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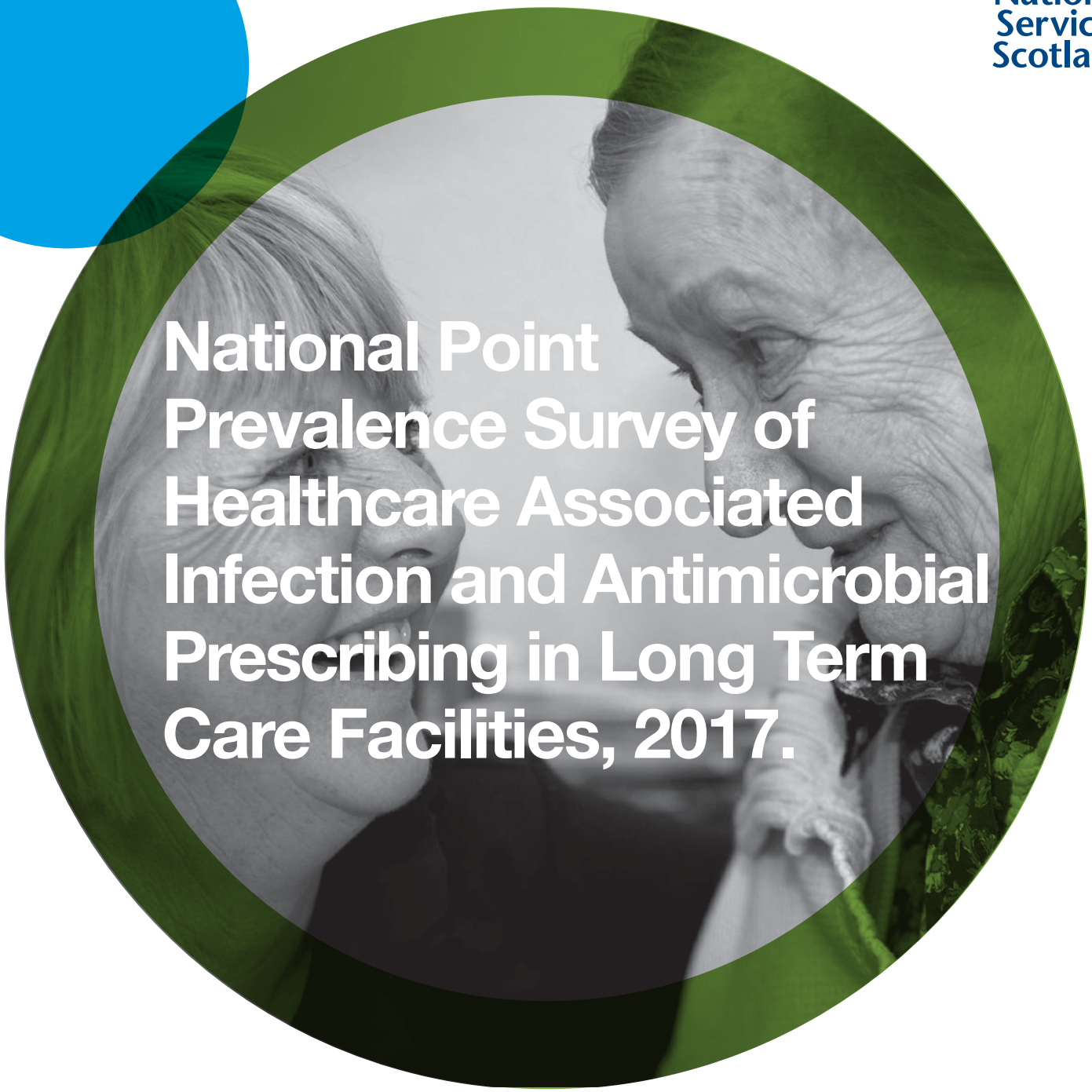

National Point Prevalence Survey of Healthcare Associated Infection and Antimicrobial Prescribing in Long Term Care Facilities, 2017.

Health Protection Scotland

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National point prevalence survey of healthcare associate infection and antimicrobial prescribing in long term care facilities, 2017

Approximately **1 in 17** eligible residents had at least one HCAI at the time of survey

Approximately **1 in 15** eligible residents were receiving at least one antimicrobial at the time of survey

IPC quality improvement priorities

- Multimodal national programme for prevention of pneumonia and LRTI across all healthcare settings
- Multimodal national programme for prevention of UTI across all healthcare settings
- Promote use of CAUTI prevention bundles and the National Catheter Passport
- Promote the national hydration campaign
- Promote hydration, nutrition and mobilisation as broad public health interventions to reduce multiple harms including HCAI
- Promote use of the NIPCM
- Promote resident (flu and PPV) and staff (flu) vaccination
- Improve availability and use of ABHR
- Promote use of extant NES educational resources for IPC and prevention of SSTI and UTI
- Develop education resources and guidance for management of residents with MDRO
- LTCF to ensure IPC governance and accountability are in line with current standards

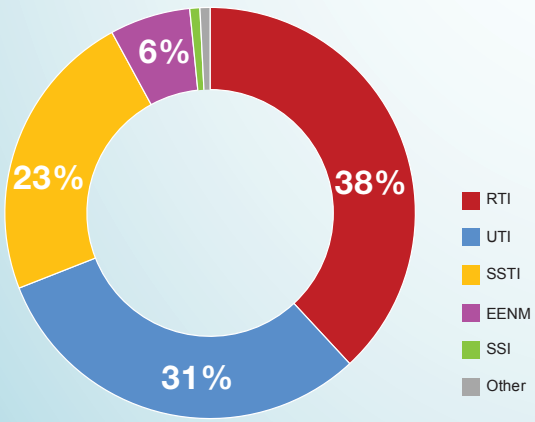
Healthcare associated infections place a significant burden on LTCF in Scotland.

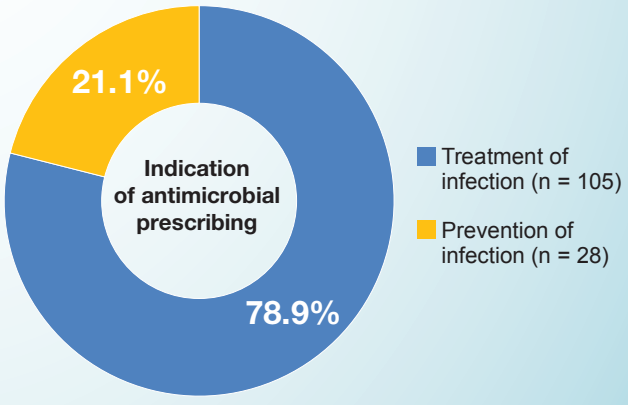
A broader and coordinated public health approach to preventing HCAI alongside strengthened IPC and antimicrobial stewardship programmes in this setting is required.

Antimicrobial stewardship priorities

- Continue work to improve prescribing by promotion of existing decision aid and guidelines
- Promote the use of the NES ScRAP Programme educational resource to reduce unnecessary prescribing in primary care
- Promote review of residents on UTI prophylaxis
- Promote sending samples to microbiology when infection is suspected
- Stop use of dipstick urine testing in diagnosis of UTI in LTCF

Infection types





Note: ABHR = Alcohol Based Hand Rub; CAUTI = catheter associated UTI; EENM = Eye, ear, nose and mouth infections; HCAI = healthcare associated infections; IPC = Infection, prevention and control; LRTI = lower respiratory tract infections; LTCF = Long term care facility; MDRO = Multidrug Resistant Organisms; NES = NHS Education for Scotland; NIPCM National Infection Prevention and Control Manual; RTI = respiratory tract infections; ScRAP = Scottish Reduction in Antimicrobial Prescribing; SSI = surgical site infections; SSTI = skin and soft tissue infections; UTI = urinary tract infections.

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List of abbreviations and acronyms

ABHR	Alcohol Based Hand Rub
AM	Antimicrobial
AMR	Antimicrobial Resistance
BSI	Bloodstream Infection
CAPA	Care About Physical Activity
CAUTI	Catheter Associated Urinary Tract Infection
CHI	Community Health Index
CI	Confidence Intervals
CPE	Carbapenemase-producing Enterobacteriaceae
ECDC	European Centre for Disease Prevention and Control
EENM	Eye, Ear, Nose and Mouth
GI	Gastrointestinal
GP	General Practitioner
HALT	Healthcare Associated Infections and Antimicrobial Prescribing in Long Term Care Facilities
HALT-1	Point prevalence survey of healthcare associated infections and antimicrobial use in European long term care facilities, 2010
HALT-2	Point prevalence survey of healthcare associated infections and antimicrobial use in European long term care facilities, 2013
HALT-3	Point prevalence survey of healthcare associated infections and antimicrobial use in European long term care facilities, 2016/2017
HCAI	Healthcare Associated Infection
HIS	Healthcare Improvement Scotland
HPS	Health Protection Scotland
HPT	Health Protection Team
IPC	Infection Prevention and Control
IPCT	Infection Prevention and Control Team
IQR	Inter-Quartile Range
IRR	Inter-Rater Reliability
ISD	Information Services Division
LTCF	Long Term Care Facility
LRTI	Lower Respiratory Tract Infection
MDRO	Multidrug Resistant Organisms
MRSA	Meticillin Resistant *Staphylococcus aureus*
NES	NHS Education for Scotland
NHS	National Health Service
NICE	National Institute for Health and Care Excellence

NIPCM	National Infection Prevention and Control Manual
NMC	Nursing and Midwifery Council
OR	Odds Ratio
PBPP	Public Benefit and Privacy Panel for Health and Social Care
PHE	Public Health England
PIA	Privacy Impact Assessment
PPS	Point Prevalence Survey
PPV	Pneumococcal Polysaccharide Vaccine
PVC	Peripheral Vascular Catheter
RTI	Respiratory Tract Infections
SAPG	Scottish Antimicrobial Prescribing Group
SARHAI	Scottish AMR and Healthcare Associated Infection Strategy Group
ScRAP	Scottish Reduction in Antimicrobial Prescribing
SICPs	Standard Infection Control Precautions
SSI	Surgical Site Infection
SSSC	Scottish Social Services Council
SSTI	Skin and Soft Tissue Infections
SUTIN	Scottish UTI Network
TBPs	Transmission Based Precautions
UTI	Urinary Tract Infections
WTE	Whole Time Equivalent

Introduction

Scotland has an increasingly older and frailer population with ever more complex health and social care needs.[1;2] In 2011, the Scottish Government set out the strategic vision for health and social care changes as the contemporaneous model was no longer adequate or sustainable. The Scottish Government's 2020 Vision is a person-centred, integrated approach to health and social care which aims to enable people to live longer, healthier lives in their homes or homely setting.[1;3;4]

Long term care facilities (LTCF) play an integral role in the 2020 Vision. LTCF are responsible for the care and wellbeing of a vulnerable population and must endeavour to (1) prevent individuals in their care from experiencing ill health and needing healthcare in the first place, (2) anticipate any health needs as early as possible so that conditions can be managed quickly and effectively and any interventions required are minimised and, (3) promote self-management where individuals are in control as much as possible of, and informed about, their healthcare choices and hospitalisations are avoided whenever possible.[4]

Care services in Scotland are regulated and inspected by the Care Inspectorate. In recent years, the Care Inspectorate has shifted focus with regards to quality of care from compliance and scrutiny to an overall, supportive approach offering advice, guidance and suggestions to help services reach the highest standards of care and resident safety. All care services in Scotland currently follow the new Health and Social Care Standards (2017)[5] which replaced the National Care Standards (2002)[6], and from April 2018, the new Standards will be taken into account by the Care Inspectorate in relation to inspections. The standards highlight the right for all individuals receiving care to be treated with dignity and respect, compassion, to feel included, to receive responsive care and support, and to be supported in their wellbeing.

The voluntary annual Scottish Care Home Census reports that the main client group of nearly three quarters of adult care homes in Scotland is 'older persons over 65 years'.[7;8] Other LTCF care for adults with learning difficulties (approximately 16%), mental health problems (approximately 5%), physical disabilities (approximately 3%), and the remaining LTCF provide services for other, unspecified clients (1.5%). Approximately 60% of Scottish care homes are privately owned, a quarter are voluntary or not for profit, and the rest are owned by local authorities.[7]

Background

Infections that occur in LTCF are considered healthcare associated. LTCF are an important source of healthcare associated infections (HCAI) which contribute to the morbidity and mortality of an older population.[9-12] HCAI can also lead to increased hospital admissions and readmissions.[13] A robust evidence base regarding the epidemiology of HCAI in LTCF is necessary to inform the development of targeted interventions for infection prevention and control (IPC) and antimicrobial stewardship. Point prevalence surveys (PPS) are useful for measuring HCAI outcome and antimicrobial prescribing and provide a snapshot of the proportion of the population with a HCAI or receiving antimicrobials at the time of the survey.[14] In July 2010, volunteer LTCF in Scotland participated in a PPS as part of the European Centre for Disease Prevention and Control's (ECDC) first European "Point prevalence survey of healthcare associated infections and antimicrobial use in European long term care facilities" (HALT-1) study.[15;16] Within the surveyed care homes in Scotland, it was reported that 2.6% (95% confidence interval (95% CI): 2.2 to 3.1) of residents had at least one HCAI at the time of survey, and the prevalence of antimicrobial prescribing was 7.3% (95% CI: 6.6 to 8.1).

The crude prevalence from across all participating European countries for HCAI was 2.4% and antimicrobial prescribing was 4.3% (HALT-1).[16] A second European survey, in which Scotland did not participate, was undertaken in 2013 (HALT-2). The prevalence of HCAI was 3.4% and antimicrobial prescribing was 4.4%.[17] In conjunction with an understanding of the epidemiology of HCAI occurring in hospitals, measuring HCAI in LTCF provides an opportunity to describe the types of infection occurring across the healthcare system.

A second Scottish PPS of HCAI and antimicrobial prescribing in LTCF, coordinated by Health Protection Scotland (HPS), was undertaken in October 2017. The results from this survey provide a robust and current evidence base that is specific to Scottish LTCF settings and will inform the development of local and national strategies to reduce HCAI and contain antimicrobial resistance (AMR).[18] The results also provide an opportunity to describe IPC and antimicrobial stewardship structures and processes in LTCF. Furthermore, the survey will contribute to ECDC's third Europe-wide HALT study (HALT-3).

Aims and objectives

The objectives of the 2017 LTCF PPS were to:

- measure the prevalence of HCAI and to describe the types of HCAI occurring in LTCF
- measure the prevalence of antimicrobial use and describe the types of antimicrobials prescribed
- describe the organisation of IPC and antimicrobial stewardship programmes
- identify priority areas for interventions to prevent and control HCAI and improve antimicrobial prescribing
- identify priority areas for training and/or additional IPC and antimicrobial stewardship resources
- contribute to the ECDC Europe-wide HALT-3 study.

Methods

Study design

A rolling PPS was carried out in volunteer Scottish LTCF (n=52) during October 2017. All LTCF registered with the Care Inspectorate as providing elderly care were invited to participate.

Data were collected by LTCF staff members who were either registered with the Nursing and Midwifery Council (NMC) or the Scottish Social Services Council (SSSC) (i.e. had a nursing or social care background). Information on residents was extracted from sources available at the time of survey which typically included residents' care plans, notes and drug charts. Data collectors were advised to seek clarification from other staff members if the information held in the records was not clear or sufficient. The Scottish User Guide[19] was developed using the ECDC HALT-3 protocol[20] and full details of the study design and data collection methods are provided in the Scottish User Guide.[19]

A Privacy Impact Assessment (PIA) was undertaken in May 2017 to identify potential impacts and implications relating to the privacy of project stakeholders and to explore ways to minimise or avoid these. This assessment was approved by the HPS Caldicott Guardian. An application was submitted to the Public Benefit and Privacy Panel for Health and Social Care (PBPP) (Application Number: 1718-0040) requesting permission to collect and analyse identifiable information from consenting residents taking part in the survey. This application was approved in August 2017.

Training and support

A one day training course was developed using the standardised training materials provided by ECDC and was delivered to LTCF staff at various locations across Scotland. The team at HPS provided training for LTCF staff to enable them to collect information using survey questionnaires and following standard definitions, including epidemiological case definitions for HCAI.

In order to participate, each LTCF was required to send at least one person to a training session. At least one data collector (n=73) representing 61 LTCF attended a training session. Nine of the LTCF that sent a member of staff for training were unable to participate in the survey and did not collect data.

A helpdesk facility was provided by HPS to support local data collection teams. This was operational during normal working hours in the months of August, September and October 2017. This was to respond to any queries following training sessions on the lead up to the data collection period, and also to provide support during the data collection period. Queries to the helpdesk were used to develop a weekly Frequently Asked Questions document which was provided to data collectors.

Inclusion and exclusion criteria

Residents were eligible for inclusion in the survey if they were living full-time (24 hours a day) in the LTCF AND were present in the LTCF at 8:00 AM on the day of the survey AND were not discharged from the LTCF at the time of the survey AND had given consent for their information to be recorded in the survey.

Respite residents and residents temporarily outside the LTCF (e.g. at an outpatients appointment or with family) were included if they met the other criteria. Residents who had been discharged from the LTCF and admitted to hospital at the time of survey were excluded. It was the responsibility of LTCF data collectors to gain consent for the collection and sharing of data from their residents. Inclusion in the survey was 'opt-in' as per the survey's information governance and PBPP approval. For residents with incapacity, family members or the appointed power of attorney was contacted. HPS provided two information leaflets: one for residents and their families, and the other for LTCF staff members. Information posters were also provided.

Note: In this survey, the term 'residents' is used to refer to the individuals living in LTCF. Other terms are often used in Scotland including 'service users', 'people experiencing care' and 'people who experience services', however the term 'residents' will be used in this report in order to align with the ECDC protocol and training materials.

Data definitions

Demographic and risk factor data

Data on resident demographics, risk factors for HCAI and indicators of relative need[21] were collected for each eligible resident. Indicators of relative need have been described by Information Services Division (ISD) Scotland as a measure of an individual's functional needs and/or their degree of dependence with specific reference to older people in the community. Demographic, risk factor and indicator data included: resident age and sex; whether the resident had a urinary catheter, vascular catheter, pressure sore or other wound at the time of survey; whether the resident was disorientated in time or space, was ambulant or non-ambulant, was incontinent for faeces or urine, had undergone surgery in the previous 30 days, had been admitted to hospital in the last three months, or had stayed in the LTCF for one year or longer. The Community Health Index (CHI) number was also recorded.

HCAI data

The ECDC case definitions for HCAI were used.[20] HCAI data were collected for residents with an active HCAI at the time of survey. A HCAI was considered active if:

- A resident had signs/symptoms on the day of the survey and (using signs/symptoms that had occurred in the 14 days prior to survey) met one of the case definitions for HCAI
- A resident was still receiving treatment for a resolved HCAI on the day of survey and the HCAI had previously met one of the case definitions in the past 14 days prior to survey

In addition, to be considered a HCAI, the onset of infection must have occurred within one of the following time frames:

- More than 48 hours (i.e. day 3 onwards) after the resident was (re-) admitted to the current LTCF
- Less than 48 hours (i.e. present on admission, on day of admission, or on day 2) after the resident was (re-) admitted to the current LTCF from another healthcare facility (e.g. LTCF or hospital)
- Deep and organ/space surgical site infections occurring less than 90 days after implant surgery
- Other surgical site infections occurring less than 30 days after an operation
- *Clostridium difficile* infections occurring less than 28 days after discharge from a healthcare facility (e.g. LTCF or hospital)

Infections originating in the community were excluded and no further data were collected on these infections.

Data were collected for each HCAI including the infection type, date of onset, origin of infection, and whether the infection was present on admission to the current LTCF. In order to decide the infection type, a data collector was required to check all signs and symptoms in the 14 days prior to survey and consider if there were enough signs and symptoms to meet an epidemiological case definitions.[19] HCAI could be categorised as:

- Confirmed
- Probable – only for urinary tract infections (UTI) which lacked microbiological data. If microbiological data were available at the time of survey, a UTI would meet the confirmed case definition if other signs/symptoms were also present
- Imported – only for infections that were clinically confirmed as healthcare associated before a resident was discharged from another healthcare facility (hospital or other LTCF) and admitted to the current LTCF BUT at the time of the survey, no notes on signs and symptoms were available and therefore no confirmed or probable case definition could be met. If signs/symptoms were available and a confirmed definition could be met; then this would supersede the imported infection status
- Other – for infections originating in a healthcare facility but that did not match any of the case definitions

Microbiology data

Microbiology data were recorded for HCAI where laboratory results were available to the LTCF at the time of survey. Antimicrobial resistance data were collected when available for a number of organisms of public health significance.

Antimicrobial data

Antimicrobial data were collected for all residents receiving antimicrobials at the time of survey. All antimicrobials with the exception of topical antimicrobials, antivirals and antiseptics were included in the survey. Systemic antibacterials, antifungals and antimycobacterials were included. A resident was defined as receiving antimicrobials if they were prescribed antimicrobials at the time of survey for the treatment or prevention of infection.

Data were recorded for each antimicrobial including the name of antimicrobial, route of administration, if the end or review date was known, indication for prescribing, diagnosis and where antimicrobial prescribing was initiated. The administration route was recorded as oral, parenteral (intravenous, intramuscular or subcutaneous) or other (rectal, inhalation). The indication for prescribing was recorded as therapeutic (for the treatment of infection) or prophylactic (for prevention of infection-medical or surgical prophylaxis).

LTCF characteristics and structure and process indicator data

LTCF were asked to provide information on: staffing levels of nurses and care staff, LTCF ownership, room numbers and occupancy, medical care and coordination, IPC practices (provision of IPC advice; IPC training; components of multimodal strategies; hand hygiene and availability of alcohol based hand rub (ABHR); and characteristics of IPC programmes) and antimicrobial stewardship indicators (training of stewardship; components of multimodal strategies; and characteristics of stewardship programmes). Information on the number of LTCF per NHS health board region and by main client type was taken from the 2016 Scottish Care Home Census.[7;8] Data for the 2017 Scottish Care Home Census were not available.

Analysis

Descriptive analyses

A map was drawn to illustrate the location of each LTCF. The percentage of LTCF surveyed per NHS health board region is given with the denominator being the total number of LTCF (in that NHS health board region) where 'older persons' is the main client type. Tables and figures were used to summarise the frequency and prevalence of HCAI and antimicrobial prescribing. These were produced in Microsoft Excel and cross-checked using R (version 3.4.2). Prevalence was estimated with the number of residents recorded as positive (had an active HCAI or were receiving antimicrobials at the time of survey) as the numerator and the total number of positive or negative residents (i.e. all surveyed residents excluding those whose HCAI or prescribing status was not recorded) as the denominator. One LTCF was excluded from the HCAI and antimicrobial prescribing prevalence estimates as those who had attended training were not nurses or care staff. Wilson's unadjusted 95% confidence intervals (95% CI) were applied to prevalence estimates. The prevalence of each risk factor and indicator of relative need was also calculated in the same way.

Statistical analysis

Epidemiology of key infection types

The epidemiology of key infection types was described by comparing characteristics of residents with and without the infection. All comparisons were univariate. Pearson's Chi square tests with a continuity correction or Fisher's Exact tests were used to determine if residents with and without infection were significantly different. A Fisher's Exact test was used when one or more of the cells in a 2 x 2 table had an observed frequency of ≤ 5. Pearson's Chi square tests were used in all other calculations. All tests were carried out in R (version 3.4.2) and statistical significance was set at $p<0.05$. The distribution of age between residents with versus without infection was compared using a Mann–Whitney U test and median ages calculated.

Factors associated with HCAI and antimicrobial prescribing prevalence

Univariate and multivariate regression analyses were conducted to identify factors associated with HCAI and antimicrobial prescribing prevalence using R version 3.4.2 (R package 'survey'). A variable for age group was created using the median, 25th and 75th quartile as thresholds (four categories) and a variable for any wounds created by combining pressure sore and other wounds. A survey weighted binomial model was used which accounted for the clustering of beds within LTCF. Univariate risk factors were initially screened and those with a p-value below 0.3 were included in the multivariate modelling process. A backward elimination approach and a forward stepwise approach were applied to select the most parsimonious model. Statistical significance was set at $p<0.05$. A category-level p-value (using the Wald test), odds ratios (OR) and 95% CI were calculated for each of the risk factors in the final models.

LTCF structure and process indicators

Percentages of LTCF that reported having each indicator were calculated with the denominator being the total number of LTCF that recorded a response and excluding those where no response was given. Data are provided for all surveyed LTCF, those with nurses and those without nurses. LTCF that recorded having any whole time equivalent (WTE) nursing staff were categorised as having nurses. ABHR per 1000 resident days per LTCF was calculated using the following formula: 1000*(Number of litres of ABHR per year) / (number of occupied beds * 365).

Gold standard validation and inter-rater reliability exercise following Scottish training sessions

Prior to data collection and following each training session, data collectors were required to complete two case studies. These were marked to measure the sensitivity and specificity and the inter-rater reliability (IRR) of the participant responses. The sensitivity, specificity and agreement between data collectors (kappa statistic) were estimated for whether a resident had prevalent HCAI (yes/no) and whether the resident was receiving antimicrobials (yes/no). Fleiss' kappa was used to calculate the kappa statistic using R version 3.4.2 (R package 'irr'.) A kappa statistic of between 0.81-1.0 is considered excellent, of 0.61-0.80 is considered good and a score of between 0.41-0.60 is considered moderate.

On-site gold standard validation study

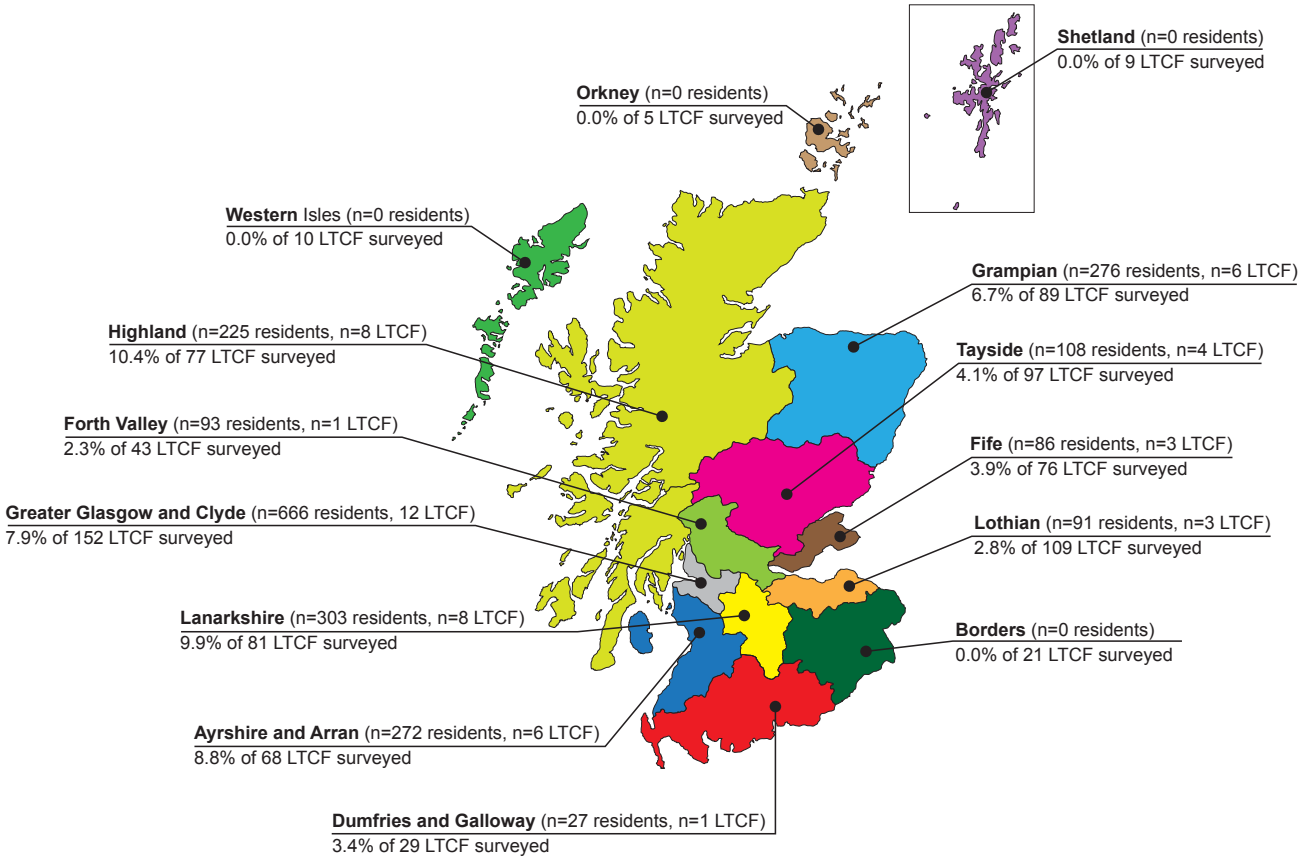
A gold standard validation study was carried out concurrently with the national data collection using the HALT validation protocol.[22] ECDC requested that all participating member states undertake a validation study so that results can be pooled and used to adjust the European prevalence. The HPS validation team consisted of one ECDC trained data collector along with one other member of staff to support the data collection process. Two LTCF were selected for inclusion in the validation study from a convenient sampling frame of LTCF that, travel time permitting, could be surveyed within one day. All residents in selected units or areas were surveyed, at least until the required number of validation records per LTCF was obtained (n=25). The validation team obtained validation data using the same data sources available to the primary data collection teams. Following completion of the survey, the validation team did not discuss or cross-check results with the primary data collectors in order to minimise bias. The sensitivity and specificity for the presence of HCAI and antimicrobials were calculated with 95% CI.

Results

Survey characteristics

A total of 2147 residents in 52 LTCF were included in the survey. For all 52 LTCF, the 'main client group' was older persons. This represents 6.0% of all Scottish LTCF where the main client group was described as older persons (n=866).[7] The total number of residents and LTCF included in the survey are described by NHS health board region as a percentage of all LTCF for older persons in that health board (Figure 1).

Figure 1: Total number of surveyed residents and LTCF in 2017, by NHS health board region



LTCF characteristics

The characteristics of surveyed LTCF are described in Table 1. More than two thirds of the LTCF were privately owned, approximately one fifth publicly owned, and approximately one in ten were described as not for profit organisations such as charities. Qualified nursing care was available 24 hours a day in 65.4% of LTCF, and there were an average of 12.2 WTE registered nurses and 61.4 WTE registered nursing assistants or carers per 100 beds. The average number of beds per LTCF was 51.4 ranging in size from 10 to 116 beds. Bed occupancy was 91.1% for all surveyed LTCF, with 99.2% of rooms being single occupancy and 87.6% of single occupancy rooms having en-suite toilet and washing facilities. Medical activities were coordinated by a medical physician in 60.0% of LTCF and the coordinating medical physician had access to residents' full medical records in 95.7% of LTCF, whereas nurses had access in 61.9% of LTCF.

An infographic summarising the characteristics of surveyed Scottish LTCF can be found here.

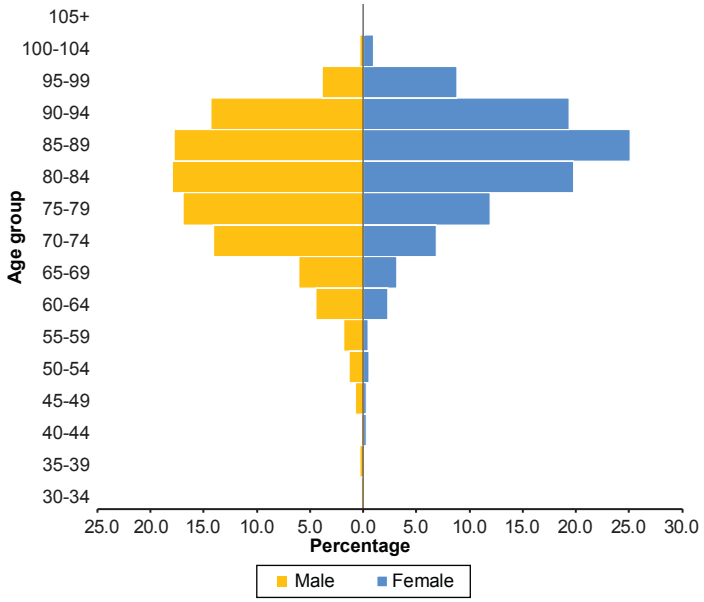
Table 1: Characteristics of surveyed Scottish LTCF in 2017

		All surveyed facilities (n=52)	Surveyed facilities with qualified nurses (n=35)	Surveyed facilities without qualified nurses (n=17)
Ownership	Public	21.2% (Data for 52 LTCF)	5.7% (Data for 35 LTCF)	52.9% (Data for 17 LTCF)
	For profit	67.3% (Data for 52 LTCF)	85.7% (Data for 35 LTCF)	29.4% (Data for 17 LTCF)
	Not for profit	11.5% (Data for 52 LTCF)	8.6% (Data for 35 LTCF)	17.6% (Data for 17 LTCF)
Staffing	LTCF with qualified nursing care available 24 hours per day	65.4% (Data for 52 LTCF)	97.1% (Data for 35 LTCF)	0.0% (Data for 17 LTCF)
	WTE registered nurses per 100 beds	12.2 (n=327.0 WTE in 52 LTCF)	15.5 (n=327.0 WTE in 35 LTCF)	Not applicable
	WTE registered nursing/care assistants per 100 beds	61.4 (n=1547.19 WTE in 48 LTCF)	59.7 (n=1211.89 WTE in 34 LTCF)	68.3 (n=335.3 WTE in 14 LTCF)
Beds and rooms	Average number of beds per LTCF (range)	51.4 beds for 52 LTCF (range 10 to 116)	60.3 beds for 35 LTCF (range 22 to 116)	33.2 beds for 17 LTCF (range 10 to 70)
	Percentage of occupied beds	91.1% (n=2435 beds in 52 LTCF)	91.3% (n=1926 beds in 35 LTCF)	90.1% (n=509 beds in 17 LTCF)
	Percentage of rooms that are single occupancy	99.2% (n=2642 rooms in 52 LTCF)	99.2% (n=2083 rooms in 35 LTCF)	98.9% (n=559 rooms in 17 LTCF)
	Percentage of single occupancy rooms that are en-suite	87.6% (n=2279 rooms in 51 LTCF)	87.5% (n=1823 rooms in 35 LTCF)	87.9% (n=456 rooms in 16 LTCF)
Medical coordination	LTCF where medical activities are coordinated by a medical physician	60.0% (Data for 50 LTCF)	63.6% (Data for 33 LTCF)	52.9% (Data for 17 LTCF)
	LTCF where the coordinating medical physician can consult medical/clinical records of all residents	95.7% (Data for 23 LTCF)	85.0% (Data for 20 LTCF)	100.0% (Data for 7 LTCF)
	LTCF where the nursing staff can consult medical/clinical records of all residents	67.7% (Data for 31 LTCF)	67.7% (Data for 31 LTCF)	Not applicable

Description of the survey population

The age and sex distribution of the surveyed LTCF population is described in Figure 2. The median age of surveyed residents was 84 years (range 33 to 105, inter-quartile range (IQR) 77 to 90) with 94.0% and 43.9% of residents over the age of 65 and 85 years, respectively. Two thirds of the residents were female (n=1449).

Figure 2: Number of residents in surveyed Scottish LTCF in 2017, by age and sex



The percentages of surveyed residents with (1) indicators of relative need and (2) risk factors for infection are shown in Figures 3 and 4, respectively, and Appendix Table A1. Approximately 70% of surveyed residents were disorientated in time or space on the day of the survey, approximately two thirds were incontinent for urine and/or faeces, and about half of residents were non-ambulant and either required a wheelchair or were bedridden. Approximately one in 12 residents had a urinary catheter in situ at the time of survey and approximately one in 12 had been admitted to hospital in the last three months. Pressure sores of any grade were recorded for 3.5% of residents and any wounds other than pressure sores were recorded for 7.2% of residents. One in ten residents had a pressure sore, other wound, or both (10.0%). Vascular catheterisation and surgery in the last 30 days prior to the survey were both uncommon (0.1% and 0.3%, respectively).

Figure 3: Characteristics of surveyed Scottish LTCF residents in 2017, by indicators of relative need

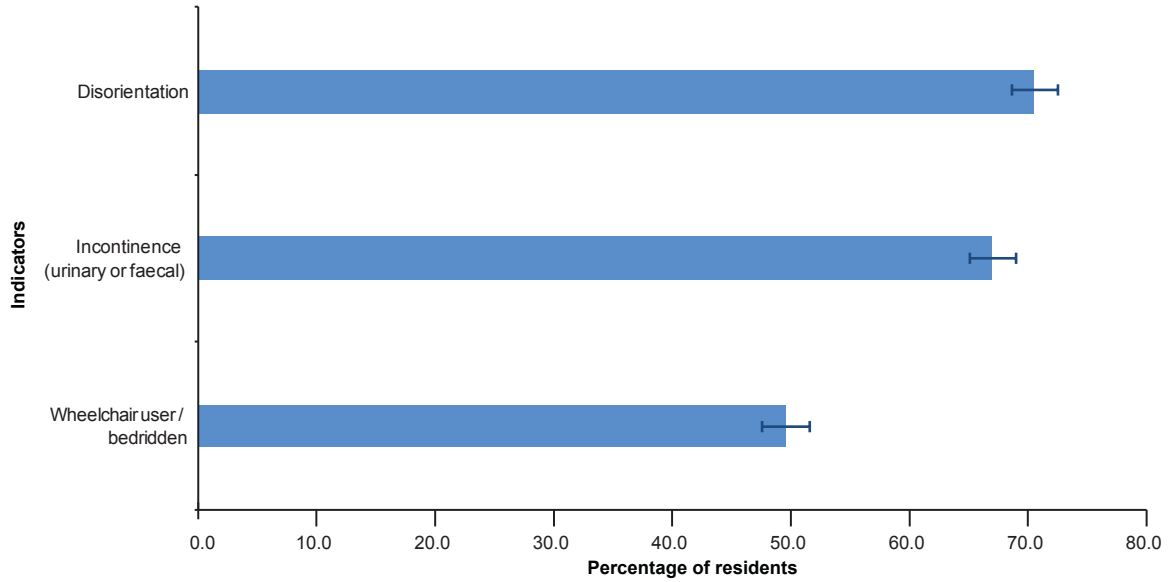
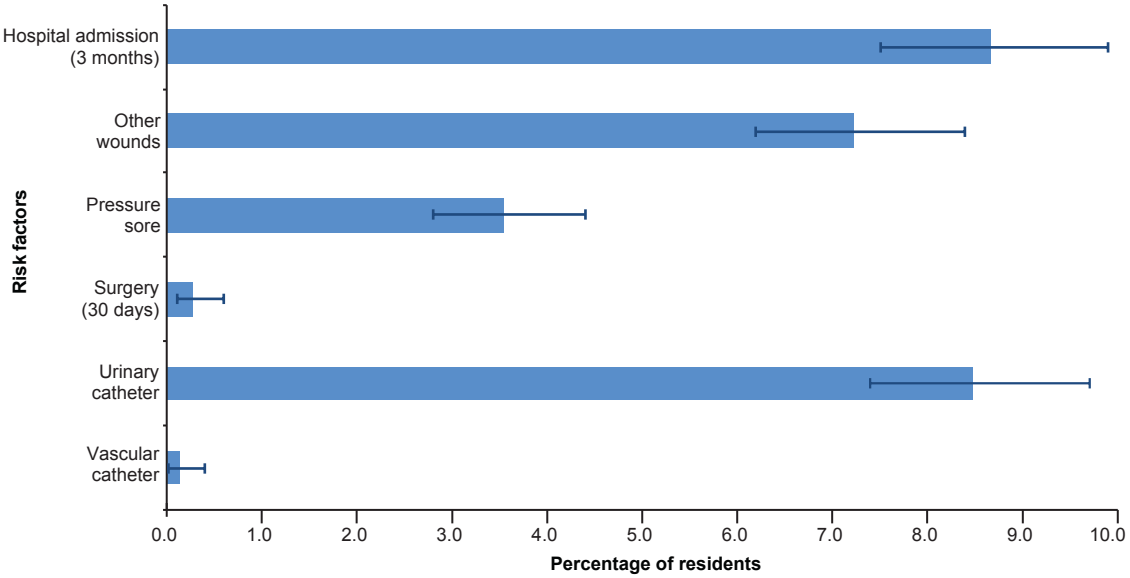


Figure 4: Characteristics of surveyed Scottish LTCF residents in 2017, by risk factors



Healthcare associated infection in Scottish LTCF

Prevalence of HCAI

The prevalence of HCAI was 5.9% (95%CI: 5.0 to 7.0). There were 125 residents with 126 HCAI that met the epidemiological case definitions at the time of survey. Of those 126 infections, 103 met the case definition for an epidemiologically confirmed HCAI (81.7%) and 19 met the case definition for a probable UTI (15.1%). Three (2.4%) were imported infections and there was one 'other' infection (0.8%). Table 2 shows the total number HCAI in surveyed residents.
An infographic summarising the epidemiology of HCAI in Scottish LTCF can be found here.

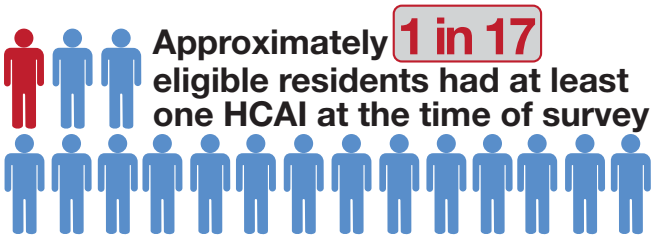


Table 2: Total number of HCAI in surveyed Scottish LTCF residents in 2017

	Total number
Total number of confirmed infections	103
Total number of imported infections	3
Total number of probable urinary tract infections (UTI)	19
Total number of 'other' infections	1
Total number of infections	126

Types of HCAI

Table 3 describes the distribution of HCAI by infection type and group, and Figure 5 describes the distribution of HCAI by infection group. The most prevalent infection type was lower respiratory tract infections (LRTI) other than common cold syndromes, pharyngitis, influenza and pneumonia comprising 31.0% of all HCAI. Collectively, respiratory tract infections (RTI) was the most prevalent HCAI group comprising nearly two fifths of all HCAI. UTI was the second most prevalent infection group accounting for a third of all HCAI. Approximately half of UTI were confirmed by microbiology and the remainder were "probable" UTI. Skin and soft

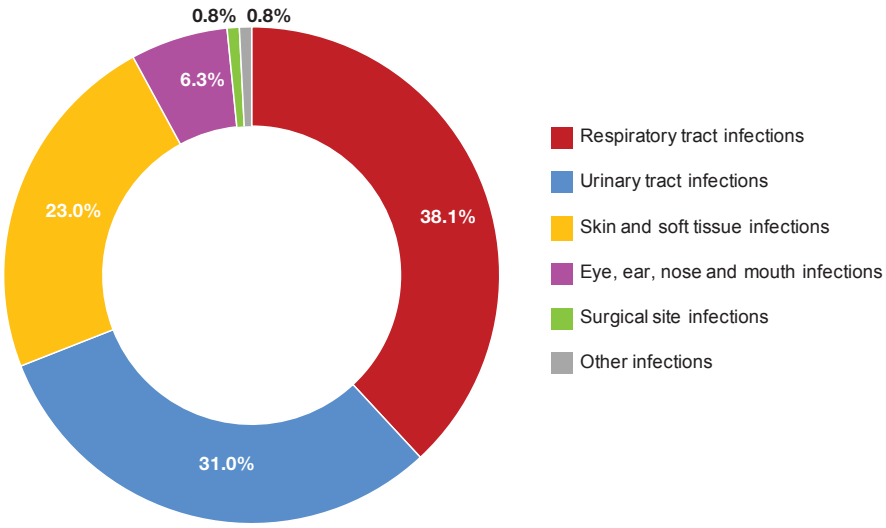
tissue infections (SSTI) was the third most prevalent HCAI group comprising 23.0% of all HCAI. There were no gastrointestinal infections or bloodstream infections recorded.

Table 3: Distribution of HCAI by infection type and group in surveyed Scottish LTCF residents in 2017

Infection group	Infection type	Total number	% of eligible residents*	% of all HCAI
Respiratory tract infections (RTI)	Common cold syndromes/pharyngitis	6	0.3	4.8
	Influenza-like illness ('Flu')	2	0.1	1.6
	Pneumonia	1	0.05	0.8
	Other lower RTI	39	1.8	31.0
	Total RTI	**48**	**2.3**	**38.1**
Urinary tract infections (UTI)	Confirmed UTI	20	0.9	15.9
	Probable UTI	19	0.9	15.1
	Total UTI	**39**	**1.8**	**31.0**
Skin and soft tissue infections (SSTI)	Cellulitis/soft tissue/wound infection	25	1.2	19.8
	Scabies	0	0.0	0.0
	Herpes simplex or herpes zoster infection	0	0.0	0.0
	Fungal infection	4	0.2	3.2
	Total SSTI	**29**	**1.4**	**23.0**
Eye, ear, nose and mouth infections	Conjunctivitis	6	0.3	4.8
	Ear infection	0	0.0	0.0
	Sinusitis	0	0.0	0.0
	Mouth infection or oral candidiasis	2	0.1	1.6
	Total EENM	**8**	**0.4**	**6.3**
Surgical site infections (SSI)	Superficial incisional SSI	1	0.05	0.8
	Deep incisional SSI	0	0.0	0.0
	Organ/space SSI	0	0.0	0.0
	Total SSI	**1**	**0.1**	**0.8**
Other infection(s)		1	0.05	0.8
Gastrointestinal tract infections (GI)	Gastroenteritis	0	0.0	0.0
	Clostridium difficile infection	0	0.0	0.0
	Total GI infections	**0**	**0.0**	**0.0**
Bloodstream infections (BSI)		0	0.0	0.0
Unexplained febrile episode		0	0.0	0.0
	Total number of infections	**126**	**6.0**	**100.0**

*Excludes residents with 'unknown' HCAI status

Figure 5: Distribution of HCAI by infection group in surveyed Scottish LTCF residents in 2017



Epidemiology of HCAI

The epidemiology of the three most prevalent HCAI types - RTI, UTI and SSTI - is described in Table 4.

Respiratory tract infections

A total of 48 RTI were reported and the prevalence of RTI was 2.3% (95% CI: 1.7 to 3.0). Residents with RTI had a median age of 86.5 years and two thirds were female. The median age of residents with RTI was statistically higher than those without (86.5 years versus 84 years, p<0.001), the percentage of residents who were non-ambulant was higher in those with RTI compared with those without (68.8% versus 49.2%, p=0.01), the percentage of residents who had been admitted to hospital in the last three months was higher in those with RTI compared with those without (18.8% versus 8.4%, p=0.02), and the percentage of residents with incontinence was higher in those with RTI compared with those without (83.3% versus 66.6%, p=0.02).

Urinary tract infections

A total of 39 UTI were reported and the prevalence of UTI was 1.9% (95% CI: 1.4 to 2.5). Residents with UTI had a median age of 85 years and three quarters were female. The median age of residents with UTI was statistically higher than those without (85 years versus 84 years, p<0.001) and the percentage of residents with urinary catheters was higher in those with UTI compared with those without (23.1% versus 8.2%, p=0.003). None of the other characteristics were univariately associated with the prevalence of UTI.

Skin and soft tissue infections

A total of 29 SSTI were reported and the prevalence of SSTI was 1.4% (95% CI: 1.0 to 2.0). Residents with SSTI had a median age of 81 years and half were female. The median age of residents with SSTI was statistically lower than those without (81 years versus 84 years, p<0.001), the percentage of residents who were male was higher in those with SSTI compared with those without (51.7% versus 32.3%, p=0.04), the percentage of residents with a urinary catheter in situ was higher in those with SSTI compared with those without (20.7% versus 8.3%, p=0.04), and the percentage of residents with other wounds was higher in those with SSTI compared with those without (27.6% versus 6.9%, p<0.001),

Table 4: Epidemiology of main infection types in surveyed Scottish LTCF residents in 2017

	Respiratory tract infections (RTI)			Urinary tract infections (UTI)			Skin and soft tissue infections (SSTI)		
Characteristic	Residents with RTI	Residents without RTI	p-value	Residents with UTI	Residents without UTI	p-value	Residents with SSTI	Residents without SSTI	p-value
Median age	86.5	84	<0.001	85	84	<0.001	81	84	<0.001
>85 years (%)	52.1	43.8	0.32	48.7	51.3	0.67	44.8	44.0	1.00
% male (%)	37.5	32.4	0.56	25.6	32.7	0.45	51.7	32.3	0.04
Urinary catheter (%)	12.5	8.4	0.46	23.1	8.2	0.003	20.7	8.3	0.04
Vascular catheter (%)	0.0	0.1	1.00	2.6	0.1	0.05	0.0	0.1	1.00
Pressure sore (%)	6.3	3.5	0.25	5.1	3.6	0.65	7.1	3.6	0.27
Other wounds (%)	12.5	7.0	0.24	10.3	7.1	0.36	27.6	6.9	<0.001
Disorientation (%)	70.8	70.4	1.00	74.4	70.3	0.72	86.2	70.1	0.07
Wheelchair/ bedridden (%)	68.8	49.2	0.01	46.2	49.7	0.78	55.2	49.5	0.68
Hospital admission (3 months, %)	18.8	8.4	0.02	17.9	8.5	0.07	20.7	8.5	0.046
Surgery (30 days, %)	2.1	0.2	0.13	0.0	0.3	1.00	0.0	0.3	1.00
Any incontinence (%)	83.3	66.6	0.02	69.2	66.9	0.90	75.9	66.8	0.41
Length of stay more than one year (%)	75.0	69.0	0.47	76.9	69.0	0.38	51.7	69.4	0.06
Facilities with nurses (%)	77.1	77.2	1.00	82.1	77.1	0.57	69.0	77.3	0.40

Origin of infection and present on admission to the current LTCF

The majority of HCAI originated in the current LTCF (97.5%, n=117), the remainder originating in hospital (1.7%, n=2) and in another LTCF (0.8%, n=1). The origin of infection is described in Figure 6.

Of all infections, 13.0% were present on admission or re-admission to the current care home (n=16). The percentage of HCAI that were present on admission is described in Figure 7.

Figure 6: Origin of HCAI in surveyed Scottish LTCF residents in 2017

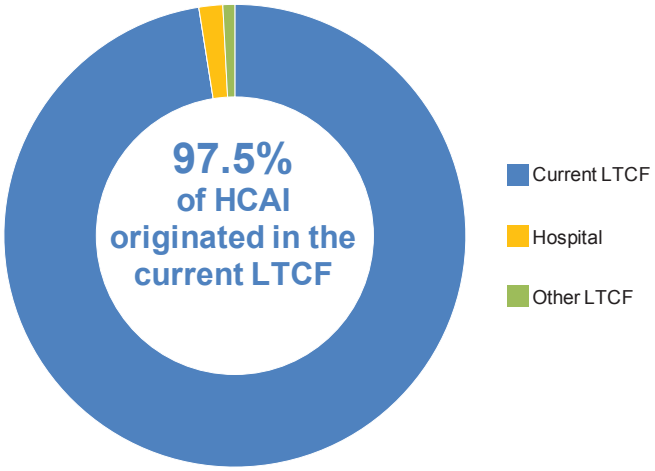
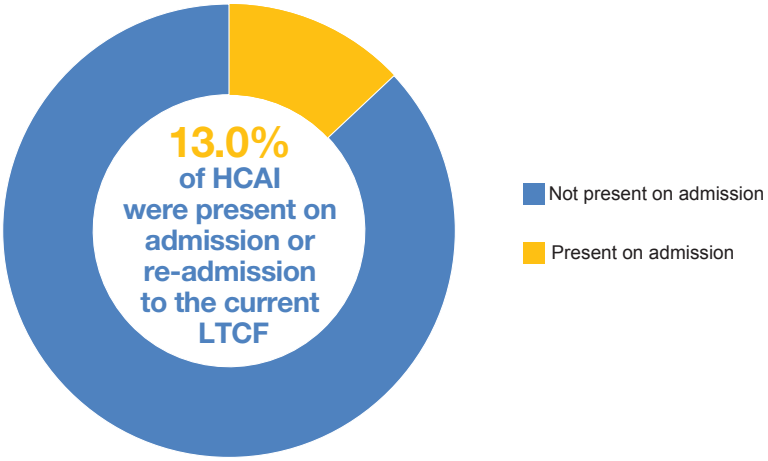


Figure 7: Percentage of HCAI present on admission or re-admission to surveyed Scottish LTCF in 2017



Microbiology

Microbiology was only available for two HCAI: *Escherichia coli* was the causative agent of one confirmed UTI and *Staphylococcus aureus* was the causative agent of one confirmed SSTI. No other microbiology data or antimicrobial resistance data were available at the time of survey.

Risk factors associated with HCAI prevalence

Univariate results

The results from univariate analyses undertaken to describe HCAI prevalence by key risk factors for infection and the univariate association between these risk factors and prevalence are provided in Table 5.

Multivariate results

The results from multivariate analyses to identify risk factors that were independently associated with HCAI prevalence are provided in Table 6. The multivariate results indicate that older age was significantly associated with the prevalence of HCAI (p=0.03) with residents aged 85 to 90 years having significantly higher prevalence of HCAI than residents aged less than 78 years (reference category). Having been admitted to hospital in the last three months (p=0.005), having a urinary catheter in place at the time of survey (p=0.02), and having any wounds (pressure sores or other wounds) (p=0.02) were all independently associated with a higher prevalence of HCAI.

Table 5: Prevalence of HCAI in surveyed Scottish LTCF residents in 2017 and univariate risk factor analysis

Risk factor	Category	Number of residents with at least one HCAI	Number of residents surveyed (n=2106)*	Prevalence (%)	95% Lower CI	95% Upper CI	Odds ratio	Odds ratio 95% Lower CI	Odds ratio 95% Upper CI	Category p-value	Risk factor p-value
Age group (years)	33 to 77	29	555	5.23	3.66	7.40	1.00				
	78 to 84	30	527	5.69	4.02	8.01	1.09	0.68	1.77	0.71	
	85 to 90	42	562	7.47	5.58	9.95	1.46	1.00	2.14	0.06	
	91 to 105	23	462	4.98	3.34	7.36	0.95	0.51	1.79	0.87	0.18
Disorientation	No	31	624	4.97	3.52	6.97	1.00				
	Yes	93	1482	6.28	5.15	7.63	1.28	0.83	1.99	0.28	0.28
Hospital admission (3 months)	No	100	1925	5.19	4.29	6.28	1.00				
	Yes	24	181	13.26	9.07	18.97	2.79	1.53	5.10	0.002	0.002
Incontinence	No	32	696	4.60	3.28	6.42	1.00				
	Yes	92	1410	6.52	5.35	7.94	1.45	1.01	2.08	0.05	0.05
Length of stay in LTCF	Less than one year	41	649	6.32	4.69	8.46	1.00				
	One year or longer	83	1457	5.70	4.62	7.01	0.90	0.58	1.39	0.63	0.63
LTCF with nurses	No	28	480	5.83	4.07	8.30	1.00				
	Yes	96	1626	5.90	4.86	7.16	1.01	0.56	1.83	0.97	0.97
Sex	Female	81	1422	5.70	4.61	7.02	1.00				
	Male	43	684	6.29	4.70	8.36	1.11	0.78	1.58	0.56	0.56
Surgery (30 days)	No	123	2100	5.86	4.93	6.94	1.00				
	Yes	1	6	16.67	3.01	56.35	3.21	0.37	28.07	0.30	0.30
Urinary catheter	No	104	1927	5.40	4.47	6.50	1.00				
	Yes	20	179	11.17	7.35	16.63	2.20	1.35	3.59	0.003	0.003
Wheelchair user or bedridden	No	57	1061	5.37	4.17	6.90	1.00				
	Yes	67	1045	6.41	5.08	8.06	1.21	0.79	1.83	0.38	0.38
Wounds[$]	No	100	1896	5.27	4.36	6.37	1.00				
	Yes	24	210	11.43	7.80	16.44	2.32	1.35	3.96	0.003	0.003

* Excludes residents with missing information for any risk factor, HCAI and those from one LTCF where non-nursing and non-care staff were trained.

[$] Includes all wounds, pressure sores and other wounds

Table 6: Prevalence of HCAI in in surveyed Scottish LTCF residents in 2017 and multivariate risk factor analysis results

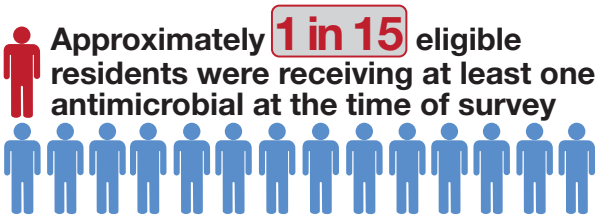
Risk factor	Category	Odds ratio	Odds ratio 95% Lower CI	Odds ratio 95% Upper CI	Category p-value	Risk factor p-value
Age group (years)	33 to 77	1.00				
	78 to 84	1.12	0.69	1.84	0.65	
	85 to 90	1.70	1.16	2.47	0.01	
	91 to 105	1.04	0.55	1.98	0.90	0.03
Hospital admission (3 months)	No	1.00				
	Yes	2.41	1.35	4.31	0.005	0.005
Urinary catheter	No	1.00				
	Yes	1.85	1.13	3.02	0.02	0.02
Wounds[$]	No	1.00				
	Yes	1.82	1.10	3.00	0.02	0.02

[$] Includes all wounds, pressure sores and other wounds

Antimicrobial prescribing in Scottish LTCF

Prevalence of antimicrobial prescribing

The overall prevalence of systemic antimicrobial prescribing was 6.5% (95% CI: 5.6 to 7.7). There were 138 residents receiving 144 antimicrobials at the time of survey. The prevalence of antimicrobial prescribing for the treatment of infection was 4.9% (95% CI: 4.0 to 5.9) with 102 residents receiving 105 antimicrobials. The prevalence of antimicrobial prescribing for prevention (prophylaxis) of infection was 1.3% (95% CI: 0.9 to 1.9) with 27 residents receiving 28 antimicrobials. The indication (treatment or prophylactic) was not recorded for 11 antimicrobials. Six residents were receiving two antimicrobials each, and two residents were receiving one antimicrobial for treatment and one for the prevention of infection at the time of survey. The prevalence of antimicrobial prescribing is described in Table 7.



An infographic summarising the prevalence of antimicrobial prescribing in surveyed Scottish LTCF can be found here.

Table 7: Prevalence of antimicrobial prescribing in surveyed Scottish LTCF residents in 2017

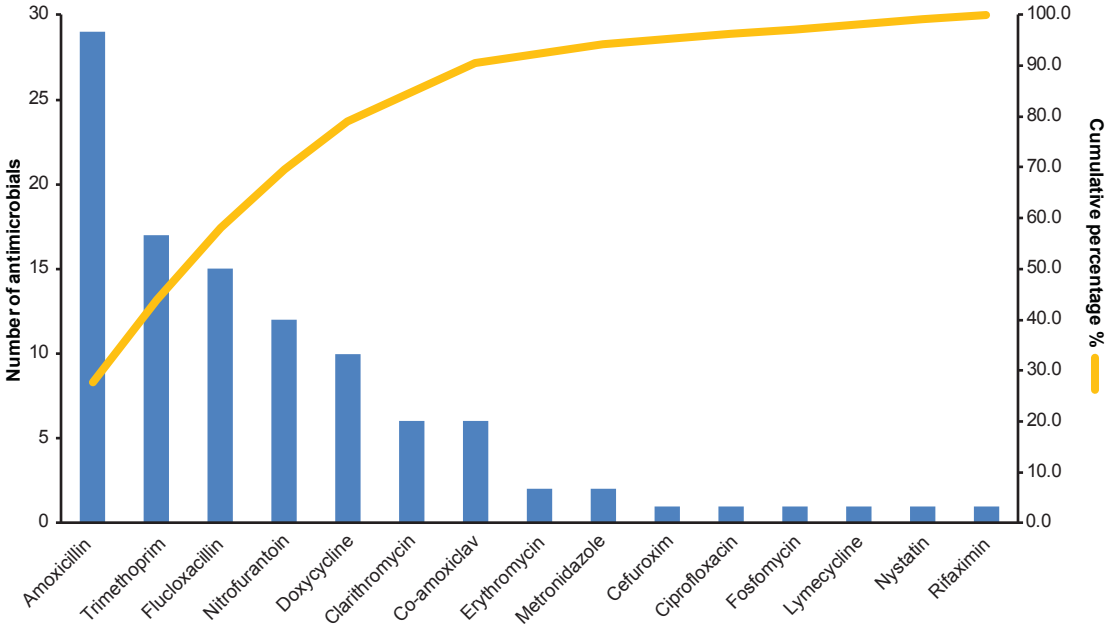
	Total number[€]	Eligible residents*	Prevalence	95% Lower CI	95% Upper CI
Overall prevalence	138	2110	6.5	5.6	7.7
Prevalence of therapeutic antimicrobials	102[ß]	2099[$]	4.9	4.0	5.9
Prevalence of prophylactic antimicrobials	27[ß]	2099[$]	1.3	0.9	1.9

[€] The total number of residents prescribed at least one systemic antimicrobial on the day of survey.
* Excludes residents with 'unknown' antimicrobial status.
[$] The treatment type was not known for 11 antimicrobials.
[ß] Two residents receiving both antimicrobial for the treatment and prevention of infections.

Antimicrobials by treatment type

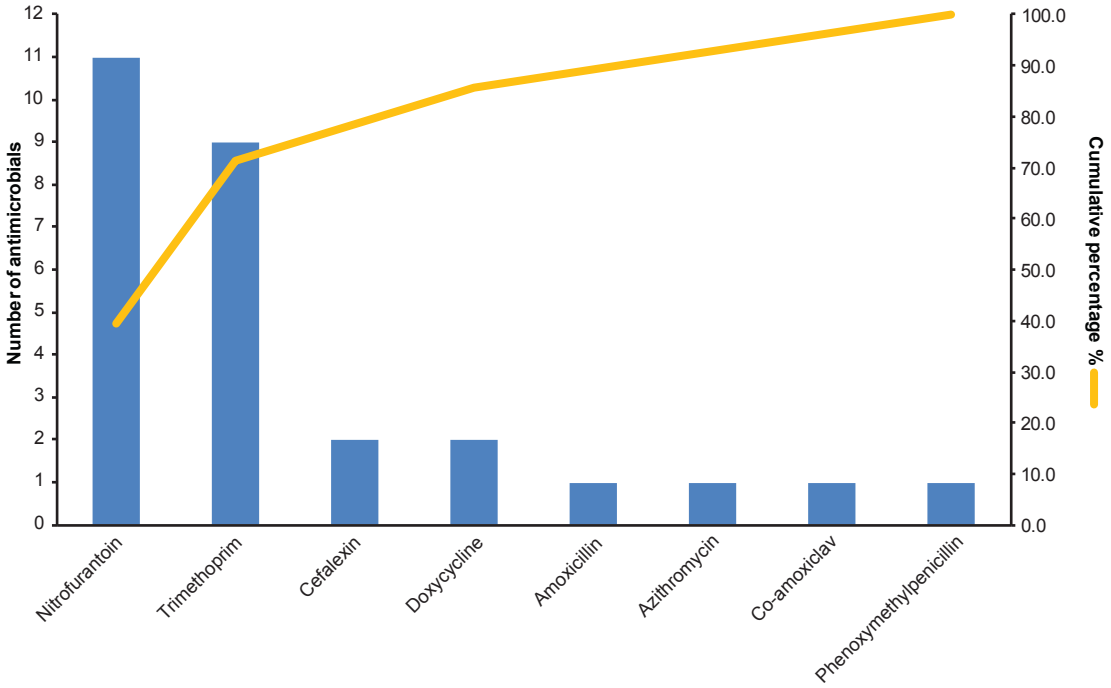
A pareto chart describing the antimicrobials prescribed for treatment of infection is shown in Figure 8. The distribution of antimicrobials is also provided in Appendix Table A2. The most commonly prescribed antimicrobial was amoxicillin (27.6%, n=29) which along with trimethoprim (16.2%, n=17), flucloxacillin (14.3%, n=15) and nitrofurantoin (11.4%, n=12) accounted for more than two thirds of all antimicrobials prescribed for treatment of infection (69.5%).

Figure 8: Number and cumulative percentage of antimicrobials prescribed for the treatment of infection in surveyed Scottish LTCF residents in 2017



A pareto chart describing the antimicrobials prescribed for prevention of infection is shown in Figure 9. The distribution of antimicrobials is also provided in Appendix Table A3. The most commonly prescribed antimicrobial was nitrofurantoin (39.3%, n=11) and along with trimethoprim (32.1%, n=9) accounted for more than two thirds of all antimicrobials prescribed for the prevention of infection (71.4%).

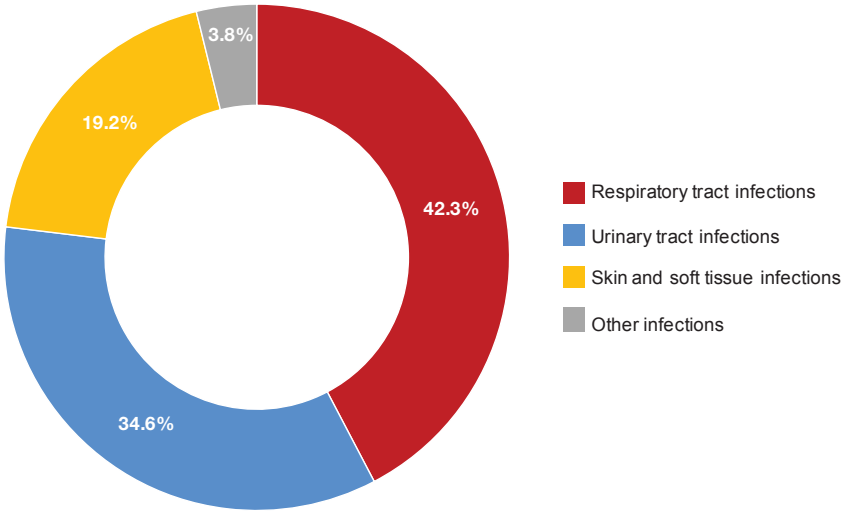
Figure 9: Number and cumulative percentage of antimicrobials prescribed for the prevention of infection in surveyed Scottish LTCF residents in 2017



Diagnoses

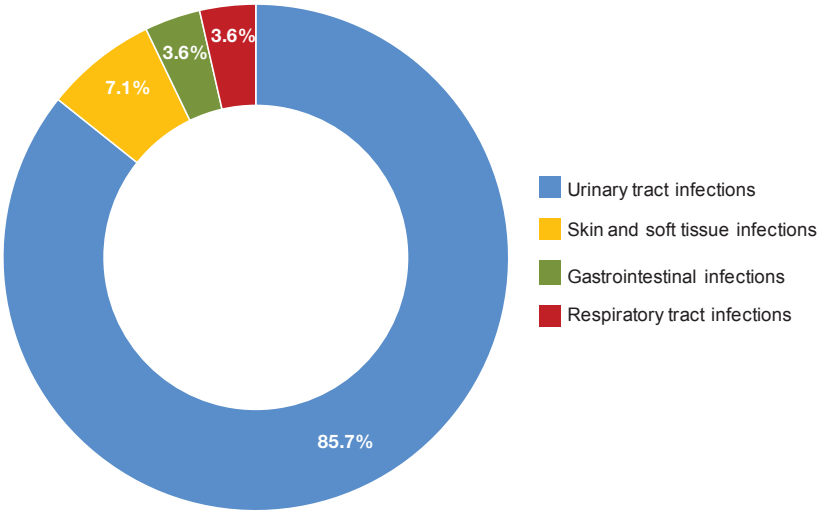
The distribution of diagnoses for the treatment of infection is shown in Figure 10 and distribution of antimicrobial name by main diagnosis groups for treatment antimicrobials is given in Appendix Table A4. The most common diagnosis was RTI with over two fifths of treatment antimicrobials (42.3%, n=44) prescribed for this reason. The second most common diagnosis type was UTI (34.6%, n=36) followed by SSTI (19.2%, n=20). The remaining 3.8% was made up of two ear, nose and mouth infections, and one each of gastrointestinal and surgical site infections. The diagnosis for one antimicrobial was not recorded.

Figure 10: Distribution of diagnoses of antimicrobials prescribed for treatment of infection in surveyed Scottish LTCF residents in 2017



The distribution of diagnoses for antimicrobials given for the prevention of infection is shown in Figure 11 and distribution of antimicrobial name by main diagnosis groups is given in Appendix Table A5. The most common reason for prescribing antimicrobials was for the prevention of UTI (85.7%, n=24). Two antimicrobials were prescribed for the prevention of SSTI (7.1%, n=2) and one each prescribed for the prevention of gastrointestinal infection and RTI (both 3.6%, n=1).

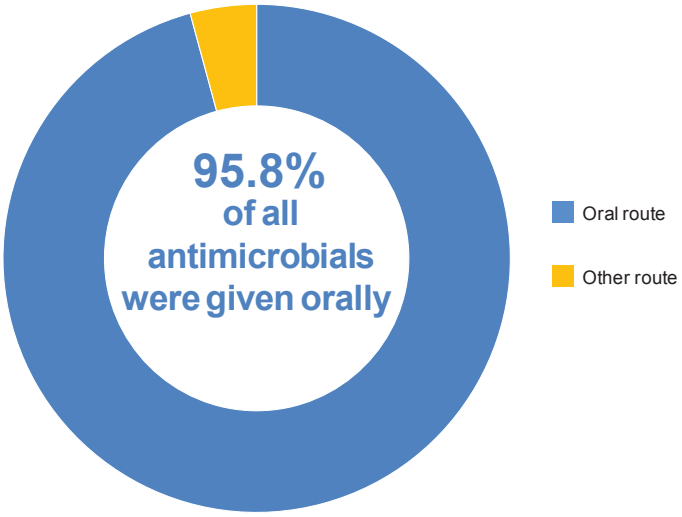
Figure 11: Distribution of diagnoses of antimicrobials prescribed for prevention of infection in surveyed Scottish LTCF residents in 2017



Characteristics of antimicrobials prescribed

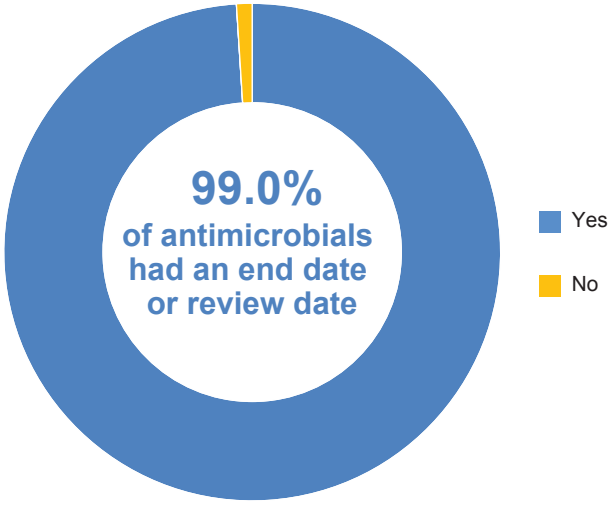
For antimicrobials where the route of administration was recorded, 95.8% were administered orally (n=136). This is described in Figure 12. Of all the antimicrobials given for treatment, 94.2% (n=98) were given orally. Of all the antimicrobials given for the prevention of infection, 100% (n=27) were given orally. No antimicrobials were given parenterally. No information about the specific route of administration of antimicrobials given by 'other' route was available.

Figure 12: Administration route of antimicrobials prescribed in surveyed Scottish LTCF residents in 2017



An end or review date for antimicrobials was recorded in the resident notes or care plans for 90.1% of antimicrobials (n=118). End or review dates were recorded for 99.0% (n=98) and 58.3% (n=14) of treatment and preventative antimicrobials, respectively. This is described for treatment antimicrobials in Figure 13.

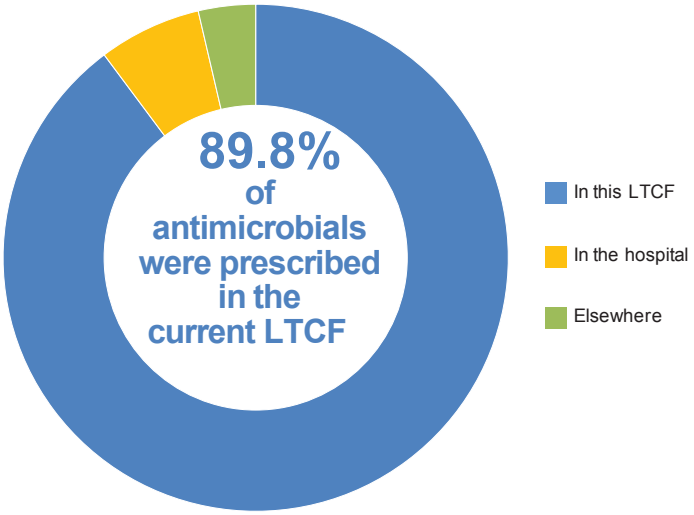
Figure 13: Percentage of treatment antimicrobials with a recorded end or review date in surveyed Scottish LTCF residents in 2017



The location of residents at the time of antimicrobial prescribing initiation is described in Figure 14. The majority of residents were in the current LTCF at the time of prescribing initiation (89.8%, n=123), 6.6% were in hospital (n=9), and 3.6% were prescribed elsewhere (n=5). For antimicrobials used for the treatment of infection (data for 101 antimicrobials); 91.1%, 6.9% and 2.0% were prescribed while the resident was in the current LTCF, in hospital, and

elsewhere, respectively. For antimicrobials used for the prevention of infection (data for 25 antimicrobials); 84.0%, 4.0% and 12.0% were prescribed while the resident was in the current LTCF, in hospital, and elsewhere, respectively.

Figure 14: Location at time of prescribing in surveyed Scottish LTCF residents in 2017



Risk factors associated with antimicrobial prescribing prevalence

Univariate results

The results from univariate analyses undertaken to describe antimicrobial prescribing prevalence by key risk factors and the univariate association between these risk factors and prevalence are provided in Table 8.

Multivariate results

The results from multivariate analyses to identify risk factors that were independently associated with antimicrobial prescribing prevalence are provided in Table 9. The results indicate that having been admitted to hospital in the last three months (p=0.007) and having any incontinence (faecal or urinary) in the 24 hours prior to the survey (p=0.004) were both independently associated with a higher prevalence of antimicrobial prescribing.

Table 8: Prevalence of antimicrobial prescribing in surveyed Scottish LTCF residents in 2017 and univariate logistic regression analysis results

Risk factor	Category	Number of residents receiving at least one AM	Number of residents surveyed (n=2106)*	Prevalence (%)	95% Lower CI	95% Upper CI	Odds ratio	Odds ratio 95% Lower CI	Odds ratio 95% Upper CI	Category p-value	Risk factor p-value
Age group (years)	33 to 77	32	555	5.8	4.1	8.0	1.00				
	78 to 84	41	528	7.8	5.8	10.4	1.38	0.87	2.17	0.17	
	85 to 90	42	560	7.5	5.6	10.0	1.33	0.84	2.08	0.23	
	91 to 105	22	463	4.8	3.2	7.1	0.82	0.47	1.40	0.46	0.26
Disorientation	No	33	624	5.3	3.8	7.3	1.00				
	Yes	104	1482	7.0	5.8	8.4	1.35	0.86	2.11	0.19	0.19
Hospital admission (3 months)	No	114	1925	5.9	5.0	7.1	1.00				
	Yes	23	181	12.7	8.6	18.3	2.31	1.28	4.17	0.01	0.01
Incontinence	No	31	696	4.5	3.2	6.3	1.00				
	Yes	106	1410	7.5	6.3	9.0	1.74	1.19	2.55	0.01	0.01
Length of stay in LTCF	Less than one year	40	651	6.1	4.5	8.3	1.00				
	One year or longer	97	1455	6.7	5.5	8.1	1.09	0.76	1.56	0.63	0.63
LTCF with nurses	No	30	480	6.3	4.4	8.8	1.00				
	Yes	107	1626	6.6	5.5	7.9	1.06	0.66	1.69	0.82	0.82
Sex	Female	91	1421	6.4	5.2	7.8	1.00				
	Male	46	685	6.7	5.1	8.8	1.05	0.75	1.47	0.77	0.77
Surgery (30 days)	No	136	2100	6.5	5.5	7.6	1.00				
	Yes	1	6	16.7	3.0	56.4	2.89	0.33	25.12	0.34	0.34
Urinary catheter	No	118	1928	6.1	5.1	7.3	1.00				
	Yes	19	178	10.7	6.9	16.1	1.83	1.04	3.24	0.04	0.04
Wheelchair user or bedridden	No	65	1062	6.1	4.8	7.7	1.00				
	Yes	72	1044	6.9	5.5	8.6	1.14	0.80	1.62	0.48	0.48
Wounds[$]	No	113	1895	6.0	5.0	7.1	1.00				
	Yes	24	211	11.4	7.8	16.4	2.02	1.16	3.53	0.02	0.02

* Excludes residents with missing information for any risk factor, HCAI and those from one LTCF were non-nursing and non-care staff were trained.

[$] Includes all wounds, pressure sores and other wounds

Table 9: Prevalence of antimicrobial prescribing in surveyed Scottish LTCF residents in 2017 and multivariate risk factor analysis results

Risk factor	Category	Odds ratio	Odds ratio 95% Lower CI	Odds ratio 95% Upper CI	Category p-value	Risk factor p-value
Hospital admission (3 months)	No	1.00				
	Yes	2.35	1.29	4.26	0.007	0.007
Incontinence	No	1.00				
	Yes	1.76	1.21	2.56	0.004	0.004

Infection prevention and control indicators

A summary of the IPC structure and process indicators is provided in Table 10.

Less than a third of surveyed LTCF reported having internal or external infection control committees (27.5%). Three quarters of LTCF reported having access to persons with training in IPC (75.0%) and more than two thirds reported having staff members who had been trained in IPC (67.3%). More than three quarters of LTCF reported that they obtained external IPC advice from local health protection teams (HPT) (76.5%), and approximately a third reported that they obtained IPC advice from local hospital IPC teams (29.4%). One in thirteen reported that they obtained IPC advice from sources other than the HPT or IPC teams (7.8%). IPC training of nursing and care staff is provided in 80.0% of LTCF; in LTCF with nurses this was 91.2%, and in LTCF without nurses this was 47.4%. Most LTCF (98.1%) reported an awareness of the NHS Education for Scotland (NES) IPC educational resources although these were reportedly only used for training in 70.8% of LTCF.

A designated member of staff responsible for reporting and managing outbreaks was reported in 84.6% of LTCF and 58.0% of LTCF reported having surveillance programmes for HCAI though only 26.9% reported providing feedback on surveillance results to the facility staff. More than half of LTCF reported making decisions on isolation and additional precautions for residents colonised with resistant microorganisms (55.8%) but only 15.4% had a registration system to record residents who were colonised or infected with multi-drug resistant organisms (MDRO).

Liquid soap was reportedly available for hand hygiene in all of the LTCF and ABHR available in 82.7% of LTCF. Nearly three fifths of LTCF reported the availability of alcohol hand wipes (58.3%) and bar soap was available for hand hygiene in clinical areas in 6.3% of LTCF. Approximately half of the LTCF reported that hand washing with water and antiseptic soap was the most frequently used method of hand hygiene (46.2%), 38.5% reporting hand washing with water and non-antiseptic soap as the most common method and 15.4% of LTCF reported that ABHR was the most common method of hand hygiene in the facility. Approximately two thirds of LTCF reported undertaking hand hygiene training in the previous year (66.0%).

Table 10: Infection prevention and control structure and process in surveyed Scottish LTCF

	Indicator	All LTCF included in survey (n=52)	All LTCF with qualified nurses (n=35)	ALL LTCF without qualified nurses (n=17)
Characteristics of IPC programmes	LTCF with infection control commitees (internal or external)	27.5% (Data for 51 LTCF)	35.3% (Data for 34 LTCF)	11.8% (Data for 17 LTCF)
Provision of IPC advice	LTCF with access to persons with training in IPC	75.0% (Data for 52 LTCF)	80.0% (Data for 35 LTCF)	64.7% (Data for 17 LTCF)
	LTCF with staff member(s) trained in IPC	67.3% (Data for 52 LTCF)	74.3% (Data for 35 LTCF)	52.9% (Data for 17 LTCF)
	LTCF that ask for external infection control advice from local health protection teams	76.5% (Data for 51 LTCF)	76.5% (Data for 34 LTCF)	76.5% (Data for 17 LTCF)
	LTCF that ask for external infection control advice from hospital infection control teams	29.4% (Data for 51 LTCF)	26.5% (Data for 34 LTCF)	35.3% (Data for 17 LTCF)
	LTCF that ask for external infection control advice from other sources	7.8% (Data for 51 LTCF)	5.9% (Data for 34 LTCF)	11.8% (Data for 17 LTCF)
IPC training	LTCF with IPC training of nursing and care staff	80.0% (Data for 50 LTCF)	91.2% (Data for 34 LTCF)	47.4% (Data for 16 LTCF)
	LTCF aware of NES educational resources on prevention and control of infection for care homes and care at home organisations	98.1% (Data for 52 LTCF)	100.0% (Data for 35 LTCF)	94.1% (Data for 17 LTCF)
	LTCF that provide infection prevention and control education using NES's DVD on "Preventing Infection in Care"	70.8% (Data for 48 LTCF)	58.1% (Data for 31 LTCF)	94.1% (Data for 17 LTCF)
Components of multimodal strategies	LTCF that have a registration system to record residents colonised/infected with MDRO	15.4% (Data for 52 LTCF)	14.3% (Data for 35 LTCF)	17.6% (Data for 17 LTCF)
	LTCF with a designated member of staff responsible for reporting and management of outbreaks	84.6% (Data for 52 LTCF)	82.9% (Data for 35 LTCF)	88.2% (Data for 17 LTCF)
	LTCF that provide feedback on surveillance results to the nursing/care/ medical staff of the facility	26.9% (Data for 52 LTCF)	28.6% (Data for 35 LTCF)	23.5% (Data for 17 LTCF)
	LTCF that supervise disinfection and sterilisation of medical and care material / equipment	28.8% (Data for 52 LTCF)	22.9% (Data for 35 LTCF)	41.2% (Data for 17 LTCF)
	LTCF that make decisions on isolation and additional precautions for residents colonised with resistant microorganisms	55.8% (Data for 52 LTCF)	57.1% (Data for 35 LTCF)	52.9% (Data for 17 LTCF)
	LTCF that offer of annual immunisation for influenza to all residents	94.2% (Data for 52 LTCF)	97.1% (Data for 35 LTCF)	88.2% (Data for 17 LTCF)
	LTCF that organise, control, and feedback on audits of infection policies and procedures on regular basis	55.8% (Data for 52 LTCF)	54.3% (Data for 35 LTCF)	58.8% (Data for 17 LTCF)
	LTCF with surveillance programme(s) for HCAI	58.0% (Data for 50 LTCF)	64.7% (Data for 34 LTCF)	43.8% (Data for 16 LTCF)
	Development of care protocols	73.1% (Data for 52 LTCF)	68.6% (Data for 35 LTCF)	82.4% (Data for 17 LTCF)
	LTCF with written protocols available for:			
	the management of MRSA and/or other MDRO	90.2% (Data for 51 LTCF)	94.3% (Data for 35 LTCF)	81.3% (Data for 16 LTCF)
	Hand hygiene	100.0% (Data for 52 LTCF)	100.0% (Data for 35 LTCF)	100.0% (Data for 17 LTCF)
	The management of urinary catheters	94.1% (Data for 51 LTCF)	97.1% (Data for 34 LTCF)	88.2% (Data for 17 LTCF)
	The management of venous catheters/ lines	24.4% (Data for 45 LTCF)	33.3% (Data for 30 LTCF)	6.7% (Data for 15 LTCF)
	The management of enteral feeding	65.3% (Data for 49 LTCF)	82.4% (Data for 34 LTCF)	26.7% (Data for 15 LTCF)
	LTCF that organise, control, and feedback on hand hygiene in the facility on a regular basis	51.9% (Data for 52 LTCF)	54.3% (Data for 35 LTCF)	47.1% (Data for 17 LTCF)

	Indicator	All LTCF included in survey (n=52)	All LTCF with qualified nurses (n=35)	ALL LTCF without qualified nurses (n=17)
Hand hygiene and availability of ABHR	**LTCF with the following products available for hand hygiene:**			
	Alcohol based hand rub solution	82.7% (Data for 52 LTCF)	85.7% (Data for 35 LTCF)	76.5% (Data for 17 LTCF)
	Wipes (alcohol)	58.3% (Data for 48 LTCF)	67.6% (Data for 34 LTCF)	35.7% (Data for 14 LTCF)
	Liquid soap (antiseptic/other)	100.0% (Data for 52 LTCF)	100.0% (Data for 35 LTCF)	100.0% (Data for 17 LTCF)
	Bar soap in clinical areas	6.3% (Data for 48 LTCF)	3.0% (Data for 33 LTCF)	13.3.0% (Data for 15 LTCF)
	Hand hygiene method most frequently used:			
	Hand disinfection with an alcohol solution	15.4% (Data for 52 LTCF)	8.6% (Data for 35 LTCF)	29.4% (Data for 17 LTCF)
	Hand washing with water and antiseptic soap	46.2% (Data for 52 LTCF)	48.6% (Data for 35 LTCF)	41.2% (Data for 17 LTCF)
	Hand washing with water and non-antiseptic soap	38.5% (Data for 52 LTCF)	42.9% (Data for 35 LTCF)	29.4% (Data for 17 LTCF)
	Number of litres of alcohol based hand rub used in the last year per 1000 residents	3.3 L per 1000 resident days (Data for 31 LTCF)	2.49 L per 1000 resident days (Data for 17 LTCF)	5.11 L per 1000 resident days (Data for 15 LTCF)
	LTCF with hand hygiene training available in the last year	66.0% (Data for 50 LTCF)	63.6% (Data for 33 LTCF)	70.6% (Data for 17 LTCF)

Antimicrobial stewardship indicators

A summary of the antimicrobial stewardship structure and process indicators is given in Table 11. The results from the survey of antimicrobial stewardship indicators should be interpreted with caution due to many missing data.

Approximately one in ten LTCF reported having a restrictive list for specified antimicrobials including: third generation cephalosporins (20.0%), fluoroquinolones (20.0%), broad spectrum antimicrobials (20.0%) and intravenous antimicrobials (80.0%), although only five LTCF provided data for this indicator. More than a third of LTCF reported being supplied with antimicrobials from more than one pharmacy (38.5%).

All LTCF reported having therapeutic guidelines for treatment of UTI though more than 80% of LTCF reported routinely or sometimes performing dipstick tests for the detection of UTI (82.7%). More than 90% of LTCF had treatment guidelines for wound and soft tissue infections and more than 80% had guidelines for treatment of RTI.

Only one LTCF reported having an antimicrobial committee in the LTCF.

Of the facilities that provide antimicrobial prescribing training (n=11), approximately half reported using Care Inspectorate resources (45.5%), half reported using resources from their own company (45.5%) and four fifths reported using Scottish Antimicrobial Prescribing Group (SAPG)/NES resources (81.8%).

Eight LTCF (15.7%) reported having a programme of surveillance of antimicrobial resistant microorganisms in place. Eight facilities reported that they had a programme of surveillance of antimicrobial consumption and feedback within the facility though none reported availability of data on annual antimicrobial consumption data by antimicrobial class.

Table 11: Antimicrobial stewardship structure and process indicators in surveyed Scottish LTCF.

	Indicator	All LTCF included in survey (n=52)	All LTCF with qualified nurses (n=35)	All LTCF without qualified nurses (n=17)
Characteristics of antimicrobial stewardship programmes	LTCF with an antimicrobial committee	1.9% (Data for 52 LTCF)	2.9% (Data for 35 LTCF)	0.0% (Data for 17 LTCF)
	LTCF that perform dipstick tests for the detection of UTI:			
	Routinely	42.3% (Data for 52 LTCF)	51.4% (Data for 35 LTCF)	23.5% (Data for 17 LTCF)
	Sometimes	40.4% (Data for 52 LTCF)	42.9% (Data for 35 LTCF)	35.3% (Data for 17 LTCF)
	Never	17.3% (Data for 52 LTCF)	5.7% (Data for 35 LTCF)	41.2% (Data for 17 LTCF)
	LTCF with a 'restrictive list' of antimicrobials to be prescribed	9.8% (Data for 51 LTCF)	14.3% (Data for 35 LTCF)	0.0% (Data for 16 LTCF)
	Of those, a restrictive list exists for:			
	Carbapenems	0.0% (Data for 5 LTCF)	0.0% (Data for 5 LTCF)	-
	Third generation cephalosporins	20.0% (Data for 5 LTCF)	20.0% (Data for 5 LTCF)	-
	Fluoroquinolones	20.0% (Data for 5 LTCF)	20.0% (Data for 5 LTCF)	-
	Vancomycin	0.0% (Data for 5 LTCF)	0.0% (Data for 5 LTCF)	-
	Mupirocin	0.0% (Data for 5 LTCF)	0.0% (Data for 5 LTCF)	-
	Glycopeptides	0.0% (Data for 5 LTCF)	0.0% (Data for 5 LTCF)	-
	Broad-spectrum antimicrobials	20.0% (Data for 5 LTCF)	20.0% (Data for 5 LTCF)	-
	Intravenously administered antimicrobials	80.0% (Data for 5 LTCF)	80.0% (Data for 5 LTCF)	-
	Antimicrobials are supplied by:			
	More than one pharmacy	38.5% (Data for 52 LTCF)	42.9% (Data for 35 LTCF)	29.4% (Data for 17 LTCF)
	Only one pharmacy	61.5% (Data for 52 LTCF)	57.1% (Data for 35 LTCF)	70.6% (Data for 17 LTCF)
	By the residents or their families	0.0% (Data for 52 LTCF)	0.0% (Data for 35 LTCF)	0.0% (Data for 17 LTCF)
Training of antimicrobial stewardship	LTCF with regular training on appropriate prescribing	1.9% (Data for 52 LTCF)	2.9% (Data for 35 LTCF)	0.0% (Data for 17 LTCF)
	LTCF that provide antimicrobial prescribing training to staff using:			
	Care Inspectorate resources	45.5% (Data for 11 LTCF)	44.4% (Data for 9 LTCF)	50.0% (Data for 2 LTCF)
	NES / SAPG resources	81.8% (Data for 11 LTCF)	77.8% (Data for 9 LTCF)	100.0% (Data for 2 LTCF)
	Company specific resources	45.5% (Data for 11 LTCF)	55.6% (Data for 9 LTCF)	0.0% (Data for 2 LTCF)
	LTCF with written guideliness for appropriate antimicrobial use in the facility	28.8% (Data for 52 LTCF)	37.1% (Data for 35 LTCF)	11.8% (Data for 17 LTCF)

	Indicator	All LTCF included in survey (n=52)	All LTCF with qualified nurses (n=35)	All LTCF without qualified nurses (n=17)
Components of multimodal strategies	**Therapeutic guidelines available for:**			
	Respiratory tract infections	81.0% (Data for 21 LTCF)	87.5% (Data for 16 LTCF)	60.0% (Data for 5 LTCF)
	Urinary tract infections	100.0% (Data for 13 LTCF)	100.0% (Data for 12 LTCF)	100.0% (Data for 1 LTCF)
	Wound and soft tissue infections	91.7% (Data for 12 LTCF)	91.7% (Data for 12 LTCF)	0.0% (Data for 0 LTCF)
	LTCF with a programme of surveillance of antimicrobial consumption and feedback	17.3% (Data for 52 LTCF)	22.9% (Data for 35 LTCF)	5.9% (Data for 17 LTCF)
	LTCF with a programme for the surveillance of resistant organisms in place in the facility (e.g. annual summary report of MRSA, *Clostridium difficile* etc)	15.7% (Data for 51 LTCF)	17.6% (Data for 34 LTCF)	11.8% (Data for 17 LTCF)
	LTCF with data available on annual antimicrobial consumption by antimicrobial class	0.0% (Data for 52 LTCF)	0.0% (Data for 35 LTCF)	0.0% (Data for 17 LTCF)

Validation of the 2017 HALT dataset

Training validation results

The results from the validation exercise undertaken following each training session are presented in Table 12. The sensitivity of HCAI diagnosis was 86.8% indicating that approximately nine out of ten of the data collectors correctly identified that the resident had a prevalent HCAI. The specificity was 80.0% which indicated that eight out of ten data collectors correctly identified when a resident didn't have a HCAI. The kappa statistic of 0.5 indicates a moderate level of agreement between data collectors.

The sensitivity of whether a resident was receiving an antimicrobial was 100.0% indicating that all data collectors correctly identified when a resident was receiving an antimicrobial. The specificity was 91.2% indicating that nine out of ten data collectors correctly identified when a resident was not receiving an antimicrobial. The kappa statistic of 0.8 indicates a good level of agreement between data collectors.

Table 12: Sensitivity, specificity and kappa statistic for validation exercise undertaken post-training

Data item	Sensitivity	Specificity	Kappa score
Resident has HCAI (yes/no)	86.8% (95% CI: 76.7 to 92.9)	80.0% (95% CI: 69.2 to 87.7)	0.5
Resident receiving antimicrobial (yes/no)	100.0% (95%CI: 94.8 to 100)	91.2% (95%CI: 82.1 to 95.9)	0.8

On-site gold standard validation results

A total of 55 residents in two LTCF were included in the gold standard validation exercise. The results are presented in Table 13. Five of the included residents had one HCAI each and five residents were receiving one antimicrobial at the time of survey. The sensitivity of HCAI data was 60.0% (95% CI: 23.1 to 88.2) indicating that six out of ten residents with HCAI were

correctly identified, and the specificity of HCAI data was 93.9% (95%CI: 83.5 to 97.9) indicating that nine out of ten residents without HCAI were correctly identified. The sensitivity of the antimicrobial data was 80.0% (95% CI: 37.6 to 96.4) indicating that eight out of ten residents receiving antimicrobials had been correctly identified, and the specificity of the antimicrobial data was 95.9% (95%CI: 86.3 to 98.9) indicating that approximately all residents without antimicrobials had been correctly identified. The very small number of HCAI identified and the resulting random variation introduced in this validation study mean the results should be interpreted with caution.

Table 13: On-site gold standard validation results

Data item	Sensitivity	Specificity
Resident has HCAI (yes/no)	60.0% (95%CI: 23.1 to 88.2)	93.9% (95%CI: 83.5 to 97.9)
Resident receiving antimicrobial (yes/no)	80.0% (95%CI: 37.6 to 96.4)	95.9% (95%CI: 86.3 to 98.9)

Discussion

This is the second PPS of HCAI and antimicrobial prescribing in Scottish LTCF. The results indicate that one in seventeen residents in Scottish LTCF had at least one infection related to the care they were receiving in the facility and one in fifteen residents were receiving at least one antimicrobial at the time of survey. On average, this means that approximately three residents in every adult LTCF in Scotland have a HCAI and are at an increased risk of morbidity and mortality associated with these infections; some of which are considered to be preventable.[23]

This is the first PPS in this setting in Scotland since 2010 and the results provide an evidence base pertaining to the epidemiology of HCAI, indicators of infection prevention and control and antimicrobial prescribing practices specific to this setting. This evidence can be used to inform the development of interventions to reduce HCAI and improve antimicrobial prescribing at both local care home and national level.[18;24]

The ageing Scottish population

Residents in care homes are at an increased risk of infection as they are older, sicker and have more care needs than the general population.[25-27] A survey of a sample of care homes in Scotland in 2014 reported that there was evidence that there had been a rise in the number of residents with more complex support needs since 2006.[21] The results from this survey indicate that the median age of residents was 84 years (IQR 77 to 90) and two thirds were female (67.5%). The level of care and support required by residents is evident in the indicators of relative need; the majority of residents surveyed (70.4%) were disorientated, more than two thirds were incontinent of urine and/or faeces (66.9%) and almost half were non-ambulant (49.6%). The majority of the residents had been living in the home long term with two thirds of residents living there for more than one year (68.7%). Nearly one in ten residents (8.7%) had been admitted to hospital at some point in the three months prior to the survey though only 0.3% had undergone surgery in the last 30 days. The relative needs of the residents are similar to those reported in the 2013 European HALT-2 survey and in three surveys undertaken in Ireland between 2010 and 2013[28] and any variation may be explained by differences in the types of facilities included in the surveys.

The demographics of the residents and their relative needs present challenges in preventing the spread of infection in LTCF and reducing risk of HCAI in an already frail population.[25;29-32] An Audit Scotland report describes a projected rise in LTCF activity arising from a growing, ageing population; the number of long-stay care home residents is predicted to increase by 35% and the number of people experiencing care at home to increase by 33%[33] highlighting the need for robust preventative measures across all health and social care settings. The Scottish Government's 2020 Vision is a person-centred, integrated approach to health and social care which aims to enable people to live longer, healthier lives in their homes or homely setting.[4] Integration of health and social care is integral to the 2020 Vision and the Scottish Government Health and Social Care Integration Delivery Plan[34] describes a model of anticipation, prevention and self-management. IPC and stewardship interventions need to be designed with consideration for this changing health and social care delivery model and the key HCAI types associated with an ageing population.

Epidemiology of HCAI and antimicrobial prescribing in Scottish LTCF

Healthcare associated infection in LTCF

The results from this survey indicate that the prevalence of HCAI was 5.9% (95% CI: 5.0 to 7.0). The prevalence of HCAI (2.6%, 95% CI: 2.2 to 3.1) reported in the 2010 PPS[15] in Scotland were not directly comparable due to differences in the protocol including case definitions for infection, the types of LTCF included in the surveys and the time of year in which the survey was undertaken (July and August 2010).[15] In addition, the 2017 survey protocol included an imported infection case definition to include infections that were healthcare associated but not associated with the current LTCF; three HCAI that originated in a hospital rather than in the current LTCF.[20]

A second HALT survey (HALT-2) was undertaken in Europe in 2013[17] and the prevalence was reported as 3.4%. England, Northern Ireland and Wales participated and the prevalence of HCAI was reported to be 6.8%, 5.8% and 3.8%, respectively. Whilst the results from these surveys are also not comparable due to differences in the protocol (with 'imported infections' not included in the HALT-2 protocol), these estimates are in line with the prevalence of HCAI measured in this survey. Whilst the protocol, case definitions and population included in this survey also differ from those used in the 2016 Scottish hospital PPS, the burden was in line with that reported in adult inpatients in Scottish acute hospitals (4.6%, 95% CI: 4.1 to 5.1).[35]

The European HALT-3 protocol[20] requires demographic, functional need and risk factor data to be collected aggregated at facility level. The Scottish protocol was amended to collect resident level risk factor data enabling multivariate analyses to identify independent risk factors associated with HCAI prevalence to be undertaken. In this survey, older age was independently associated with HCAI prevalence. Residents with a urinary catheter or wound had a significantly higher prevalence of HCAI after adjusting for the confounding effects of age. A linear relationship between increasing age and HCAI prevalence has previously been reported in older persons being cared for in Scottish acute care hospitals.[36] Several LTCF studies have also reported univariate associations between HCAI and pressure sores or other wounds, and HCAI and urinary catheters,[37-39] and a French PPS of HCAI in 'hospital at home' settings found that the presence of a urinary catheter, at least one vascular catheter and the most severe McCabe scores were independently associated with infection.[40]

Respiratory tract infections (38.1%), urinary tract infections (31.0%) and skin and soft tissue infections (23.0%) were the most commonly reported HCAI in the surveyed LTCF. This differs to the previous 2010 Scottish LTCF PPS; more than half of HCAI were UTI (52.7%), one in five were RTI (19.4%) and 15.5% were SSTI; this is likely relative to seasonality differences. The types of HCAI were similar to those reported in the 2013 Europe-wide HALT survey (HALT-2) where the most common HCAI groups were RTI (31.1%), UTI (31.1%) and skin or wound infections (22.8%)[17] and to those reported in the Scottish hospital PPS where the most common infections reported were UTI (24.5%) and pneumonia (22.4%).[35] There were few severe infections such as pneumonia (n=1) and no sepsis or bacteraemia reported in this survey; this likely reflects that LTCF residents who develop severe infections would be transferred to acute care for management. This will result in an underestimate of the number of these severe HCAI originating in the LTCF.

Antimicrobial prescribing in LTCF

The overall prevalence of systemic antimicrobial prescribing in Scottish LTCF was 6.5% (95% CI: 5.6 to 7.7) which is similar to the prevalence reported in the 2010 survey (7.3%, 95% CI: 6.6 to 8.1).[15] The prevalence of prescribing for the treatment of infection and for the prevention of infection (medical prophylaxis) were 4.9% (95% CI: 4.0 to 5.9) and 1.3% (95% CI: 0.9 to 1.9), respectively. The prevalence of prescribing in the 2013 European HALT-2 survey was 4.4%. England, Northern Ireland and Wales participated and the prevalence of prescribing was reported as 9.0%, 10.6% and 7.5%, respectively.[17] Less than a quarter of antimicrobials were prescribed for the prevention of infection (21.9%). This is similar to that reported in the 2013 European HALT-2 survey (27.2%) but less than that reported in Northern Ireland where more than half of the antimicrobials prescribed were given for prevention rather than treatment (53.3%); this was the highest in Europe.[17] In addition, any differences may also reflect differences in included resident population, LTCF structure and type of care given.

The most common reasons for prescribing for treatment of infection in surveyed Scottish LTCF in 2017 were; RTI (42.3%), UTI (34.6%) and SSTI (19.2%). This reflects the Europe-wide results from 2013 where the most common reasons were also RTI (39.0%), UTI (35.1%), and SSTI (16.0%).[17;41;42] The most commonly prescribed antimicrobials for treatment of infection were amoxicillin, trimethoprim, flucloxacillin and nitrofurantoin. There were few residents receiving broad spectrum antimicrobials associated with an increased risk of *Clostridium difficile* infection (n=11) and none were receiving very broad spectrum antimicrobials such as piperacillin/tazobactam or carbepenem antimicrobials. These very broad spectrum antimicrobials are likely only to be prescribed in an acute setting and there has been work undertaken in primary care in Scotland[43] to optimise antibiotic use through reducing unnecessary use of broad spectrum antibiotics. These results may reflect that clinicians are following local prescribing guidelines.

Respiratory tract infections

The most common HCAI reported in the survey were RTI; accounting for more than a third of HCAI and 2.3% of all surveyed residents had a RTI at the time of survey. The majority of these infections were lower respiratory tract infections (31.0%), with the remainder being common cold syndromes or pharyngitis, influenza-like illness, and pneumonia which accounted for 4.8%, 1.6% and 0.8%, respectively. There was only one resident with pneumonia at the time of survey. This likely reflects that residents still receiving active care and treatment, especially during the acute phase, would be transferred to hospital for treatment. The Public Health England (PHE) "Management and treatment of common infections: Antibiotic guidance for primary care" recommends that patients with a CURB65 score (risk score based on confusion, urea, respiratory rate and blood pressure) greater than or equal to 3 or where the patient is causing clinical concern, should be admitted to acute care for intravenous antibiotics.[44] This guidance has been adopted in Scotland as recommended by SAPG. These results indicate that the burden of treating pneumonia is likely to lie with secondary care and it is not possible from these data to determine the burden of pneumonia associated with healthcare in the LTCF. The results from the 2016 Scottish hospital PPS indicated that 2.6% of acute hospital patients aged over 65 years that were being treated for pneumonia that wasn't acquired in the hospital, had acquired the pneumonia in a LTCF.[35]

In the 2013 European survey, RTI was the most common HCAI group and the most common reason for prescribing antimicrobials for the treatment of infection.[17] The 2016 Scottish hospital PPS reported a similar burden of RTI which accounted for nearly a quarter of all HCAI in acute adult patients and 15% of HCAI in non-acute hospital patients, the majority of these HCAI were pneumonia.[35] RTI were also the most common reason for prescribing to

treat infection with over a third of all antimicrobials prescribed to treat community acquired infection given to treat pneumonia.[35]

There is a need for national guidelines for the prevention of pneumonia or LRTI for use in LTCF and the wider healthcare system. The current National Institute for Health and Care Excellence (NICE) guidelines for diagnosis and management of pneumonia in adults does not include recommendations for interventions to prevent pneumonia.[45] Many IPC interventions for the prevention of healthcare associated RTI focus on ventilator associated pneumonia in hospital.[46;47] A review of guidance and literature relating to pneumonia in non-ventilated patients reported that there was a lack of evidence for preventative measures and no specific national guidance had been issued by professional societies or professional medical associations for the prevention of these infections.[47]

Many of guidelines relating to LRTI focus on the management of infections rather than prevention. The PHE guidelines for minimising transmission of RTI focus on the IPC precautions rather than reducing the individual risk of infection.[48] There is some evidence that good oral care; prevention, early diagnosis and treatment of aspiration and dysphagia; and early mobilisation of patients to improve clearance of respiratory secretions were associated with a reduced risk of pneumonia[47] and these interventions will potentially reduce the risk of RTI more generally. Approximately half of the residents in this survey were non-ambulant and these residents had a higher prevalence of RTI than those who were ambulant, though this comparison was not adjusted for confounding by other risk factors. Improvement programmes are under way in Scotland such as Care about Physical Activity (CAPA) designed to help older people in care to move more often[49] and have the potential to reduce the risk of RTI as a result of immobility.

RTI were also the most common reason for prescribing antimicrobials to treat infection in this survey; accounting for nearly half of all prescribed. Amoxicillin, doxycycline and clarithromycin were the most commonly prescribed antimicrobials and these are in line with what is recommended in the PHE guidance although the appropriateness or compliance with local prescribing policy were not assessed in this survey. The Scottish Reduction in Antimicrobial Prescribing (ScRAP) programme, launched in 2013, is an educational toolkit to help support a reduction in unnecessary prescribing for RTI in primary care.[50]

One of the key public health interventions for the prevention of RTI is vaccination. In Scotland, the vaccination schedule[51] for over 65s includes pneumococcal polysaccharide vaccine (PPV) and influenza vaccine. The majority, though not all, of the facilities reported offering annual influenza vaccination to residents. The benefits of vaccination in reducing RTI, including bacterial infections secondary to influenza, should be promoted in this setting. In addition to resident vaccination, staff vaccination for influenza in LTCF should be considered an integral component of infection control procedures and providers should arrange for vaccination of their staff.[52]

Development of quality improvement tools for the prevention of LRTI and pneumonia and good prescribing stewardship based on the above noted evidence may assist frontline health and social care staff in reducing the risk of these infections and may reduce the burden these infections place on patients/residents and the wider healthcare system.

Urinary tract infections

The results from this survey and other surveys indicate that UTI place a significant burden on residents and LTCF.[17;37-40;53] UTI were the second most common HCAI in the surveyed LTCF accounting for nearly a third of all HCAI (31.0%) with one in fifty residents having a UTI at the time of survey. In the 2013 European survey, 31.2% of all infections were UTI.[17] More

than a third of antimicrobials prescribed to treat infection were for UTI; this is similar to the proportion reported in European countries[17;37-40] and in a survey of LTCF in the United States.[53] UTI were also the most commonly reported HCAI reported in the 2016 Scottish hospital PPS indicating the scale of the burden across Scottish healthcare systems.[35]

Catheterisation is a recognised risk factor for UTI.[54] Approximately one in twelve residents were catheterised and this represents a significant burden of residents who are at a higher extrinsic risk of UTI. It was not possible to determine which of these UTI were catheter associated UTI (CAUTI) although residents with UTI had a significantly higher prevalence of catheterisation. In addition, catheterisation was significantly associated with the prevalence of HCAI in the multivariate modelling indicating an association between this risk factor and a higher prevalence of all HCAI. There are limitations to the interpretation of this association between an extrinsic risk factor (urinary catheterisation) and infection outcome using prevalence data as it is not possible to determine the temporal relationship between the risk factor and outcome; it is possible that a resident was catheterised to treat the symptoms of a UTI. Nonetheless, urinary catheter care is paramount in reducing risk of UTI.

The National Catheter Passport,[55] developed by Scottish UTI Network[56] (SUTIN) and launched in January 2018, aims to ensure continuity of catheter care across care settings, including the management of catheters in LTCF settings, and to minimise the risk of CAUTI. The passport is not mandatory though its use is encouraged in all health and care settings including LTCF and is free at point of use. The majority of LTCF reported that there were written protocols available for the management of urinary catheters (94.1%). A key component of any guidance is ensuring that alternatives to catheterisation have been considered as the key intervention to minimise the risk of CAUTI is not to catheterise in the first place.[57] Ensuring consistent application of standard infection control precautions (SICPs) and use of CAUTI prevention care bundles are essential in the prevention of UTI[58;59] and further promotion of the use of nationally developed evidence based bundles should be considered for the LTCF setting.[60]

More than two thirds of residents in this survey were incontinent of urine and/or faeces. Scottish Care promote the view that continence should be the 'norm' and that the focus should always be on 'cure' and where 'cure' is not possible, there should be a culture promoting continence rather than over reliance on products.[61] Optimising fluid intake is an essential component of strategies to improve continence and interventions to improve hydration have been shown to reduce UTI and improve other outcomes in older persons; including reducing the risk of falls, skin damage including pressure ulcers, delirium, acute kidney injury and other infection types.[54;62-65] A national hydration campaign is being launched in Scotland in April 2018 when campaign materials including posters and leaflets (some with a specific LTCF focus) will be made available to care providers.[56] Using a whole health population approach but mindful of high risk groups including older people, this campaign aims to:

- Support the prevention of UTI and Gram negative bloodstream infections within the general population
- Convey the public health benefits of good hydration in terms of UTI prevention
- Support the work of other national health programmes where good hydration can be beneficial to outcome e.g. prevention/reduction of falls, pressure ulcers, delirium and acute kidney injury

Half of the UTI reported in this survey were diagnosed without a microbiology report and more than 80% of LTCF reported using dipstick tests to diagnose UTI. This is contrary to the

recommendation in the SAPG decision aid for diagnosis and management of suspected UTI in older people[66] and in people with indwelling catheters[67] that dipstick testing should not be used to diagnosis UTI. The 'To Dip or Not to Dip' quality improvement project undertaken in older people living in care homes in a trust in England promoted using the SAPG decision aid in place of using a urine dipstick to diagnose UTI.[68] Whilst it was not possible to determine whether the antimicrobials given for UTI were prescribed appropriately based on the decision aid, the results from this survey indicate that further work is required to improve diagnosis of UTI in older persons including the use of dipstick testing in this population.

Trimethoprim and nitrofurantoin were the most commonly prescribed antimicrobials for treatment of UTI, accounting for more than 80% of antimicrobials prescribed. This is in line with the first line choice antimicrobials in the SAPG decision aid for older people[66] and detailed in local antimicrobial guidelines. It is possible that other antimicrobials were prescribed following culture results or in residents who were catheterised, where the SAPG decision aid for the management of CAUTI recommends following local policy or advice from the microbiology laboratory.[67] The majority of antimicrobials prescribed to prevent infection were prescribed to prevent UTI (85.7%) and two fifths of all antimicrobials prescribed for the urinary tract were prescribed to prevent UTI rather than treat. The evidence base for prophylactic use of antimicrobials for UTI is limited and not current[69] and these data provide some preliminary evidence pertaining to routine use in LTCF. Training staff in the evidence base for diagnostic testing and stewardship is key to reducing inappropriate prescribing. The Scottish Reduction in Antimicrobial Prescribing (ScRAP) programme is an educational toolkit to help support a reduction in unnecessary prescribing in primary care and was updated in 2017 to include sessions on the management of UTI.[50] This programme also promotes the SAPG decision aid and sending urine for culture rather than dipstick testing, if relevant symptoms are present, as a method of diagnosing UTI in older persons and persons with catheters.

Skin and soft tissue infections

Skin and soft tissue infections accounted for almost a quarter of HCAI in this survey; the majority of which were soft tissue infections (19.8% of all HCAI). There was only one resident with a prevalent surgical site infection at the time of survey. The case definitions for SSTI used in this survey did not distinguish between different types of soft tissue infections. These infections may include pressure ulcers, venous ulcers, traumatic wounds or skin tears that have become infected. The multivariate analyses indicated that residents with wounds had a significantly higher prevalence of all HCAI than those without wounds; though it is not possible to determine if this is a result of wounds representing a symptom of infection or a risk factor for infection. This is a limitation of measuring the association between some extrinsic risk factors and the prevalence of HCAI.

Approximately one in ten residents had a wound of any sort and the prevalence of pressure ulcers of any grade was 3.5%. The key intervention for reducing infections associated with pressure ulcers and skin tears is to prevent them developing in the first place and to manage them appropriately should they develop.[70] The HIS Standards for prevention and management of pressure ulcers specify a minimum set of performance standards[70] and in 2017, the Care Inspectorate published a Tissue Viability template policy intended to support care providers in developing local policies and procedures.[71] NES have developed online modules on the "Prevention and Management of Pressure Ulcers" and "Skin Tears: Prevention, Assessment and Management"[72] that are available for use by health and social care staff and forms part of the integrated programme for a national coordinated approach to Tissue Viability.[73]

A fifth of antimicrobials prescribed to treat infection were for SSTI with flucloxacillin the most commonly prescribed antimicrobial (70.0%). This is the recommended first line therapy for

SSTI in patients without penicillin allergy in the PHE current guidance indicating that the policy is being followed in primary care.[44]

The organisation of IPC and antimicrobial stewardship in LTCF

The IPC and stewardship indicator data collected in this survey provide an opportunity to describe the way IPC is organised and services are delivered.[74] There is variation in the organisation of IPC and this likely reflects the differences in the ownership (public, for profit, not for profit) and the types of care that are delivered in the facilities (with/without nursing care). Surveys undertaken in other countries have previously reported gaps in IPC and antimicrobial stewardship activities and the need for national initiatives specific to the LTCF setting.[75-77]

The Scottish infection control standards for adult care homes published in 2005[78] state that accountability and clear lines of responsibility are required and that an IPC "group" should be set up to support and endorse the IPC programme and monitor the progress of the programme. Three quarters of LTCF reported that they did not have an infection control committee whereas approximately half of LTCF facilities included in the 2013 European HALT-2 survey reported having an IPC committee.[17] Results from the other UK countries participating in the 2013 HALT survey indicated that there was variation with England, Northern Ireland and Wales reporting that 68.8%, 36.7% and 7.5% of LTCF facilities with an IPC committee, respectively. It is possible that this variation is explained by interpretation of the protocol, variation due to the small number of LTCF included in England (n=16) and participation bias.

Three quarters of LTCF reported having access to persons with training in IPC and more than two thirds reported having staff members who had been trained in IPC. The majority of the LTCF reported having an awareness of the NES IPC educational resources though only two thirds reported having used the training resources. The NES "Preventing Infection in Care" education programme was developed to help prevent and control the risk of infection and to provide a safe, clean environment within all care settings including care homes, home environments, residential housing and day care services for adults.[79] Further promotion of this resource in LTCF would further develop the LTCF staff in IPC.

There was variation in the way that the LTCF received their IPC advice. Three quarters of LTCF reported obtaining IPC advice from the local health protection teams (HPT), approximately a third from local hospital infection prevention and control team (IPCT) and one in thirteen receiving advice from somewhere other than the HPT or IPCT; with some reporting receiving advice from more than one source. There was also variation in the surveillance and audit activities within LTCF with approximately a half undertaking HCAI surveillance and approximately half undertaking surveillance/audit of compliance with IPC policies and procedures. Surveillance/audit and feedback of the results is a core component of an effective IPC programme in acute care facilities[80] and intelligence from surveillance and audit in LTCF would further assist with the identification of local quality improvement priorities in this setting.

The management of multidrug resistant organisms (MDRO) in this setting can be challenging as the care environment is also the residents' home. Whilst most of the rooms in these facilities were single occupancy (99.2%), it can be difficult to isolate residents particularly in a population where more than two thirds of the residents are disoriented in time and place and are encouraged to use communal social and dining areas. Whilst the level of risk for infected or colonised individuals is lower than that in acute care settings, if infection control precautions in care settings are inadequate, resistant bacteria may spread among individuals

who more commonly congregate together, or use communal facilities or care equipment such as bathrooms, hoists or commodes. The prevalence of MDRO such as carbapenemase-producing Enterobactericeae (CPE) is still thought to relatively low in Scotland though the number of MDRO reported are increasing each year.[81] Measures to prevent the spread of these microorganisms in all health and social care settings are key to containing AMR and ensuring that antimicrobials continue to be effective in the future. Whilst the SICPs and transmission based precautions (TBPs) described in the NIPCM[82] should be applied in all care settings, the interventions and guidelines need to be tailored with consideration for the homely setting of a LTCF. A toolkit for the management of CPE in Scottish non-acute care setting was developed with the mental and physical health and wellbeing of the individual in mind and provides a risk based approach for managing individuals with CPE.[83] Only one in six facilities reported having a registration system for recording residents who were colonised or infected with a MDRO though the majority did report having a written protocol for the management of MRSA and/or other MDRO and eight reported undertaking surveillance of MDRO. Just over half reported making decisions on isolation and additional precautions for residents colonised with MDRO. In addition to variation in a coordinated approach to the management of residents with MDRO, microbiology results were only available for two of the HCAI reported in this survey. This doesn't necessarily reflect that samples were not sent for testing, rather that the actions are taken by the GP practice and the details of the results not provided to or not recorded in the resident's notes held by LTCF. Whilst this might be suitable for management of the individual resident's care, it does not provide insight into the epidemiology of MDRO in the facility particularly as facilities may be served by more than one practice.

In only two thirds of LTCF, did nursing staff report being able to consult all residents' medical and clinical records. As with microorganism data, medical and clinical records generated by general practice staff are generally held at the GP practice and therefore LTCF nursing staff unlikely to have access to this. Nursing staff have access to nursing/clinical notes generated within their own LTCF and to which visiting clinicians may input.

Hand hygiene is one of the most important interventions for the prevention of HCAI. Two thirds of facilities reported having delivered hand hygiene training in the past year. Availability of ABHR at the point of care is an enabler of good hand hygiene uptake and practice[84] and the NIPCM states that ABHR must be available as near to point of care as possible.[82] More than three quarters of facilities reported having ABHR available for hand hygiene, however only 15.4% of LTCF reported this as the most frequently used method of hand hygiene. These results are similar to that reported in the UK countries that participated in the 2013 European survey where 5.0%-12.5% of facilities used ABHR as the most common method of hand hygiene despite the majority of facilities having ABHR products available for use.[17] There may be practical reasons for not having ABHR at point of care in this setting but where this is not possible, personal ABHR dispensers can be used.[82] More than half of facilities reported having alcohol wipes for hand hygiene and this is contrary to the NIPCM[82] which states that these products should be only be used for hand hygiene when there is no running water in the facility; the survey did not collect information about whether this was a commonly used method of hand hygiene. Nearly half of the surveyed facilities reported using water and antiseptic soap and over a third reported using water and non-antiseptic soap as the most common method of hand hygiene.

Whilst good quality evidence to support IPC programmes in LTCF is limited[85-90], multimodal strategies have been proven to be effective in LTCF.[25;91-93] Multimodal is described as a cultural approach to IPC taking account of local context and conditions, surveillance, training/education, bundles and guidance developed and owned by local interdisciplinary teams.[94] It is a quality improvement approach at an organisational level. The development of local multimodal strategies within LTCF settings may be challenging due to the differences in the ownership and

organisation of the service, including the way IPC is organised. However, a key recommendation from the Scottish hospital PPS of 2016 was the development of national multimodal strategies for the prevention of pneumonia and UTI.[35] Given the proportion of patients with community acquired pneumonia and UTI admitted to hospitals, including those coming from care homes, a health and social care approach across this collective pathway should be considered.

Antimicrobial stewardship indicator data were also collected in this survey and provide an insight into the organisation of stewardship in LTCF. It should be noted that these data were often incomplete and the missing data likely reflects that the vast majority of prescribing is by clinicians who are not based in the facility rather than the staff who were collecting the survey data. Only one of the included LTCF reported having an antimicrobial committee that was in charge of the development of local guidelines and protocols for use in the facility. This is not surprising since local antimicrobial stewardship is coordinated in Scotland through health board Antimicrobial Management Teams based in secondary care but with a remit for and links to primary care teams. None of the facilities reporting having data available on antimicrobial consumption though nine reported a programme of surveillance of antimicrobial consumption and feedback. Local surveillance data is available via a national database which can be accessed by Prescribing Advisers who share reports on these data at regular meetings with GP practice teams. Reports can be prepared at practice level and can include data for patients living in LTCF. Five of the facilities reported having a restrictive list of antimicrobials and the restriction included third-generation cephalosporins (n=1), fluoroquinolones (n=1), broad spectrum antimicrobials (n=1) and intravenous antimicrobials (n=4). LTCF in Scotland would not be expected to have a restricted list of antimicrobials since prescribing will be done by primary care clinicians who follow local guidelines that restrict broad spectrum antimicrobials. More than a third of facilities reported being supplied with antimicrobials from more than one pharmacy. This has implications for monitoring use of antimicrobials and preventing duplication as well as potential confusion in providing a pharmaceutical care service to a LTCF. Community pharmacists have a legal requirement to provide various checks of LTCF that they supply medicines for to ensure safe and secure storage of medicines and also to provide advice for LTCF staff. Involvement of more than one community pharmacy in providing a service may make this difficult.

Limitations

Prevalence surveys report the prevalence at the time of survey and may not represent the LTCF HCAI prevalence at all times. Furthermore, there may have been an overestimation of specific infection types since prevalence surveys tend to be biased towards identifying HCAI of longer duration. In addition, the burden of more severe HCAI is likely underestimated in this population as residents with these infections may be transferred to hospital for treatment. This is notable, for example, in the absence of sepsis and bloodstream infections in the reported HCAI types.

The main limitation of the survey lies in the accurate application of specified definitions by a large number of data collectors. Many of the data collectors had not been involved in an epidemiological survey before, and many of the medical, nursing and epidemiological terms used in the standard definitions may have been new to many data collectors too. In addition, due to a limited number of training sessions and capacity issues within the LTCF, most LTCF only trained one data collector each, meaning that one person had the responsibility for accurately collecting all data. However, the post-training assessment exercise indicated a good level of agreement between data collectors and nine out of ten data collectors correctly identified when a resident had a HCAI. There was some evidence of underreporting of HCAI in this survey based on the results from the gold standard validation survey with three out of five HCAI correctly identified as meeting the case definition by the local data collection

team. Whilst the sensitivity of 60% was in line with that reported in the 2016 hospital PPS,[35] the wide confidence intervals around the sensitivity estimates limit the interpretation of the results. These results, based on a small number of LTCF (n=2) and HCAI cases (n=5), should be interpreted with caution and for this reason, the prevalence estimate was not adjusted to account for this in the same way the hospital HCAI prevalence estimate was.[35]

The number of participating LTCF and residents was lower than expected, and since the survey was voluntary, the sample may not have captured those LTCF with higher prevalence. This may have affected the confidence surrounding the prevalence estimates and the representativeness of the sample. This said, the sample representativeness was categorised as 'good' by ECDC as more than 25 LTCF were included and a sufficient number of residents.[20]

Microorganism data were only available for two HCAI. This information is usually held within GP records and not in resident notes at the LTCF. If a test result is positive, then the GP will usually contact the LTCF or send a prescription directly to the pharmacy and medications to treat an infection will be delivered to the LTCF. The lack of specific microbiological data may have affected the completeness and accuracy of a HCAI diagnosis.

Missing data was an issue for a few data items, including the IPC and antimicrobial stewardship indicator data. Residents or LTCF with missing data were excluded from the denominator.

Summary

Healthcare associated infections place a significant burden on LTCF in Scotland; it is estimated that, on average, there are three residents in every LTCF in Scotland with a HCAI at any one time. This burden, alongside the challenges in infection prevention and control in a LTCF setting, represent a public health threat with implications for resident safety and containing the threat of MDRO in Scotland.

This survey, the first for seven years, has provided important evidence regarding the epidemiology of infection in LTCF and has highlighted the importance of this type of intelligence in informing priorities for quality improvement. RTI, UTI and SSTI were the most commonly reported infections and there is a need for HCAI specific interventions to reduce the risk alongside the need for broader public health interventions such as promotion of hydration, nutrition and mobilisation in older persons. The lack of information relating to causative organisms circulating in LTCF highlights that the burden of MDRO in this setting is not well understood. Further epidemiological characterisation of HCAI in LTCF, including the epidemiology of MDRO, will be essential to the successful prevention and control of HCAI and containment of AMR.

Approximately one in fifteen residents were receiving an antimicrobial, highlighting the need for effective stewardship programmes in this setting. There was some indication that the antimicrobials prescribed for treatment of specific infection types were largely in line with national recommendations. This provides some evidence that policies and decision aids are being used in primary care in terms of the antimicrobials being prescribed as treatment. However, further improvement work is required to ensure appropriate diagnostic testing is undertaken and that the routine use of UTI prophylaxis is reduced.

This survey has also highlighted that there is much variation in the way IPC is organised and delivered in Scottish LTCF; more so than in NHS hospitals. This will, in part, be due to the multiple stakeholders and service providers involved in delivering care in this setting and the different types of ownership. Nonetheless, there is a need to ensure IPC and antimicrobial stewardship programmes are strengthened in this setting including the provision of these services in a changing healthcare delivery model.

In conclusion, the results from this survey has identified the need for broader and coordinated public health approach to preventing HCAI alongside strengthened IPC and antimicrobial stewardship programmes in this setting. The public health goals should be to: reduce resident morbidity and mortality as a result of potentially preventable infection; reduce prescribing associated with treating these infections and risk of AMR; reduce the need for residents to be admitted to hospital for treatment; and reduce the risk of HCAI should admission to hospital be required.

An infographic of the executive summary of results and recommendations from the survey can be found here.

Recommendations

These data should be considered by the Scottish AMR and HAI Strategy Group (SARHAI) and the Care Inspectorate in order to inform future policy priorities and activity using intelligence on the current epidemiology of HCAI, antimicrobial prescribing and IPC indicators in LTCF.

Priority areas for IPC quality improvement

- Development of a multimodal national programme for prevention of pneumonia and lower respiratory tract infections across all health and social care settings
- Development of a multimodal national programme for prevention of UTI across all health and social care settings
- Further focus on implementation of CAUTI prevention bundles for insertion and maintenance of urinary catheters in LTCF setting
- Promote the National Catheter Passport in LTCF setting
- Promote hydration, nutrition and mobilisation as broad public health interventions with potential to impact on reducing multiple harms including the key HCAI types reported in this survey
- Promote the national hydration campaign and available materials for use in the LTCF setting
- Promote NIPCM use in LTCF settings ensuring interventions and guidelines are tailored with consideration for the homely setting of a LTCF
- Improve availability and use of ABHR at point of care where appropriate or the use of personal ABHR
- Promote the use of extant NES IPC educational resources for LTCF staff
- Promote the use of extant NES educational resources to support prevention of SSTI
- Promote the use of extant NES education resources to promote continence and support prevention of UTI
- Develop educational resources for management of residents with MDRO that are accessible to health and social care staff
- Development of pragmatic guidance for management of residents with MDRO in LTCF
- Promote vaccination schedule for over 65s (flu and PPV) in LTCF
- Promote flu vaccination of health and social care staff working in LTCF
- LTCF to ensure IPC governance and accountability are in line with current standards

Priority areas for surveillance activities

- Develop intelligence on the epidemiology of HCAI, AMR and antimicrobial prescribing in LTCF using, where possible, existing national datasets
- Undertake five yearly PPS in LTCF

Priority areas for antimicrobial stewardship

- Continue work to improve prescribing by promotion of the SAPG decision aids and the PHE guidelines for management and treatment of common infections
- Promote the use of NES ScRAP educational resource to reduce unnecessary prescribing in primary care
- Promote review of residents on UTI prophylaxis
- Promote sending samples to microbiology for culture and sensitivity testing when infection is suspected
- Stop use of dipstick urine testing in diagnosis of UTI in LTCF

Appendices

Appendix Table A1: Characteristics of surveyed Scottish LTCF residents in 2017

Characteristic group	Characteristic	Number of residents with each characteristic	Number of residents surveyed	Prevalence (%)	95% Lower CI	95% Upper CI
Demographics	>85 years	942	2147	43.9	41.8	46.0
	Male	698	2147	32.5	30.6	34.5
Indicators of relative need	Disorientation	1511	2146	70.4	68.4	72.3
	Incontinence	1437	2147	66.9	64.9	68.9
	Wheelchair user or bedridden	1064	2147	49.6	47.4	51.7
Risk factors	Hospital admission (3 months)	186	2147	8.7	7.5	9.9
	Other wounds	155	2147	7.2	6.2	8.4
	Pressure sore	76	2146	3.5	2.8	4.4
	Surgery (30 days)	6	2147	0.3	0.1	0.6
	Urinary catheter	182	2146	8.5	7.4	9.7
	Vascular catheter	3	2146	0.1	0.0	0.4
Other	Length of stay one year or longer	1475	2146	68.7	66.7	70.7

Appendix Table A2: Number antimicrobials prescribed for the treatment of HCAI in surveyed Scottish LTCF residents in 2017

Antimicrobial name	Number of antimicrobials	Percentage
Amoxicillin	29	27.6
Trimethoprim	17	16.2
Flucloxacillin	15	14.3
Nitrofuratoin	12	11.4
Doxycycline	10	9.5
Clarithromycin	6	5.7
Co-amoxiclav	6	5.7
Erythromycin	2	1.9
Metronidazole	2	1.9
Cefuroxim	1	1.0
Ciprofloxacin	1	1.0
Fosfomycin	1	1.0
Lymecycline	1	1.0
Nystatin	1	1.0
Rifaximin	1	1.0
Total	**105**	**100.0**

Appendix Table A3: Number of antimicrobials prescribed for the prevention of HCAI in surveyed Scottish LTCF residents in 2017

Antimicrobial name	Number of antimicrobials	Percentage
Nitrofurantoin	11	39.3
Trimethoprim	9	32.1
Cefalexin	2	7.1
Doxycycline	2	7.1
Amoxicillin	1	3.6
Azithromycin	1	3.6
Co-amoxiclav	1	3.6
Phenoxymethylpenicillin	1	3.6
Total	**28**	**100.0**

Appendix Table A4: Distribution of antimicrobials for treatment of infection in surveyed Scottish LTCF residents in 2017, by main diagnosis group

Diagnosis group	Antimicrobial name	Number of antimicrobials prescribed	Percentage
Respiratory tract infections	Amoxicillin	21	47.7
	Doxycycline	10	22.7
	Clarithromycin	6	13.6
	Co-amoxiclav	4	9.1
	Metronidazole	2	4.5
	Flucloxacillin	1	2.3
	Total	**44**	**100.0**
Urinary tract infections	Trimethoprim	17	47.2
	Nitrofurantoin	12	33.3
	Amoxicillin	3	8.3
	Co-amoxiclav	2	5.6
	Ciprofloxacin	1	2.8
	Fosfomycin	1	2.8
	Total	**36**	**100.0**
Skin and soft tissue infections	Flucloxacillin	14	70.0
	Amoxicillin	3	15.0
	Erythromycin	2	10.0
	Lymecycline	1	5.0
	Total	**20**	**100.0**

Appendix Table A5: Distribution of antimicrobials for prevention of infection in surveyed Scottish LTCF residents in 2017, by main diagnosis group

Diagnosis group	Antimicrobial name	Number of antimicrobials prescribed	Percentage
Urinary tract infections	Nitrofurantoin	11	45.8
	Trimethoprim	9	37.5
	Cefalexin	2	8.3
	Co-amoxiclav	1	4.2
	Phenoxymethylpenicillin	1	4.2
	Total	**24**	**100.0**
Skin and soft tissue infections	Doxycycline	2	100.0
	Total	**2**	**100.0**
Respiratory tract infections	Azithromycin	1	100.0
	Total	**1**	**100.0**

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