 +22.5 %
EBIT	MNOK 25.1 (20.8)	 +20.3 %
Currency		 - 8.1 %
Number of units sold or outplaced:		
Flow systems	30	 0 %
Imaging systems	17	 +70 %
Flow probes (ex USA)	1 996	 +50.9 %
Imaging probes	38	 +137.5 %
Procedures (USA)	18 822	 +28.9 %

3rd quarter in a row with sales over MNOK 100

- First time a 3rd quarter is above MNOK 100 in sales revenues
 - Imaging sales up 43.5% in NOK, Flow sales up 16.3% in NOK
 - Vascular sales up 57.0% in NOK, Cardiac sales up 17.9 %in NOK
 - Currency neutral growth was 30.6% in total and 33.0% for own products:
 - USA up 24.9%, Europe up 39.3%, Asia up 27.8%, RoW up 126%
- Third-party products grow by 19.0 %

Solid EBIT growth with margin at 24.6%

Highlights YTD September

YTD 2021		YTD o YTD	
Revenue	MNOK 314.5 (268.9)		+17.0 %
EBIT	MNOK 96.8 (73.3)		+ 32.0 %
Currency			- 7.5 %
Number of units sold or outplaced:			
Flow systems	104		- 8.0 %
Imaging systems	68		+ 51.1 %
Flow probes (ex USA)	5 727		+ 28.7 %
Imaging probes	104		+ 36.8 %
Procedures (USA)	54 211		+ 28.6 %

Best YTD September ever for revenue and EBIT

- Sales revenue YTD September is up 15% to MNOK 309.2
 - Imaging sales up 23.2%, Flow up 11.9% in NOK
 - Vascular sales up 10.1 %, Cardiac up 14.4% in NOK
 - Currency neutral growth was 24.5% in total and 25.3% for own products:
 - USA up 23.3%, Europe up 25.1%, Asia up 28.3%, RoW down 9.7%
- Total revenue YTD September is up 17% to MNOK 314.5, due to the extraordinary revenue of MNOK 5.3 from the COVID-related U.S. Paycheck Protection Program granted in Q2
- Third-party products grow by 20.8 %

EBIT YTD September of MNOK 96.8 is higher than for the full year of 2020 (MNOK 95.5)

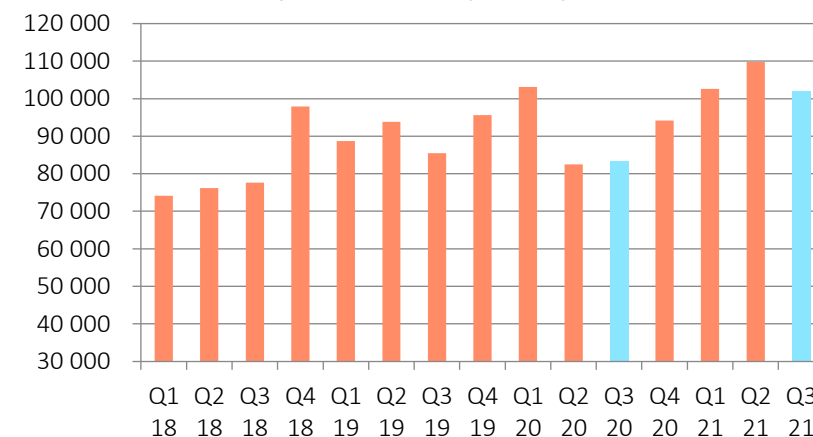


02 Financial Statements

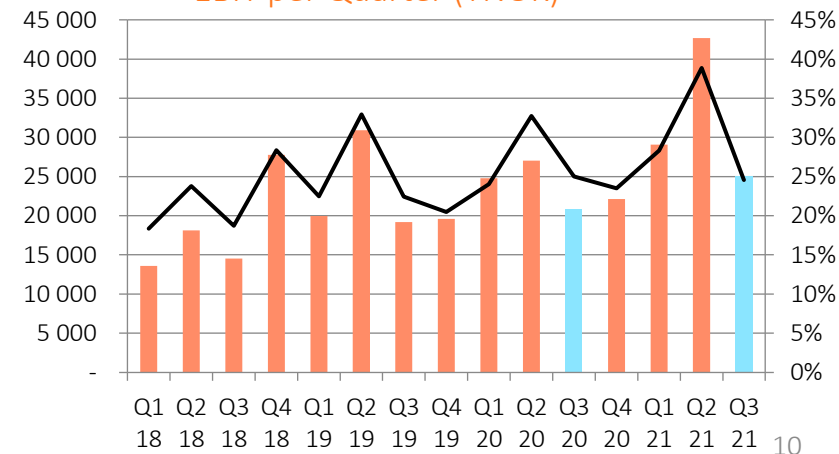
Profit and loss Q3 2021

Profit & loss	Q3 2021	Q3 2020
<i>All numbers in NOK 1000</i>		
Sales revenue	102 138	83 361
Other revenue	-	-
Total revenue	102 138	83 361
Cost of goods sold	23 793	15 379
Salary and social expenses	35 478	31 186
Other operating expenses	11 882	10 170
Total operating expenses	71 152	56 736
Op. res. before depr. and write-offs (EBITDA)	30 986	26 625
<i>EBITDA %</i>	<i>30,3 %</i>	<i>31,9 %</i>
Depreciation	5 909	5 772
Operating result (EBIT)	25 077	20 853
<i>EBIT %</i>	<i>24,6 %</i>	<i>25,0 %</i>
Financial income	3 258	4 678
Financial expenses	4 351	6 864
Net finance	-1 093	-2 185
Pre tax profit	23 984	18 668
Tax	5 186	4 225
Profit after tax	18 798	14 442
Dividend	-	-

Sales per Quarter (TNOK)



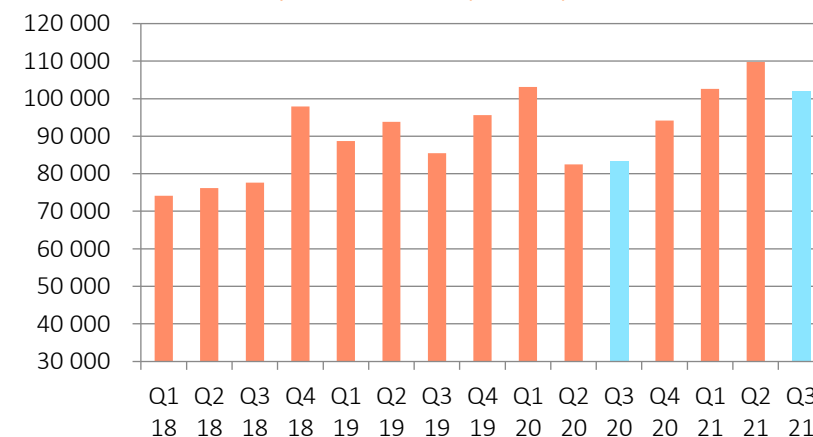
EBIT per Quarter (TNOK)



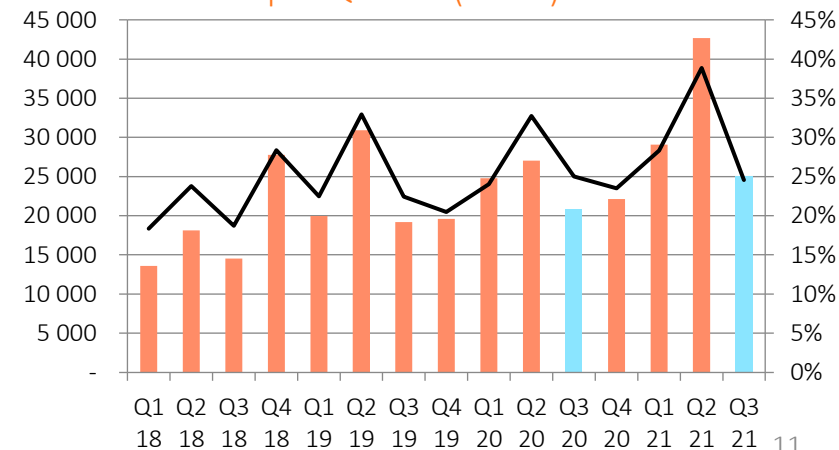
Profit and loss YTD September 2021

Profit & loss	YTD 30.09.21	YTD 30.09.20
<i>All numbers in NOK 1000</i>		
Sales revenue	309 244	268 949
Other revenue	5 292	-
Total revenue	314 536	268 949
Cost of goods sold	69 231	54 346
Salary and social expenses	93 089	86 889
Other operating expenses	38 000	37 517
Total operating expenses	200 319	178 752
Op. res. before depr. and write-offs (EBITDA)	114 217	90 197
<i>EBITDA %</i>	<i>36,3 %</i>	<i>33,5 %</i>
Depreciation	17 400	16 848
Operating result (EBIT)	96 817	73 348
<i>EBIT %</i>	<i>30,8 %</i>	<i>27,3 %</i>
Financial income	6 509	12 704
Financial expenses	8 670	14 367
Net finance	-2 161	-1 663
Pre tax profit	94 656	71 686
Tax	19 869	15 867
Profit after tax	74 788	55 818

Sales per Quarter (TNOK)



EBIT per Quarter (TNOK)



Balance sheet – Assets

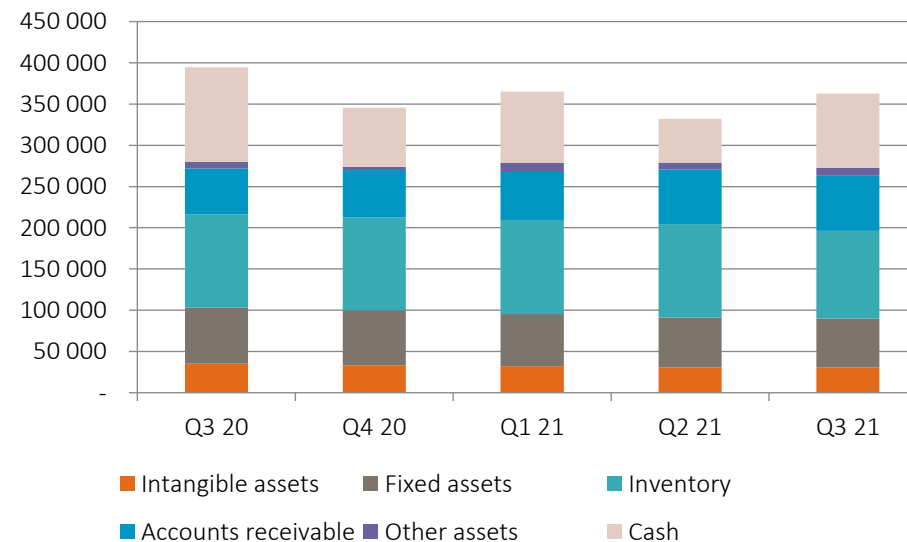
- Cash position by end of quarter was MNOK 89.6
- Securing end-of-life components and keeping security stocks of components explain the high inventory level
- A dividend of NOK 3.00 per share, total MNOK 54.6, was paid in May

Balance sheet 30.09.2021 31.12.2020

All numbers in NOK 1000

Assets

Intangible assets	30 643	33 464
Fixed assets	59 406	66 570
Total intangible and fixed assets	90 048	100 034
Inventory	106 128	112 667
Customers receivables	66 907	57 485
Other receivables	9 847	3 744
Cash	89 658	71 891
Total current assets	272 540	245 786
Total assets	362 588	345 820



Balance sheet **30.09.2021** **31.12.2020**

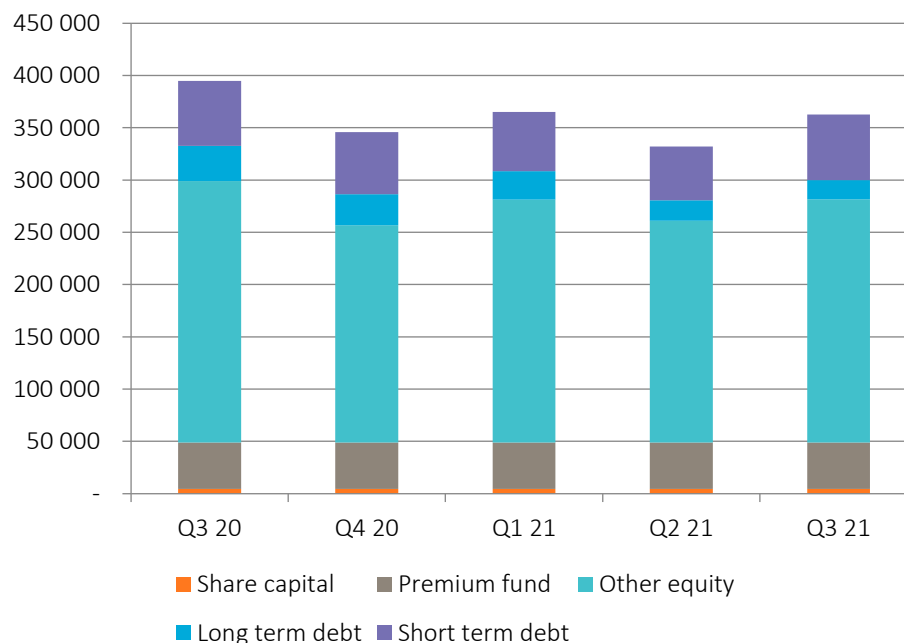
All numbers in NOK 1000

Share capital	4 585	4 585
Premium fund	44 172	44 172
Other equity	232 907	208 089
Total equity	281 664	256 846

Total long term debt	18 339	29 497
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Total short term debt	62 585	59 477
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Total equity and liability	362 588	345 820
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Balance sheet – Equity and Liability

● 2.25 MNOK in interest-bearing debt

● 23.3 MNOK in obligations related to lease contracts where 16.4 MNOK is long term

● Strong balance sheet with 77.7 % equity ratio

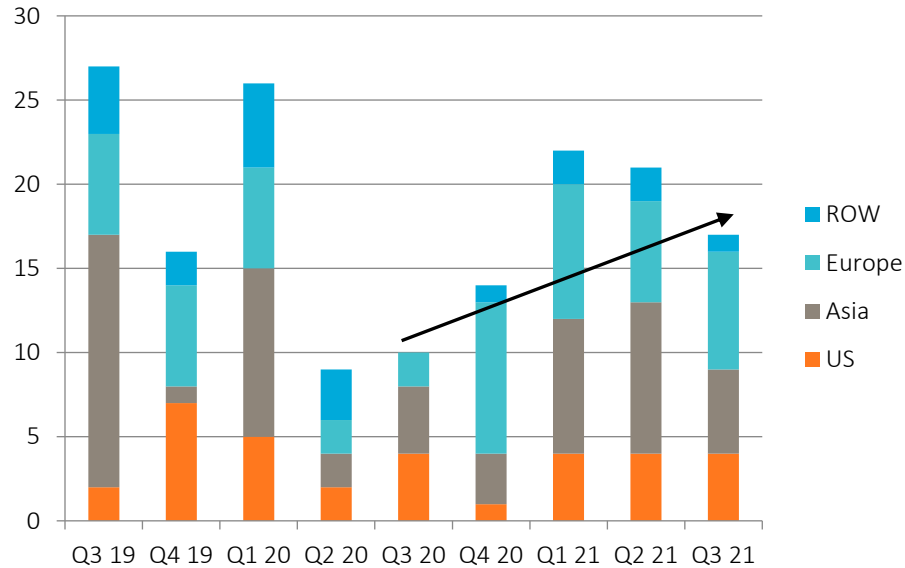


03 Business segments update

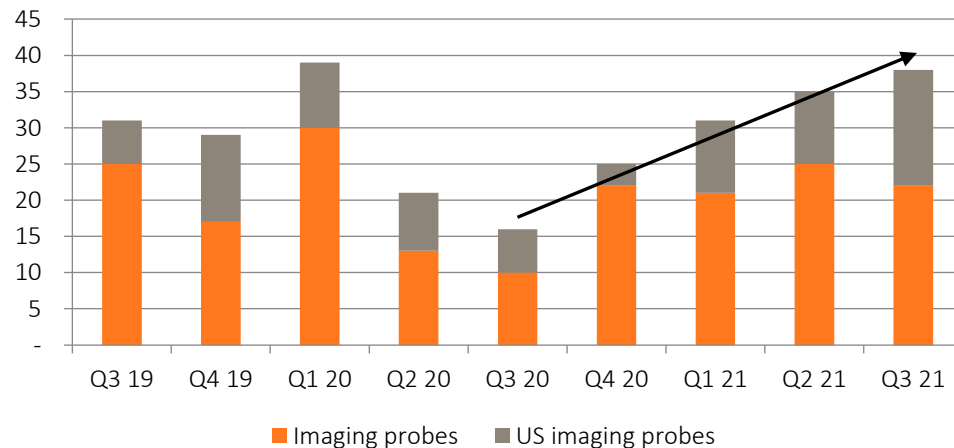
Imaging probes and systems in units

- Unit sales of imaging systems sold as capital equipment continue to be strong after the COVID slow down, **growing 70%** this quarter
- Unit sales of imaging probes are also back to normal, **growing 137.5%** this quarter

Imaging systems in units



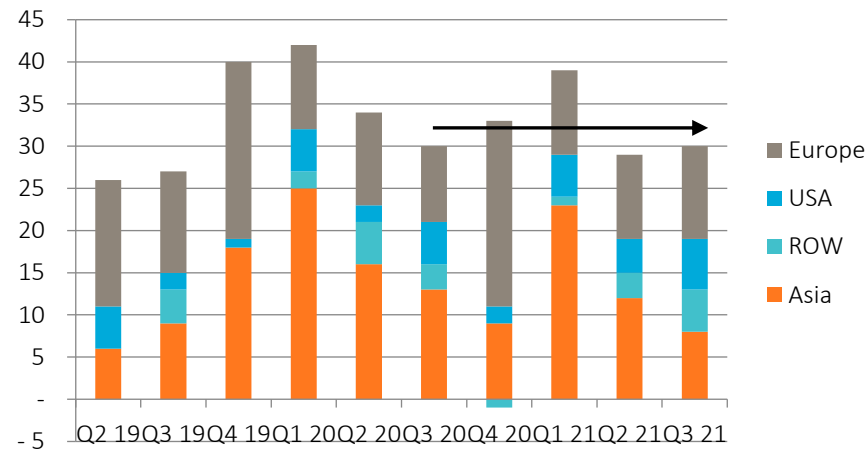
Imaging probes in units



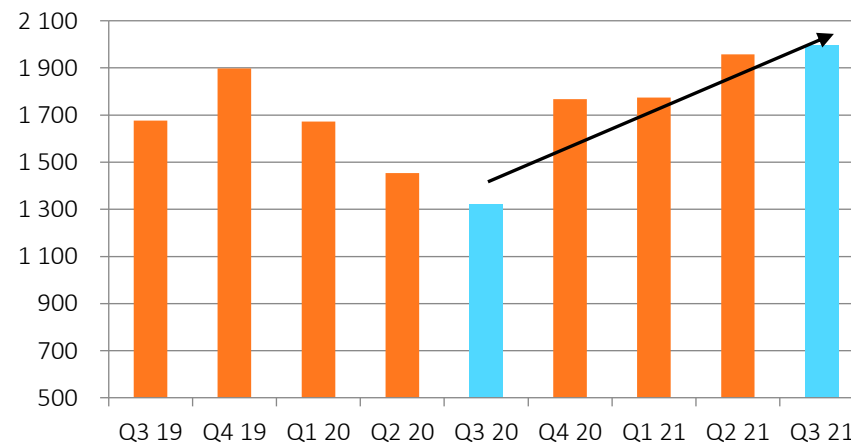
Flow probes and systems in units

- Number of flow systems sold as capital equipment is **flat** from Q3 last year.
- It is Medistim's strategy to convert the market from Flow-only to Flow-and-Imaging technology
- The **total sale of systems** (Flow and Flow-and-Imaging) sold as capital equipment shows an increase of 7 units or **17.5%**
- 50.9% growth in number of flow probes sold this quarter reflects that the surgical **activity level is getting back to normal**

Flow systems in units (MiraQ capital sales)



Flow probes in units (excl USA)



Revenue performance by region

Mill NOK	Q3 21	Q3 20	Q / Q	YTD 21	YTD 20	YTD / YTD	2020
Europe	45,8	35,9	27,4 %	140,8	117,4	19,9 %	173,3
USA	38,5	34,5	11,8 %	115,0	99,4	15,7 %	126,4
Asia	13,2	10,8	22,0 %	46,5	38,0	22,4 %	46,8
ROW (MEA, CAN, SA, AUS)	4,6	2,1	116,4 %	12,2	14,1	-13,8 %	16,7
Total	102,1	83,4	22,5 %	314,5	268,9	17,0 %	363,1

- In Europe, Q3 sales of own products increased with 33.0% in NOK and 39.3% currency neutral. YTD September, sales of own products increased with 19.4% in NOK and 25.1% currency neutral. 3. party increased with 19% in Q3 and 20.8% YTD.
- In the USA, currency neutral sales for the quarter increased with 24.9%. Total revenues YTD include the extraordinary MNOK 5.3 related to the U.S. Paycheck Protection Program. When excluding this, sales revenue YTD was NOK 109.8, a 10.4 % increase. Currency neutral this corresponds to an increase of with 23.3 %.
- In Asia, solid growth both for the quarter and YTD.
- ROW continues to be a small sales territory for Medistim, with significant quarter to quarter variation.

Negative currency effects for YTD 2021 vs 2020 was 20.0 MNOK.

Average actual exchange rate for USD 8.55 and EUR 10.23 versus last year USD 9.55 and EUR 10.72.

Revenue performance by product category

Mill NOK	Q3 21	Q3 20	Q / Q	YTD 21	YTD 20	H1 / H1	2020
Procedures (USA)	28,4	25,3	12,2 %	83,2	76,0	9,4 %	99,4
Flow probes	30,2	23,4	28,7 %	85,4	69,8	22,3 %	92,6
Flow systems (MiraQ)	12,0	9,9	21,3 %	33,5	33,8	-0,9 %	47,2
Imaging systems (MiraQ)	12,5	9,3	35,5 %	42,8	34,2	25,1 %	44,2
Imaging probes	1,6	0,8	96,0 %	5,1	3,9	29,5 %	5,2
3rd party	17,0	14,3	19,0 %	55,9	46,3	20,8 %	67,5
Other	0,5	0,4	22,6 %	8,7	4,9	77,2 %	6,9
Total revenues	102,1	83,4	22,5 %	314,5	268,9	17,0 %	363,1

- **Procedure sale in the USA:** The total number of procedures increased with 28.9% for the quarter and with 28.6 % YTD September. Lower % growth in NOK is explained by unfavorable currency.
- **Flow probes:** In units the growth is 50.9 % for the quarter and 28.7 % YTD September. The lower % growth in NOK is due to higher sales through distributors and unfavorable currency.
- **Flow systems (capital):** At the the same level in number of units but higher sales through direct operation increases revenue in NOK.
- **Imaging systems (capital):** 80% increase in capital units. The lower increase in NOK is related to high sales through distributors this quarter and currency. YTD September, the % growth in number of capital units sold is 51%. The lower increase in NOK has same explanation as for the quarter.
- **3rd party products:** Strong quarter and YTD September.
- **Other:** Includes an extraordinary revenue of MNOK 5.3 related to the U.S. Paycheck Protection Program

Conclusion: We are in recovery from the COVID-19 pandemic

From gradually decreasing impact to strong recovery in 2nd and 3rd quarter 2021



Currency neutral sales development

- Q2-20: - 19.3 % vs LY
- Q3-20: - 9.7 % vs LY
- Q4-20: - 7.2 % vs LY
- Q1-21: + 4.4 % vs LY
- Q2-21: + 36.7 % vs LY
(strongest quarter ever)
- Q3-21: + 30.6 % vs LY



Not completely back to normal

- Still some travel and hospital access restrictions
- In some countries, and some states in the U.S.A., elective surgeries may still be postponed



A positive outlook

- Increasing vaccination rates ensure capacity for cardiovascular surgery
- Medistim remains optimistic about the future



04 Implementing the strategy

Medistim growth strategy

GEOGRAPHIES

Emerging high-growth economies (e.g. BRIC)	3		
Developing Medistim markets (e.g. USA, UK, France)	2		
Strong Medistim markets (e.g. Jp, Nordic, Germany) >50% CABG share	1	4	
	CABG surgery (2 BNOK)	Vascular surgery (>1.5 BNOK)	Other open heart surgery (1BNOK)

APPLICATION AREAS

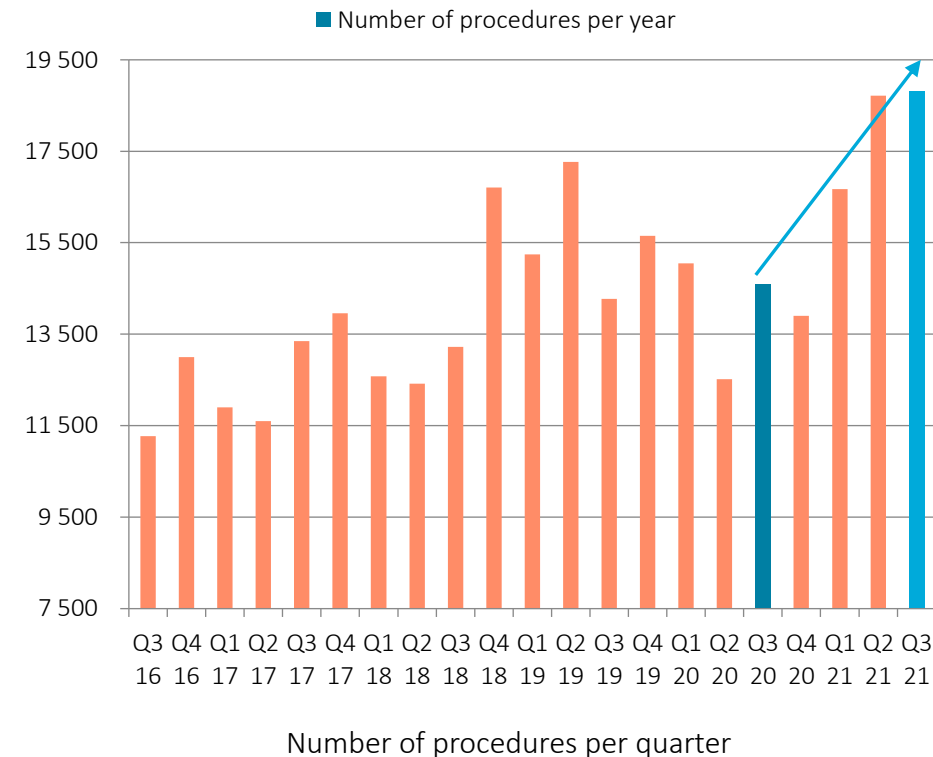
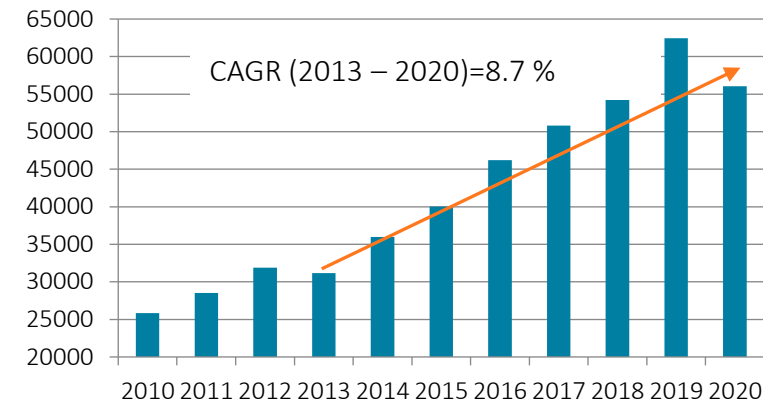
1. **Convert** the routine Flow market to a Flow-and-Imaging market by establishing *Surgical Guidance and Quality Assessment* as the new standard of care through
 - Early adopter & KOL support
 - REQUEST study
 - Ease conversion from flow to imaging with MiraQ
2. **Achieve routine use** of both Flow and Imaging by fighting ignorance, indifference and ease-of-use objections through
 - Clinical marketing, guidelines and educational programs
 - Product innovation for ease of use
 - Increased sales force capacity
3. **Offer an entry-level solution** to reach emerging, price-sensitive, high-growth markets
4. Build and **strengthen position in vascular surgery**
 - Dedicated system (MiraQ Vascular) & probes
 - Build position with societies and KOLs
5. Expand our **direct** market coverage



Sales growth in the USA

Performance US sales

- **Currency neutral sales revenue**
grow by 24.9% in Q3 and by 23.3% YTD
 - Total YTD revenue in USD includes the Paycheck Protection Program revenue of TUSD 630. YTD total revenue grows by 29.2%
- **Total number of procedures** was up 28.9% in Q3 and 28.6% YTD
 - **Flow** procedures up 19.5% in Q3
 - **Imaging** procedures up 87.8% in Q3
- **Capital systems sales:**
 - 10 units in Q3 vs 9 LY
 - 27 units YTD September vs 23 LY
- **Strong growth in new customers**
 - 33 YTD September vs 18 last year





New publications

Hot off the press: Review-article in CIRCULATION, Oct 5th 2021

- Authored by 19 cardiac surgeon experts (4 from REQUEST study) from all over the world
- Published in Circulation, one of the highest ranked journals in cardiology and cardiovascular medicine

	Title	Type	↓ SJR	H Index	Total Docs. (2020)	Total Docs. (3years)	Total Refs. (2020)	Total Cites (3years)	Citable Docs. (3years)	Cites / Doc. (2years)	Ref. / Doc. (2020)	
1	Journal of the American College of Cardiology	journal	10.315 Q1	431	935	2960	22363	23475	1191	7.44	23.92	🇺🇸
2	Circulation	journal	7.795 Q1	607	778	2685	22242	26532	1702	9.48	28.59	🇺🇸
3	JACC: Heart Failure	journal	6.123 Q1	67	184	596	2888	2708	262	4.38	15.70	🇳🇱
4	JAMA Cardiology	journal	6.108 Q1	63	349	944	4752	4608	486	4.92	13.62	🇺🇸
5	JACC: Cardiovascular Imaging	journal	5.790 Q1	120	481	1051	9756	4889	422	4.57	20.28	🇺🇸
6	Nature Reviews Cardiology	journal	5.495 Q1	130	175	550	8971	3856	268	7.24	51.26	🇬🇧
7	European Journal of Heart Failure	journal	5.149 Q1	133	397	855	12087	5341	445	6.01	30.45	🇺🇸
8	Circulation Research	journal	4.899 Q1	336	352	1256	19861	10880	933	7.71	56.42	🇺🇸
9	European Heart Journal	journal	4.336 Q1	293	1008	2579	16028	14482	1859	5.52	15.90	🇬🇧
10	Journal of Heart and Lung Transplantation	journal	3.549 Q1	135	1537	645	4734	3313	371	4.74	3.08	🇺🇸
11	Stroke	journal	3.397 Q1	319	775	2080	15700	11233	1632	4.99	20.26	🇺🇸

review-article

Circulation

IN DEPTH

The Use of Intraoperative Transit Time Flow Measurement for Coronary Artery Bypass Surgery Systematic Review of the Evidence and Expert Opinion Statements

Mario Gaudino¹, MD, MSCE; Sigrid Sandner², MD; Gabriele Di Giammarco, MD; Antonino Di Franco, MD; Hirokuni Arai, MD; Tohru Asa³, MD; Faisal Bakaeen, MD; Torsten Doentz, MD; Stephen E. Fremes⁴, MD; David Glineur, MD; Teresa M. Kieser⁵, MD, PhD; Jennifer S. Lawton, MD; Roberto Lorusso, MD; Nirav Patel, MD; John D. Puskas, MD; James Tatlouis, MD; David P. Taggart, MD; Michael Vallety, MD; Marc Rue⁶, MD

ABSTRACT: Transit time flow measurement (TTFM) allows quality control in coronary artery bypass grafting but remains largely underused, probably because of limited information and the lack of standardization. We performed a systematic review of the evidence on TTFM and other methods for quality control in coronary artery bypass grafting following PRISMA standards and elaborated expert recommendations by using a structured process. A panel of 19 experts took part in the consensus process using a 3-step modified Delphi method that consisted of 2 rounds of electronic voting and a final face-to-face virtual meeting. Eighty percent agreement was required for acceptance of the statements. A 2-level scale (strong, moderate) was used to grade the statements based on the perceived likelihood of a clinical benefit.

The existing evidence supports an association between TTFM readings and graft patency and postoperative clinical outcomes, although there is high methodological heterogeneity among the published series. The evidence is more robust for arterial, rather than venous, grafts and for grafts to the left anterior descending artery. Although TTFM use increases the duration and the cost of surgery, there are no data to quantify this effect. Based on the systematic review, 10 expert statements for TTFM use in clinical practice were formulated. Six were approved at the first round of voting, 3 at the second round, and 1 at the virtual meeting.

In conclusion, although TTFM use may increase the costs and duration of the procedure and requires a learning curve, its cost/benefit ratio seems largely favorable, in view of the potential clinical consequences of graft dysfunction. These consensus statements will help to standardize the use of TTFM in clinical practice and provide guidance in clinical decision-making.

Key Words: coronary artery bypass ■ quality control ■ time

Intraoperative quality control is standard practice in every aspect of contemporary cardiac surgery but remains underused in coronary artery bypass grafting (CABG). Transit time flow measurement (TTFM) allows quality control in CABG by intraoperative evaluation of coronary graft function, but it is currently adopted in only 30% of the procedures.¹

Current myocardial revascularization guidelines provide only generic recommendations on TTFM use,^{2,3} and

the reluctance to its widespread adoption by the surgical community is likely based on limited information, and concerns pertaining to the lack of standardization and familiarity with TTFM interpretation, as well.

In this article, a group of coronary surgeons with extensive experience with TTFM performed a systematic review of the existing evidence and critically evaluated the available data. Because of the high statistical and methodological heterogeneity of the published stud-

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The opinions expressed in this article are not necessarily those of the editors or of the American Heart Association.
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The Data Supplement is available with this article at <https://www.ahajournals.org/doi/suppl/10.1161/CIRCULATIONAHA.121.054311>
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Circulation is available at www.ahajournals.org/journal/circ

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“The Use of Intraoperative TTFM for CABG”

Circulation, October 2021

Method

- Systematic review of 229 publications
 - 2,200 articles identified
 - 1,550 screened
 - 38 cited in the review
- 10 expert statements for TTFM use were formulated
 - 2 x electronic voting, 1 F2F
 - 80% agreement was required for acceptance of the statements
 - 2-level scale for clinical benefit (strong, moderate)

Conclusion

- “...TTFM’s cost/benefit ratio seems largely favorable, in view of the potential clinical consequences of graft dysfunction.”
- “These consensus statements will help to **standardize** the use of TTFM in clinical practice and provide **guidance** in clinical decision-making”

10 CONSENSUS STATEMENTS:

#1 reads:

“TTFM should be used in every CABG case”

review-article

Circulation

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Systematic Review of the Evidence and Expert Opinion Statements

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Several expert consensus statements published in 2021

● The **advocacy** is getting loader and more prominent

● Influencing peers; driving routine use and setting the standard-of-care

● Reasonable to expect new and stronger clinical guideline endorsements

Editorial

Intraoperative Graft Patency Assessment: Time to Recognize the Elephant Outside the Operating Room?

Innovations
000 1-4
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Editorial

Introduction

Coronary artery bypass grafting (CABG) commonly performed procedure for the revascularization of the coronary arteries. The metrics for success of CABG on decreasing mortality, improving quality of life, and symptom severity. All of these outcomes are technical success of the operation itself, but the ultimate goal is the achievement of an adequately patent bypass grafts.

While there have been many advances developed in recent years to improve clinical outcomes, less attention has been given to the technical success of the procedure in several tools are available, including transit time flow measurement (TTFM; Fig. 1), high-frequency (HFUS; Fig. 2, Fig. 3), thermal coronary anastomosis, and fluorescence imaging. In structural echocardiography to immediately evaluate valve replacement/repair is widely accepted. However, although CABG is technically demanding with regards to precision, and where distal anastomosis is <1 mm, there is no standard operative quality assessment of grafts or the use of which have well-defined roles in patient outcomes that level of technical complexity.

Perioperative graft failure may occur in 9% of patients undergoing CABG surgery, though underutilized, tool to address this problem is rarely discussed “elephant outside the box” (Supplemental Video). The first published CABG date back to 1994 in 2 separate publications as well as Carver and Dumez.¹ Since that time, CABG has been well validated as a means of revascularization, and from 2010 through its most recent European Society of Cardiology and European Association of Cardio-Thoracic Surgery guidelines.

In spite of the above, in the United States, over 400,000 CABG procedures are performed annually, and the use of CABG is increasing. CABG receive more than one artery bypass graft (ABG) in the United States, and the use of CABG is increasing. CABG receive more than one artery bypass graft (ABG) in the United States, and the use of CABG is increasing.

Several modalities for intraoperative quality assessment of CABGs exist, among them coronary angiography and intraoperative fluorescence imaging. However, these are limited mainly by cost and/or practical applicability. Intraoperative transit time flow measurement (TTFM) is the technology most frequently adopted, yet it is used in only 20% of CABG procedures in the United States.²

The most frequently cited limitations to widespread adoption are:

- (i) a lack of standardization of how TTFM should be performed;
- (ii) a lack of standardization of how TTFM measurements should be interpreted, based on the concern that some grafts may be revised unnecessarily;
- (iii) the expectation that TTFM should be able to predict not only the immediate intraoperative status of the graft but also long-term patency and clinical outcomes, for which there is little robust evidence;
- (iv) intraoperative quality control is not addressed in current clinical practice guidelines of any of the North American cardiovascular societies; and
- (v) differences in opinion among CABG leaders exist as to when TTFM should be used.

The 10 Commandments for Multiarterial Grafting

Rami Akhrass¹, MD and Faisal G. Bakaeen¹, MD

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EDITORIAL

Introduction

Coronary artery bypass grafting (CABG), introduced over 50 years ago at the Cleveland Clinic, has remained the gold standard in multivessel coronary artery disease with heavy burden.¹ While utilizing the internal thoracic bypass the left anterior descending artery (LAD) cornerstone of CABG since 1986,² there has been a shift in the importance of multiarterial grafting the use of at least 2 arterial grafts, resulting in improved survival and freedom from major adverse cardiac events.^{3,4} Indeed, the most recent CABG guidelines set forth by the Society of Thoracic Surgeons supplement the use of the ITA graft to the LAD, multivessel disease, with the use of additional I artery (RA) grafts.⁵ The incremental benefit of graft has been somewhat equivocal, although observational studies suggested better long-term survival with 3, compared to 2, arterial grafts.⁶

The outcome advantage attained with CABG percutaneous coronary intervention is most pronounced in patients that receive at least one ITA conduits, in particular the ITA, are rarely affected by atherosclerosis making them ideal conduits to use with long-term survival.⁷ The ITA has unique biological characteristics that may also explain its effect on native coronary circulation that has been well documented.

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Journal of
CARDIAC SURGERY WILEY

Transit time flow measurement in coronary artery bypass grafting: For every patient and every surgeon

Quality assurance in cardiac surgery has evolved over the past decade to include intraoperative performance measures, predicated on the fact that intraoperative evaluation of quality leads to improved patient outcomes. Routine intraoperative quality control measures have been implemented in most aspects of cardiac surgery, including treatment of structural valve disease, and congenital and pediatric cardiac surgery. However, this is not the case in coronary surgery.

In the United States, 18.2 million adults age 20 and older have coronary artery disease.¹ With close to 200,000 coronary artery bypass graft (CABG) surgeries performed in the U.S. per year,² this is the most frequently performed cardiac surgical procedure. The STS Adult Cardiac Surgery performance measure assesses surgical performance based on a combination of CABG process and outcomes measures, including risk-adjusted operative mortality and morbidity, use of an internal mammary artery, and secondary prevention measures at discharge.³ And yet, the ultimately relevant outcomes for the patient—survival and symptom relief—are based on a single primary underlying premise—that the patient leaves the operating room with functioning grafts. So why is there no routine intraoperative graft quality control measure in place in coronary surgery?

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review-article

Circulation

IN DEPTH

The Use of Intraoperative Transit Time Flow Measurement for Coronary Artery Bypass Surgery: Systematic Review of the Evidence and Expert Opinion Statements

Mario Gaudino¹, MD, MSCE; Sigrid Sandner², MD; Gabriele Di Giammarco, MD; Antonino Di Franco, MD; Hirokuni Arai, MD; Tohru Asai³, MD; Faisal Bakaeen, MD; Torsten Doenst, MD; Stephen E. Fries⁴, MD; David Glineur, MD; Teresa M. Kieser⁵, MD, PhD; Jennifer S. Lawton, MD; Roberto Lorusso, MD; Nirav Patel, MD; John D. Puskas, MD; James Tatlouis, MD; David P. Taggart, MD; Michael Vallely, MD; Marc Ruef⁶, MD

ABSTRACT: Transit time flow measurement (TTFM) allows quality control in coronary artery bypass grafting but remains largely underused, probably because of limited information and the lack of standardization. We performed a systematic review of the evidence on TTFM and other methods for quality control in coronary artery bypass grafting following PRISMA standards and elaborated expert recommendations by using a structured process. A panel of 19 experts took part in the consensus process using a 3-step modified Delphi method that consisted of 2 rounds of electronic voting and a final face-to-face virtual meeting. Eighty percent agreement was required for acceptance of the statements. A 2-level scale (strong, moderate) was used to grade the statements based on the perceived likelihood of a clinical benefit.

The existing evidence supports an association between TTFM readings and graft patency and postoperative clinical outcomes, although there is high methodological heterogeneity among the published series. The evidence is more robust for arterial, rather than venous, grafts and for grafts to the left anterior descending artery. Although TTFM use increases the duration and the cost of surgery, there are no data to quantify this effect. Based on the systematic review, 10 expert statements for TTFM use in clinical practice were formulated. Six were approved at the first round of voting, 3 at the second round, and 1 at the virtual meeting.

In conclusion, although TTFM use may increase the costs and duration of the procedure and requires a learning curve, its cost/benefit ratio seems largely favorable, in view of the potential clinical consequences of graft dysfunction. These consensus statements will help to standardize the use of TTFM in clinical practice and provide guidance in clinical decision-making.

Key Words: coronary artery bypass ■ quality control ■ time

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Intraoperative quality control is standard practice in every aspect of contemporary cardiac surgery but remains underused in coronary artery bypass grafting (CABG). Transit time flow measurement (TTFM) allows quality control in CABG by intraoperative evaluation of coronary graft function, but it is currently adopted in only 30% of the procedures.¹

the reluctance to its widespread adoption by the surgical community is likely based on limited information, and concerns pertaining to the lack of standardization and familiarity with TTFM interpretation, as well.

In this article, a group of coronary surgeons with extensive experience with TTFM performed a systematic review of the existing evidence and critically evaluated



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3	INTERTRADE SHIPPING AS	1 285 000	7,01 %	Norway	Ordinary
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5	State Street Bank and Trust Comp	1 103 921	6,02 %	United States	Nominee
6	Skandinaviska Enskilda Banken AB	1 029 728	5,62 %	Sweden	Nominee
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