A SMALL MOLECULE DRUG SCREENING IDENTIFIES THE ANTIBIOTIC COLISTIN SULFATE AS AN ENHANCER OF NK CELL CYTOTOXICITY

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Abstract

Cancer immunotherapy is an encompassing term referring to therapeutic strategies that aim to boost the immune system to fight cancer. These strategies include administering immune cells that have been altered to have greater anti-tumor activity or using biologics and small molecules that target immune components to also promote tumor clearance. Natural Killer (NK) cells are cells of the innate immune system that recognize and kill abnormal cells such as cancer cells and play an important role in the anti-tumor response. Because of their crucial role in tumor immunity, NK cells are prime targets for immunotherapies. Repurposing small molecule drugs is an attractive strategy to identify new immunotherapies from already approved drugs. Here, we screened 1,200 approved drugs from the Prestwick Chemical Library to identify drugs that increase NK cell cytotoxicity. We used a high-throughput luciferase-release cytotoxicity assay to measure the killing of the myeloid leukemia cell line, K562 cells expressing nano luciferase (NL) by NK92 cells, a human NK cell line. From the drug candidates identified from the screening assay, the antibiotic colistin sulfate increased cytotoxicity of the NK92 cell line and unstimulated human NK cells towards K562-NL cells. This increase in NK cytotoxicity was short-lived as pre-treating NK92 cells with colistin for 1 hour or 24 hours did not increase cytotoxicity. Also, we show pre-treating K562-NL target cells with colistin does not sensitize them to NK-mediated killing. Further studies are needed to uncover the mechanism of action of colistin, thus contributing to knowledge of fundamental NK cell biology regarding NK cell cytotoxicity which will aid in identifying additional small molecule drugs that enhance NK cell activity.

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List of Abbreviations

ADCC: antibody-dependent cell-mediated cytotoxicity

CAR: chimeric antigen receptor

CD: Cluster of Differentiation

CTZ: coelenterazine

E:T: effector:target

Fab: fragment, antigen-biding

FASL: FAS ligand

FBS: fetal bovine serum

Fc: fragment crystallizable

FMZ: furimazine

HLA: human leukocyte antigen

IFN-γ: interferon gamma

ILC1: type 1 innate lymphoid cell

KEGG: Kyoto Encyclopedia of Genes and Genomes

LPS: lipopolysaccharide

MAPK: mitogen-activated protein kinase

NK: Natural Killer

NL: nano luciferase

PBMCs: peripheral blood mononuclear cells

PI3K: phosphoinositide 3-kinase

SD: standard deviation

TLR: Toll-like receptor

TNF: tumor necrosis factor

TRAIL: TNF-related apoptosis-inducing ligand

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1. Introduction

1.1. Cancer immunotherapy overview

Historically, surgery, radiation and chemotherapy were the first cancer therapeutics used to treat cancer and for many cancer indications they remain first-line therapies today[1]. Since cancer is heterogenous disease, multiple therapeutic options are necessary for patients that are resistant to initial therapy or are no longer responsive to therapy after disease relapse or progression. As the field of cancer biology has progressed, cancer therapeutics have evolved to target more specific components such as growth factors, receptors or enzymes implicated in these malignancies using small molecules or monoclonal antibodies[2], thus adding to the therapeutic toolbox. Seminal studies from the 1990s and early 2000s highlighted the importance of the immune system in tumor biology through processes such as immunosurveillance and immunoediting[3], which in turn led to the most recent advances in cancer therapeutics: immunotherapies. Cancer immunotherapy is an encompassing term referring to therapeutic strategies that target components of the immune system to enhance clearance of the malignant cells. Various categories of immunotherapies exist such as immune checkpoint blockade, adoptive cell transfer, cytokines administration, cancer vaccines, and oncolytic virus therapy[4]. Encouragingly, some immunotherapies are becoming first-line treatments for cancer types such as colorectal and non-small cell lung cancer[5,6]. As the field of immunotherapy continues to develop, we have gained a better understanding of how some immune cells can contribute to immunotherapy efficacy, for instance Natural Killer (NK) cells. NK cells are innate lymphoid cells that play a crucial role in tumor surveillance and clearance[7]. Because of this role, NK cells can either be administered as an immunotherapy (adoptive cell therapy) or can be the target of immunotherapies that enhance their anti-tumor activity[8].

1.2. NK cells overview

NK cells are derived from the common lymphoid progenitor and further classified as type 1 innate lymphoid cells (ILC1s)[9]. NK cells develop in the bone marrow and secondary lymphoid tissues[9], they make up 5-20% of peripheral blood and are found at varying frequencies in different tissues of the body[10,11]. NK cells are mainly recognized as cytotoxic cells that kill abnormal cells such as infected or cancerous cells. However, they are also involved in homeostatic functions such as modulating uterine vasculature during pregnancy[11], and in the contraction of immune responses upon infections or autoimmunity[12]. NK cells also produce cytokines that modulate the activity of other immune cells such as macrophages and T cells[13].

1.3. NK cell surface markers, receptors, and cytotoxicity

In humans, NK cells are distinguished from other immune cell types by surface expression of CD56 and lack of expression of CD3. Clinically, markers such as CD57, CD56, CD16 or NKp46 are used to identify NK cells in tissues[14]. NK cells are further subdivided as $CD56^{dim}CD16^{+}$ and $CD56^{bright}CD16^{-}$, with the former making up 90% of peripheral blood NK cells and the latter mostly found in secondary lymphoid tissues[15]. NK cells express a variety of germline encoded receptors that are classified as activating and inhibitory receptors that are used to interact with their surroundings and modulate their activity depending on the encountered target[16]. Activating receptors recognize ligands that become upregulated on unhealthy cells such as stressed, infected or cancerous cells[17]. Examples of activating receptors are CD16, NKG2D, NKp46, NKp30 and 2B4[18]. NK cells rely on the synergistic signaling of several activating receptors to become activated[19,20]. Activation leads to an increase in intracellular calcium, actin polymerization, degranulation, and cytokine production[18]. Inhibitory receptors recognize HLA molecules on host cells to ensure that NK cells do not kill healthy cells[21]. Another type of inhibitory receptors called

checkpoint receptors are typically upregulated in settings of chronic infection, cancer or exhaustion and function to dampen NK cell activity[21]. An NK cell's activity relies on the interplay of activating and inhibitory signaling, with typically the inhibitory signals prevailing[22]. If inhibitory signals are present, there needs to be sufficient engagement of multiple activating receptors to pass the critical threshold for NK activation. If inhibitory signals are missing altogether, activating signals will prevail. NK activation can also occur through Toll-like receptors (TLRs) which recognize microbial components such as DNA, RNA, lipids, and other molecules derived from microbes[23,24].

NK cells exert their cytotoxicity through various mechanisms such as degranulation of lytic granules, the death receptor pathway or via antibody-dependent cell-mediated cytotoxicity (ADCC). The first mechanism, degranulation occurs when the NK cell has received sufficient activating signals that cause lytic granules to polarize to the immunological synapse formed between a NK cell and its target[19,20]. The lytic granules are then released via exocytosis[25]. Lytic granules contain various cytotoxic effector molecules such as perforins that perforate the target cell's membrane, as well as granzymes and granulysin that induce target cell apoptosis[26]. Calcium is necessary for exocytosis of lytic granules and formation of perforin pores, thus without calcium NK cells will show reduced cytotoxicity[27,28]. The second mechanism in which NK cells kill their targets is mediated through the death receptor pathway which is less dependent on calcium than the perforin/granzyme pathway[29]. NK cells express ligands such as FASL, TNF and TRAIL that bind to death receptors expressed on target cells[30] and engagement induces caspase signalling, ultimately leading to programmed target cell death[31]. Finally, antibody-dependent cell-mediated cytotoxicity or ADCC mediates target cell death through Fc receptors such as CD16 that bind to Fc portion of antibodies whose Fab portion is bound to target cells[32]. This allows an NK cell to

come into proximity with its target and kill it by the two other cytotoxicity mechanisms, degranulation, or death receptor pathway[32]. Altogether, NK cells contain an arsenal of receptors and cytotoxicity mechanisms necessary for the first line of defense against host threats.

1.4. NK cells, cancer, and NK cell-based immunotherapies

The importance of NK cells in immunosurveillance is appreciated from the observation that mice without functional NK cells show impaired tumor control[33,34] and that patients with defective or decreased frequency of NK cells are at greater risk of developing malignancies, specifically virally induced cancers[35,36]. Recently, a thorough systematic review and meta-analysis encompassing 15 solid cancer types found that NK cell infiltration in solid tumors was associated with improved overall survival[14]. As well, an increased frequency of NK cells in peripheral blood is also a prognostic factor in several cancer indications[37–39]. On the contrary, low frequency of circulating or tumor-infiltrating NK cells or NK cells that display impaired function are associated with worse prognosis in several cancer types[38,40–42]. Clinical trials investigating the efficacy of NK cell-based therapies are currently underway[43]. These studies are utilizing several platforms of NK cell-based therapies such as adoptive transfer of ex-vivo expanded autologous or allogenic NK cells or NK cell lines, as well as genetically modified NK cells such as CAR-NK cells[43]. Therapeutic interventions can also be used to boost patients' own NK cell activity to promote tumor clearance. For instance, immune checkpoint blockade by monoclonal antibodies against checkpoint receptors can restore NK cell activity[44,45]. Small molecule drugs also have the potential to enhance NK cell tumoricidal activity. For example, agonists for TLRs, checkpoint receptor antagonists and signaling molecule inhibitors are all in the clinical pipeline for small molecule immunotherapeutics[46]. In addition to enhancing cytotoxicity, small molecules can also be used to promote proliferation and maturation in expansion protocols for NK cells that are used for adoptive

cell therapies[47,48]. Overall, small molecule immunotherapies are advantageous as they are orally bioavailable, usually cost less than biological immunotherapies, can target both extracellular and intracellular components and have a greater ability to penetrate through physiological barriers[49].

1.5. Drug repurposing and NK cell drug library screenings

From small molecule identification to development of a lead drug compound, the clinical drug pipeline can take years if not decades before the drug sees use in the clinic. Drug repurposing is an attractive alternative that identifies new indications for previously approved drugs. Repurposed drugs already have a safety and efficacy profile associated with them which makes this a favorable route. Identifying new uses for repurposed drugs can be initiated by computational or experimental methods[50]. Experimental methods include high-throughput phenotypic screenings or binding assays for target interactions[50]. Several studies have conducted high-throughput drug screenings to identify drugs that modulate NK cell activity. These studies utilized commercially available libraries containing repurposed drugs[51–53] or natural compound libraries[54,55] and have identified small molecules that were not previously known to modulate NK cell activity. Overall, drug repurposing can be utilized to identify new small molecule immunotherapies.

1.6. Rationale, Objectives and Aims

Currently, there are various therapeutic strategies in pre-clinical or clinical stages investigating small molecules immunotherapies[46]. Here, the main objective was to identify small molecules that increased NK cell-mediated cytotoxicity. To meet this objective, we screened the Prestwick Chemical Library for compounds capable of enhancing cytotoxicity of the human NK cell line, NK92 towards the myeloid leukemia K562 target cell line. NK92 cells were chosen as they are phenotypically and functionally like human NK cells[56,57] and their mechanism of cytotoxicity towards K562 cells has been well characterized[19,58]. The Prestwick Chemical Library

is a commercially available drug library with 1,200 compounds that have regulatory approval for use in human or veterinary medicine. Prior to screening this library, we first aimed to optimize an NK cell cytotoxicity assay that was feasible to be used in a high-throughput format. We chose to use a luciferase-release cytotoxicity assay format for our screening and subsequent cytotoxicity assay experiments. Our final aim included validating the candidate drugs identified from the drug screening and testing whether the identified compounds could also enhance cytotoxicity of healthy donor NK cells. Overall, we identified colistin sulfate salt, an antibiotic as an enhancer of NK cell cytotoxicity.

2. Materials & Methods

2.1. Cell culture

All cell lines were cultured in a humidified incubator at 37˚C and 5% CO_2 in media supplemented with 100 U/ml penicillin (Gibco, California, USA; Cat # 15140-122), 100 µg/ml streptomycin (Gibco, California, USA; Cat # 15140-122), 10 g/ml gentamycin sulfate (Gibco, California, USA; Cat # 15710-072), 20 mM HEPES (Fisher, Ontario, Canada; Cat # BP310-500). NK92 cells were cultured in RMPI-1640 containing 10% fetal bovine serum (FBS) (Gibco, California, USA; Cat # 11875-093). K562-NL cells were cultured in RMPI-1640 containing 5% FBS. A375-NL cells and 786O-NL cells were cultured in DMEM (Corning, Virginia USA; Cat # 10-013-CV) containing 10% FBS. 786O-NL cells were kindly provided by Dr. Jean-Simon Diallo's laboratory.

2.2. Reagents and drugs

Preparation of coelenterazine substrate: 500 µg of coelenterazine substrate (CTZ) (Gold Biotechnology, Missouri, USA; Cat # CZ2.5) was reconstituted in 610 µL of 100% ethanol and 6.2 µL of 12 N hydrochloric acid. The reconstituted substrate was protected from light and stored at -80˚C until use. Prior to measuring luciferase activity, the reconstituted CTZ was mixed with 1X salt buffer (45 mM EDTA, 30 mM sodium pyrophosphate, 1.425 M NaCl) at a 1:200 dilution (5 µL CTZ per 1 mL salt buffer).

The Prestwick Chemical Library (https://www.prestwickchemical.com) was kindly provided by Dr. Jean-Simon Diallo's laboratory.

Preparation of candidate drugs: colistin sulfate salt (Sigma-Aldrich, Missouri, USA; Cat # C4461), nicotinamide (Sigma-Aldrich, Missouri, USA; Cat # N0636), monensin sodium salt (Sigma-Aldrich, Missouri, USA; Cat # M5273), zafirlukast (Sigma-Aldrich, Missouri, USA; Cat # Z4152),

tizanidine hydrochloride (Sigma-Aldrich, Missouri, USA; Cat # T6950), closantel (Sigma-Aldrich, Missouri, USA; Cat # 34093), benazepril hydrochloride (Sigma-Aldrich, Missouri, USA; Cat # 1048619), and diflorasone diacetate (Sigma-Aldrich, Missouri, USA; Cat # 1197302) were prepared at a master stock concentration of 1 mM in 100% DMSO, with exception of colistin sulfate salt which was dissolved in water. A working stock concentration was prepared for all candidate drugs of 100 μM in PBS with a final DMSO concentration of 10%. All candidate drugs were stored at -20˚C until use.

Fluorochrome-conjugated antibodies: AF647-CD3 (BD Biosciences, California, USA; Clone UCHT-1), APC R700-CD4 (BD Biosciences, California, USA; Clone RPA-T4), BV786-CD8 (BD Biosciences, California, USA; Clone RPA-T8), PE-CD56 (BD Biosciences, California, USA; Clone B159), BV711-CD16 (BD Biosciences, California, USA; Clone 3G8), BV650-CD19 (BD Biosciences, California, USA; Clone SJ25-C1) and PerCP Cy5.5-CD14 (BD Biosciences, California, USA; Clone MφP9).

2.3. Generating K562-NL and A375-NL cells

Lentiviral particles were produced by co-transfecting 293T cells with a lentiviral plasmid encoding nano luciferase plenti-NL (pLenti NL was a gift from Erich Wanker (Addgene plasmid # 113450 ; http://n2t.net/addgene:113450 ; RRID:Addgene_113450), packaging plasmids pCMV-dR8.2dvpr (pCMV-dR8.2 dvpr was a gift from Bob Weinberg (Addgene plasmid # 8455 ; http://n2t.net/addgene:8455 ; RRID:Addgene_8455) and pCMV-VSV-G (pCMV-VSV-G was a gift from Bob Weinberg (Addgene plasmid # 8454 ; http://n2t.net/addgene:8454 ; RRID:Addgene_8454), following Lipofectamine 3000 transfection instructions for a 10 cm dish (Invitrogen, California, USA; Cat # 2021-04-16). 72 hours following the transfection, supernatant containing lentiviral particles was collected and used to transduce K562 and A375 cells by spin-

infection (500 g for 2 hours at 37˚C) with 8 μg/mL polybrene (Sigma-Aldrich, Missouri, USA; Cat # H9268-10G). Four days post-transduction, nano luciferase expression was confirmed by using the Nano-glo luciferase assay system (Promega, Wisconsin, USA; Cat # N1110). After nano luciferase expression was confirmed, single cells from the transduced cell populations were sorted into five 96-well plates using the MoFlow XDP Cell Sorter (Beckman Coulter, Ontario, Canada). After several weeks of culture, wells with cell growth were tested for luciferase expression. Selected clones were mixed at an equal ratio to make a polyclonal population of K562-NL cells or A375-NL cells.

2.4. Luciferase-release NK92 cytotoxicity assays

NK92 cells were co-cultured with target cells expressing NL in triplicate at various E:T (effector: target) ratios in RPMI 5% FBS in 96-well V bottom plates (Sarstedt, Quebec, Canada; Cat # 82.1583.001) for 5 hours at 37˚C. After the incubation, 50 μL of supernatant from each well was transferred to round-bottom black 96-well plates (Corning, Maine USA; Cat # 3792). Depending on the experiment, either 25 μL of Nano-glo substrate or CTZ substrate was added to each well and the Biotek Synergy Mx plate reader (Biotek, Vermont, USA) was used to measure luminescence. Percentage (%) specific lysis was calculated using the following equation (Equation 1), where experimental release are the raw luminescence values from NK92+target cells, spontaneous release are the raw luminescence values from the target cells in absence of effector cells, and maximal release are the raw luminescent values from target cells treated with 30 μg/mL of digitonin (Sigma-Aldrich, Missouri, USA; Cat # D141-500MG).

$$\%\ specific\ lysis = \frac{(experimental\ release - spontaneous\ release)}{(maximal\ release - spontaneous\ release)}\ x\ 100 \quad \text{(Equation 1)}$$

2.5. Flow cytometry-based cytotoxicity assays

NK92 cells were co-cultured with either K562-NL or A375-NL targets cells in triplicate at various E:T ratios with 10,000 target cells per well in RPMI 5% FBS in 96-well V bottom plate (Sarstedt, Quebec, Canada; Cat # 82.1583.001) for 5 hours at 37˚C. Prior to co-culture with NK92 cells, target cells were stained with CFSE (BD Biosciences, California, USA; Cat # 565082) for 10 minutes at 37˚C. After the 5-hour incubation, all cells were stained with Zombie NIR™ Fixable Viability Kit (Biolegend, California, USA; Cat # 423106). Prior to acquisition, APC counting beads (Spherotech, Illinois, USA; Cat # ECFPF6) were added. Samples were acquired using the HTS function of the LSR Fortessa (BD Biosciences, California, USA). Percentage specific lysis was calculated using Equation 1, where experimental release is the ratio of beads to live target cells from NK92+target cell wells, spontaneous release is the ratio of beads to live target cells from the target cells in absence of effector cells wells, and for maximal release, the value 0 was used as we would expect there to be no live cells.

2.6. Screening of the Prestwick Chemical Library and plate configuration

The Prestwick Chemical Library, which contains 1,200 regulatory-approved drugs, was screened to identify compounds capable of enhancing NK92 cytotoxicity. K562-NL cells alone or a co-culture of NK92+K562-NL cells at a 1:1 E:T ratio were treated with 10 μM of each drug for 5-hours at 37˚C. Each compound was evaluated in singlet over 2 biological replicates.

The Prestwick Chemical Library's 15 stock plates were stored at -20˚C in 10% DMSO at a concentration of 100 μM in deep well plates (Axygen, Tamaulipas, Mexico; Cat # P-96-450V-C-S), with compounds only in columns 2-11. On the day of the screen, the stock plates were thawed, and the Bravo Automated Liquid Handling Platform (Agilent, California, USA) was used to dispense 10 μL of each drug (final drug concentration of 10 μM) to columns 2-11 to a total of

thirty 96-well V-bottom assay plates (Sarstedt, Quebec, Canada, Cat # 82.1583.001). For the 15 assay plates containing K562-NL cells alone, 45 µL of K562-NL cells plus 45 µL of media was dispensed to all columns for a final assay volume of 100 µL. For the 15 assay plates containing K562-NL+NK92 cells, 45 uL of K562-NL was dispensed to all columns and 45 µL of NK92 cells was dispensed from column 1-11 for a final assay volume of 100 µL. Controls were dispensed in column 1 and 12 for each assay plate. For all 30 assay plates, 10 µL of 10% DMSO was dispensed to column 1 (final DMSO concentration of 1%). For the 15 assay plates containing K562-NL cells alone, 10 µL of 300 µg/mL of digitonin was dispensed to column 12 (final concentration of 30 µg/mL) as a maximal release control. For the 15 assay plates containing K562-NL+NK92 cells, NK92 and K562-NL cells were dispensed at a 9:1 E:T ratio in column 12 as a positive control for NK92 cytotoxicity. Negative controls in column 1 were K562-NL+DMSO (K562-NL alone plates) and 1:1 E:T+DMSO (NK92+K562-NL plates).

After the incubation, 50 µL of supernatant from each assay plate was transferred to round-bottom black 96-well plates (Corning, Maine, USA; Cat # CLS3792) using the Bravo Automated Liquid Handling Platform. Biotek plate reader was used to dispense 25 µL of CTZ to each well and measure luminescence.

2.7. Z' factor, fold-change and normalization analysis

Raw luminescence values from the screenings were exported to Excel to calculate Z'-factor and luminescent fold-change. To evaluate the overall screening assay stability, Z' factor was calculated for each assay plate using the negative (column 1: DMSO) and positive (column 12: 9:1 E:T or digitonin) control values in each plate. The following equation was used to calculate Z' factor (Equation 2), where SD^+ represents the standard deviation of the positive control, SD^- represent

the standard deviation of the negative control, m^+ represents the mean of the positive control and m^- represents the mean of the negative control.

$$Z' = 1 - \frac{3SD^+ + 3SD^-}{|m^+ - m^-|} \quad \text{(Equation 2)}$$

To identify compounds capable of enhancing NK92 cytotoxicity, the luminescent fold-change over DMSO control was calculated for all compounds in the 1:1 E:T condition and K562-NL alone condition. Compounds that had a fold-change ≥1.3 were considered drug hits. Drugs were excluded if the fold-change ≥1.3 in the K562-NL alone treated with drugs condition. Fold-change for each plate was calculated by using the controls on individual plates.

2.8. Dose-response experiments

K562-NL cells alone or NK92 and K562-NL cells mixed at a 1:1 and 3:1 E:T ratio were treated with either 0, 1, 5, 10 and 20 μM of drug candidates for 5 hours at 37˚C. Luciferase activity was measured as previously described.

2.9. Colistin pre-treatment experiments

NK92 or K562-NL cells alone were treated for either 24 hours or 1 hour with 10 μM of colistin. Prior to mixing the cells together, the drug was washed out. Pre-treated NK92 cells were mixed with untreated K562-NL cells, and pre-treated K562-NL cells were mixed with untreated NK92 cells. A condition where drug treatment was present during the 5-hour incubation was also included. Luciferase activity was measured as previously described.

2.10. Human PBMC isolation

Human blood samples were obtained from healthy donors using the Perioperative Human Blood and Tissue Specimen Collection Program protocol approved by The Ottawa Health Science Network Research Ethics Board (OHSN - REB 2011884-01H). PBMCs were isolated from

peripheral blood of healthy donors by Ficoll (GE Healthcare, Uppsala, Sweden, Cat # 17-1440-03) gradient centrifugation at 19˚C. Cells were resuspended in CryoStor® CS10 and cryopreservation of cells was followed according to the manufacturer's instructions (BioLife Solutions, Washington, USA; Cat # 210373).

2.11. Human NK cell cytotoxicity assays with colistin treatment

Previously frozen human PBMCs from healthy donors were thawed according to CryoStor® CS10 thawing cells protocol (BioLife Solutions, Washington, USA; Cat # 210373), afterwards, PBMCs were kept overnight at 4˚C. NK cells were isolated from PBMCs using EasySep™ Human NK Cell Isolation Kit (Stemcell Technologies, British Columbia, Canada; Cat # 17955). NK cells were co-cultured with K562-NL cells at different E:T ratios and treated with 10 μM of colistin for 5 hours at 37˚C. Luciferase activity was measured as previously described.

2.12. Statistical analysis

Two to three independent biological replicates were conducted for each experiment unless otherwise stated. Statistical analyses conducted included unpaired two-tail Student's t test, one or two-way ANOVA with either Dunnett's, Sidak, Tukey's or Bonferroni's multiple comparison test. Specific statistical analyses for each experiment are described in figure captions. Statistical significance was defined as p value ≤ 0.05 and GraphPad Prism 9 was used for these analyses. For flow cytometry experiments, FlowJo V.10.7.1 was used for analysis.

3. Results

3.1. Preparing for a high-throughput drug screening

Before screening the Prestwick Chemical Library to identify compounds that increase NK cell cytotoxicity, we needed to choose an NK cell cytotoxicity assay format that can be used in a high-throughput setting. Traditional methods that measure NK cell cytotoxicity such as chromium-release assays or flow cytometry-based assays are difficult to scale up for a high-throughput use. Matta *et al* developed a sensitive and robust luciferase cytotoxicity assay by using target cells that express luciferase and release the enzyme when killed[59]. This format is useful for high-throughput screenings and has been utilized in a previous NK cell drug screening[51]. Using a luciferase-release cytotoxicity assay offers an appealing alternative to these other methods, therefore we decided to use this cytotoxicity assay format for our high-throughput drug screening. For this cytotoxicity assay format to work, target cells expressing luciferase must release luciferase into the culture medium when killed by effector cells and this must be detectable above spontaneous release of luciferase by target cells. To develop a luciferase-release cytotoxicity assay, we first needed generated target cell lines that express luciferase.

3.1.1. Establishing K562-NL target cells

The myeloid leukemia target cell line, K562 was transduced with a lentiviral plasmid encoding nano luciferase (NL). We tested K562 cells for NL expression using the Promega NanoGlo Luciferase assay system which uses the furimazine substrate. NL expression was detectable in lysed transduced K562 cells (**Supplemental Figure 1A**). To determine if transduced K562 cells are suitable targets for a luciferase-release cytotoxicity assay, the bulk population of transduced cells were mixed with NK92 cells at increasing effector:target (E:T) ratios (**Figure 1A**). After a 5-hour incubation, the supernatant was collected after a centrifugation step and

luciferase activity was tested by measuring luminescence. At increasing E:T ratios, there was a higher detection of luminescence, suggesting that more NL is being released in the supernatant as K562-NL cells are killed.

After confirming that K562-NL cells are suitable targets for a luciferase-release cytotoxicity assay, we needed to obtain a pure population of K562-NL cells from the bulk population of transduced cells. To obtain a polyclonal population of K562 cells expressing NL, single cells were sorted into five 96-well plates. Wells with cell growth were tested for luciferase expression. K562 clones expressing NL were selected and tested in a NK92 cytotoxicity assay to compare to the unsorted K562-NL population (**Supplemental Figure 1B**). Clones that were killed by NK92 cells similarly to the K562 bulk population were selected and mixed at an equal ratio to make a polyclonal population of K562-NL cells. This cell population was then used in all subsequent experiments.

3.1.2. Optimizing conditions for a high-throughput luciferase-release cytotoxicity assay

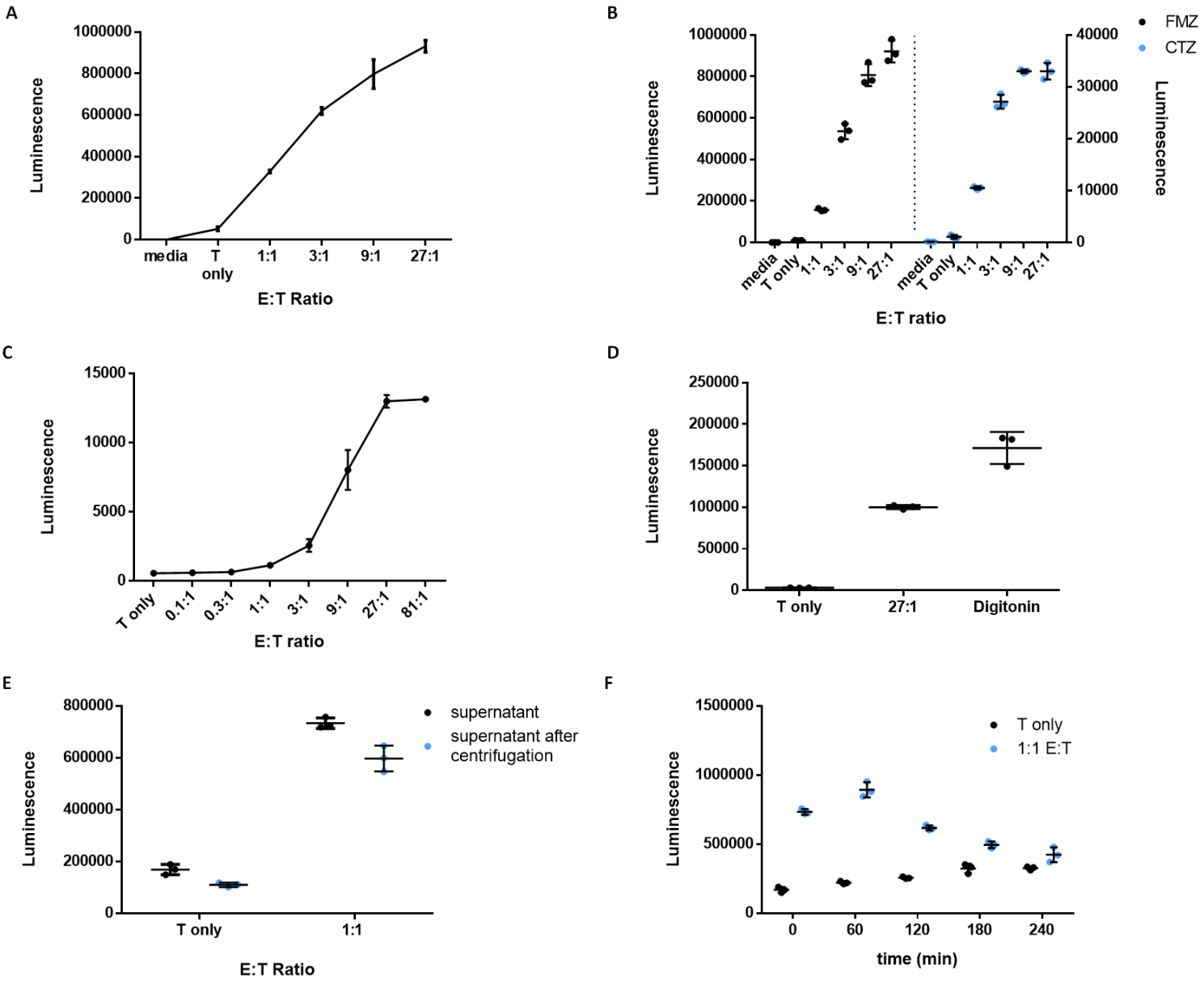
Previously when testing for NL activity, the substrate furimazine (FMZ), the optimized substrate for NL was used. However, using furimazine in a high-throughput setting can be expensive. Instead, we tested if coelenterazine (CTZ), the substrate most used for Renilla and Gaussia luciferase can be used as an economical alternative. After conducting a luciferase-release cytotoxicity assay, either FMZ or CTZ was added to the transferred assay supernatant. We observed that NL activity was detectable after addition of CTZ, although the magnitude of luminescence was lower than NL activity measured after addition of FMZ (**Figure 1B**). Given these results, we decided to use CTZ as substrate for subsequent experiments. Next, we wanted to determine the ideal E:T ratio to use for the drug screening. We conducted a luciferase-release cytotoxicity assay that included a range of E:T ratios (**Figure 1C**). We chose to use a 1:1 E:T ratio

as this ratio shows minimal killing, has detectable luminescence above K562-NL target cells and there is large dynamic range between the 1:1 and 81:1 ratio, an E:T ratio that shows saturation in killing. After identifying an E:T ratio to use for the drug screening, several conditions needed to be improved before this assay was ready for a high-throughput format. First, we needed to identify a maximal release control to be used as a positive control of NL release for the drug screening. After testing several agents, we found that digitonin, a mild detergent, was effective at inducing maximal release of NL. We compared K562-NL cells treated with 30 µg/mL of digitonin for 5 hours to K562-NL cells mixed with NK92 cells at a 27:1 E:T ratio, an E:T ratio that shows saturation in killing. We observed that K562-NL treated with digitonin showed increase NL release compared to the 27:1 E:T ratio (**Figure 1D**). Up until this point, the supernatant from the luciferase-release cytotoxicity assay was collected and transferred to a new plate after a centrifugation step, which would be hardly feasible in high-throughput conditions. We were concerned that if we skipped the centrifugation step prior to collecting the supernatant, we would capture live target cells that would lyse after addition of the substrate, resulting in similar luminescence detection between K562-NL cells alone and K562-NL+NK92 cells. Therefore, to see if this centrifugation step was needed, we tested the difference between directly collecting the assay's supernatant at the end of the 5-hour cytotoxicity assay with or without a centrifugation step. We observed a slight increase in luminescent readings from supernatant that was directly collected vs supernatant that was collected after a centrifugation step, however the difference between the target cells alone and target cells+NK92 cells was still retained without the centrifugation step (**Figure 1E**). Based on these results, we deemed that a centrifugation step prior to supernatant collection was unnecessary and decided to proceed with directly collecting the assay supernatant for the drug screening. To determining the optimal timing of our high-throughput drug

screening workflow, we needed to estimate how long it would take to plate all the drug screening assay plates and if leaving the cells at room temperature for an extended amount of time before they were seeded would affect the cytotoxicity assay results. Logistically, we could not keep cells in their cell culture conditions (humidified incubator, 37˚C, 5% CO_2) when seeding the drug screening assay plates, therefore, we wanted to test if leaving the cells at room temperature would affect NK92 cytotoxicity. We simulated drug screen plating conditions by incubating NK92 and K562-NL cells separately at room temperature for 0, 60, 120, 180, and 240 minutes before the cells were seeded into assay plates. We observed that leaving the cells at room temperature >120 minutes before being seeded into assay plates decreased NK92 cytotoxicity as the difference in luminescence between K562-NL cells alone and cells at a 1:1 E:T ratio became smaller (**Figure 1F**). We also observed a slight increase in spontaneous lysis in the K562-NL alone condition as time progressed, shown by the increase in luminescence detection at the last two time points (**Figure 1F**). Based on these results, we needed to seed all our drug screening assay plates in 1-hour to maintain a large luminescence range between the 1:1 E:T and K562-NL alone conditions.

Figure 1. Optimizing a luciferase-release cytotoxicity assay for a high-throughput screen.

NK92 cells were co-cultured with K562-NL cells at indicated E:T ratios for 5-hrs at 37˚C. After incubation, the supernatant was collected, the indicated substrate added, and luminescence read by Biotek Synergy microplate reader. **A.** Luciferase-release cytotoxicity assay using transduced K562-NL cells (bulk population, unsorted). 20,000 K562-NL targets were seeded per well. After the incubation, luciferase activity was measured using Promega Nano-glo luciferase assay system. Mean +/- SD of three technical replicates. **B.** After the incubation, luciferase activity was measured after addition of either Promega Nano-glo luciferase assay system (FMZ, black circles) or CTZ (blue circles) substrate. 10,000 K562-NL targets were seeded per well. Mean +/- SD of three technical replicates. Graph is representative of 3 biological replicates. **C.** Luciferase-release cytotoxicity assay with extended E:T ratios where NK92 cells were co-cultured with 10,000 K562-NL cells for 5-hrs. After the incubation, luciferase activity was tested after addition of CTZ. Mean +/- SD of three technical replicates. Graph is representative of 2 biological replicates. **D.** K562-NL cells were treated with 30 μg/mL digitonin and compared to K562-NL cells co-cultured at a 27:1 E:T ratio with NK92 cells. 10,000 K562-NL cells were seeded per well. After the incubation, luciferase activity was tested after addition of CTZ. Mean +/- SD of three technical replicates. Graph is representative of 2 biological replicates. **E.** After the incubation, the supernatant was either collected directly (supernatant, black circles) or collected after a centrifugation step (supernatant after centrifugation, blue circles). Mean +/- SD of three technical replicates. Graph is representative of 2 biological replicates. **F.** NK92 and K562-NL cells were incubated at room temperature at indicated times (minutes) prior to co-culture incubation at 37˚C. Black circles represent K562-NL cells alone and blue circles represent NK92+K562-NL at 1:1 E:T ratio and 10,000 K562-NL cells were seeded per well. Mean +/- SD of three technical replicates. Graph is representative of 3 biological replicates.


A
Luminescence
1000000
800000
600000
400000
200000
0
media
T only
1:1
3:1
9:1
27:1
E:T Ratio
B
Luminescence
1000000
800000
600000
400000
200000
0
40000
30000
20000
10000
0
Luminescence
FMZ
CTZ
media
T only
1:1
3:1
9:1
27:1
media
T only
1:1
3:1
9:1
27:1
E:T ratio
C
Luminescence
15000
10000
5000
0
T only
0.1:1
0.3:1
1:1
3:1
9:1
27:1
81:1
E:T ratio
D
Luminescence
250000
200000
150000
100000
50000
0
T only
27:1
Digitonin
E
Luminescence
800000
600000
400000
200000
0
supernatant
supernatant after centrifugation
T only
1:1
E:T Ratio
F
Luminescence
1500000
1000000
500000
0
T only
1:1 E:T
0
60
120
180
240
time (min)

3.2. Screening the Prestwick Chemical Library

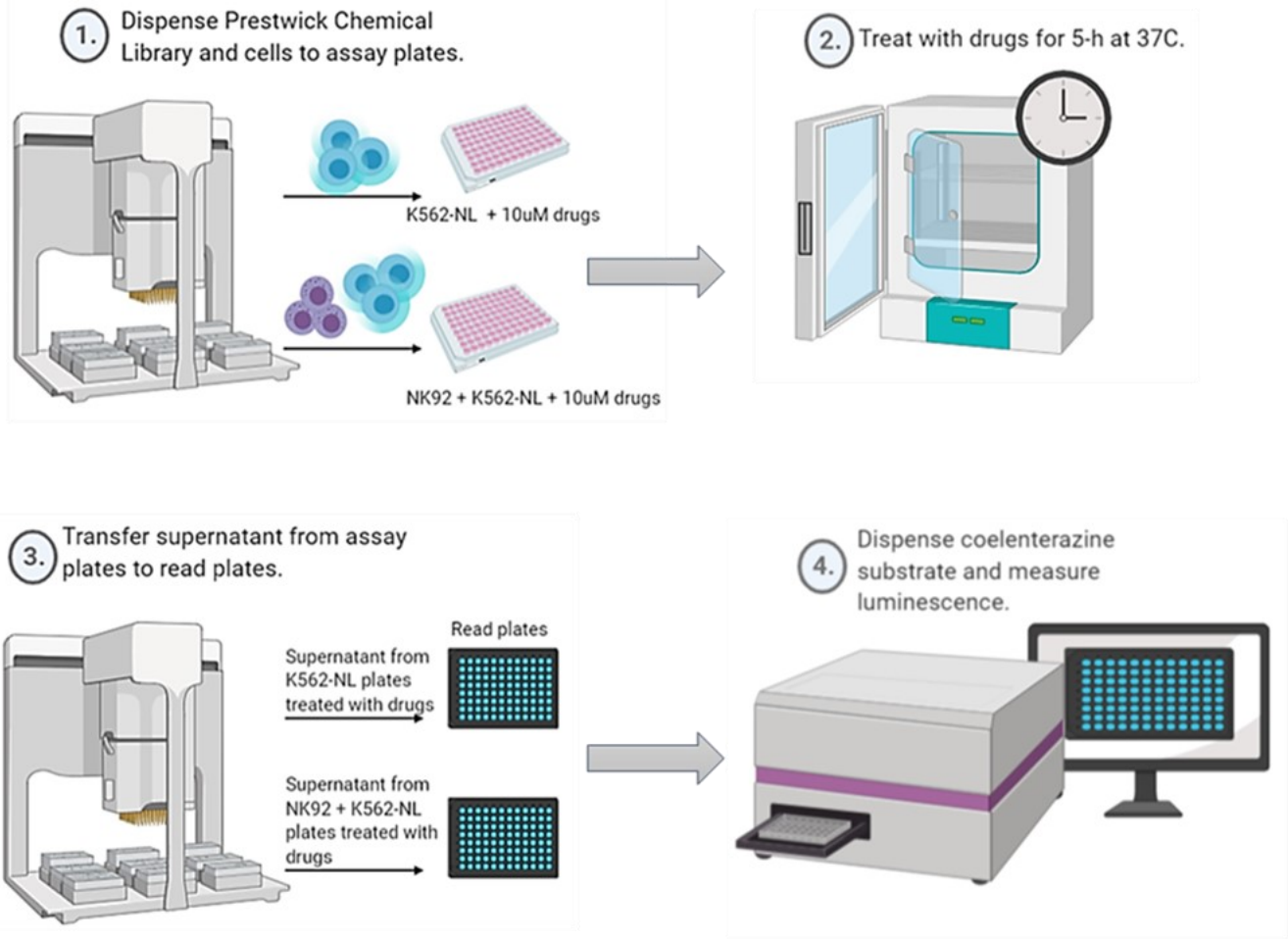
3.2.1. Overview of the Prestwick Chemical Library drug screening

The Prestwick Chemical Library was screened to identify compounds capable of enhancing NK cell cytotoxicity. K562-NL cells alone or NK92 + K562-NL cells mixed at a 1:1 E:T ratio were treated with 10 μM of each drug for 5 hours at 37˚C (**Figure 2A**). Each compound was evaluated in singlet over 2 biological replicates. To identify compounds that increased NK92 cytotoxicity, the luminescent values of all wells containing drugs were compared to the DMSO control wells from the same plate and this difference was quantified as fold-change over DMSO control (**Figure 2B**). Compounds that had a fold-change ≥ 1.3 were chosen for further analysis. Twelve compounds that had a fold-change ≥ 1.3 in the K562-NL alone condition were excluded from analysis as these drugs were considered cytotoxic to K562-NL cells in absence of NK92 cells. Alexidine dihydrochloride was the only excluded drug that showed a fold-change ≥ 1.3 in the 1:1 E:T condition. The other excluded drugs either had a fold-change around 1 or less than one, indicating that the drug's cytotoxicity was not additive to NK92 cytotoxicity and that the drug also slightly impaired NK92 cells. Fold-change values for all compounds and the list of excluded compounds can be found in the Appendix (**Supplemental Table 1** **&** **Supplemental Table 2**).

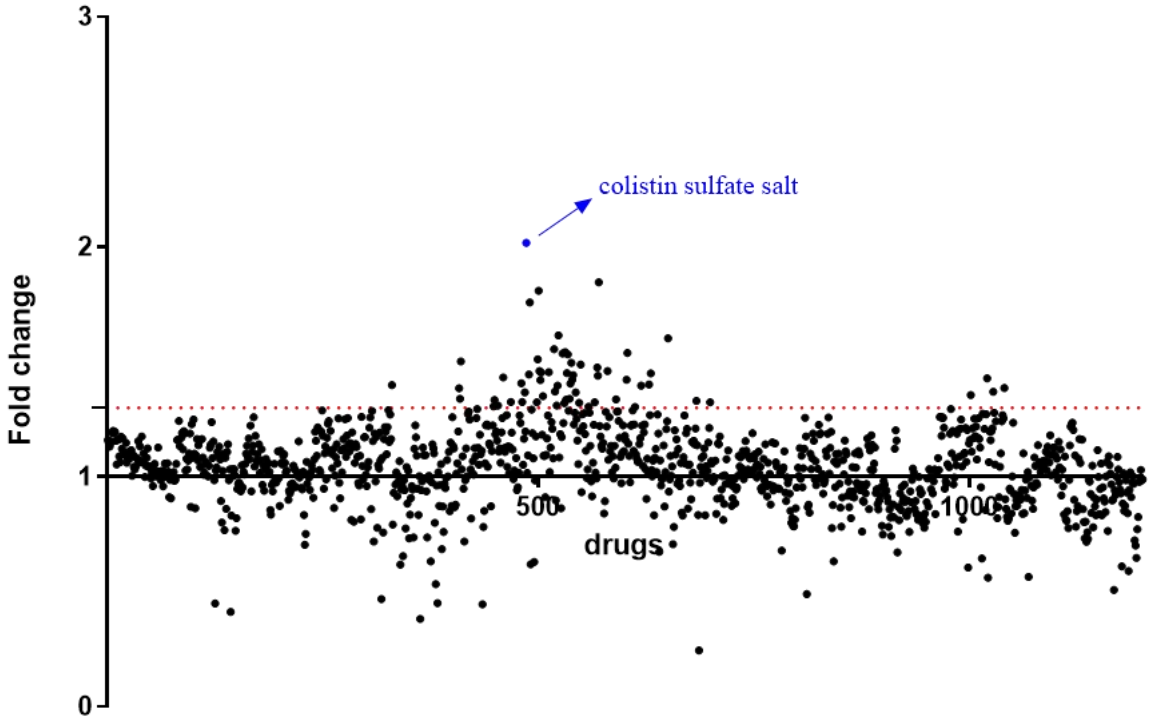
Figure 2. Screening of the Prestwick Chemical Library.

A. Schematic workflow of the Prestwick Chemical Library screening. **B.** Average luminescent fold-change over DMSO control of all 1,200 compounds from NK92+K562-NL condition are plotted. NK92 and K562-NL cells were seeded into 96-well V bottom plates containing compounds (10 μM**)** from the Prestwick Chemical Library at a 1:1 E:T ratio, 10,000 K562-NL targets per well for 5-hrs at 37˚C. After the incubation, the supernatant was collected, transferred to 96-well black plates. The Biotek Synergy microplate reader was used to dispense CTZ and read luminescence. The Prestwick Chemical Library was screened in singlet, n=2 biological replicates. The dotted red line indicates 1.3-fold-change. Compounds with a luminescent fold-change over DMSO control $\geq$1.3 were considered enhancers of NK92 cytotoxicity. Points represent the average fold-change of n=2 biological replicates, except points 321-400 and 481-560 which represent fold-change from one replicate.

A


1. Dispense Prestwick Chemical Library and cells to assay plates.
K562-NL + 10uM drugs
NK92 + K562-NL + 10uM drugs
2. Treat with drugs for 5-h at 37C.
3. Transfer supernatant from assay plates to read plates.
Read plates
Supernatant from K562-NL plates treated with drugs
Supernatant from NK92 + K562-NL plates treated with drugs
4. Dispense coelenterazine substrate and measure luminescence.

B


Fold change
3
2
1
0
colistin sulfate salt
500
1000
drugs

3.2.2. Identification of candidate drugs and overall quality of the screening assay

We identified 87 drugs that had a fold-change ≥1.3 from the first screening of the Prestwick Chemical Library and 119 drugs that had a fold-change ≥1.3 from the second screening. Upon closer inspection, 14 drugs from the total drugs identified over both screening days had a fold-change ≥ 1.3 on both screening days (**Table 1**). From these 14 drugs, 8 candidate drugs were selected for follow-up experiments. Drugs with higher fold-change were prioritized and drugs that were no longer in use, not available in the North American market or already published as an enhancer of NK cytotoxicity in a previous Prestwick Chemical Library screening were excluded. The 8 candidate drugs and associated fold-change were colistin sulfate salt (2.02), nicotinamide (1.85), monensin sodium salt (1.62), zafirlukast (1.54), tizanidine hydrochloride (1.42), closantel (1.41), benazepril hydrochloride (1.40), and diflorasone diacetate (1.40) (**Table 1**).

To evaluate the overall screening assay stability, Z' factor was calculated for each assay plate from the screening of the Prestwick Chemical Library by using the positive and negative control values in each plate. The screening assay had an average Z' factor of 0.72 for K562-NL alone plates treated with drugs and 0.44 for the NK92 + K562-NL (1:1 E:T) plates treated with drugs. A Z' factor close to 0.5 is considered fair and Z' factor 0.5-1 is considered good[60]. Z'-factor for each individual plate can be found in the Appendix (**Supplemental Table 3**). Overall, the Z'-factor suggests that the overall quality of the drug screening was fair but has room for improvement.

Table 1. Compounds identified as enhancers of NK92 cytotoxicity from screening the Prestwick Chemical Library. Listed drugs had a luminescent fold-change ≥ 1.3 on both screening days. Drug class for each compound is listed. [a]Candidate drugs that were selected for further investigation. [b]Fold-change of single screening.

	Drug	Fold-change	Drug class
1	Colistin sulfate salt[a.b]	2.02	antibiotic
2	Nicotinamide[a]	1.85	vitamin B3
3	Monensin sodium salt[a]	1.62	antibiotic
4	Butirosin disulfate salt	1.60	aminoglycoside antibiotic
5	Zafirlukast[a]	1.54	anti-asthmatic
6	Amphotericin B	1.50	antifungal
7	Argatroban	1.46	anti-coagulant
8	Dimethisoquin hydrochloride	1.45	anesthetic
9	Tizanidine hydrochloride[a]	1.42	adrenergic agonist
10	Closantel[a]	1.41	anti-parasitic
11	Benazepril hydrochloride[a]	1.40	ACE inhibitor
12	Diflorasone diacetate[a]	1.40	topical steroid
13	Butoconazole nitrate	1.38	anti-fungal
14	Etretinate	1.34	retinoid

3.3. Validating candidate drugs identified from the Prestwick Chemical Library screening

3.3.1. Repeating the drug screening's experimental conditions with candidate drugs

To begin validating the 8 candidate drugs, the drug screening experimental conditions were repeated. We found that NK92 cells treated with colistin sulfate salt (herein colistin) during the 5-hour incubation showed the greatest increase in cytotoxicity compared to the other tested drugs (fold-change 2) (**Figure 3A**). In contrast from the drug screening results, monensin sodium salt significantly decreased NK92 cytotoxicity (**Figure 3C**). NK92 cells treated with the rest of the candidate drugs showed similar killing levels as untreated cells (**Figure 3**).

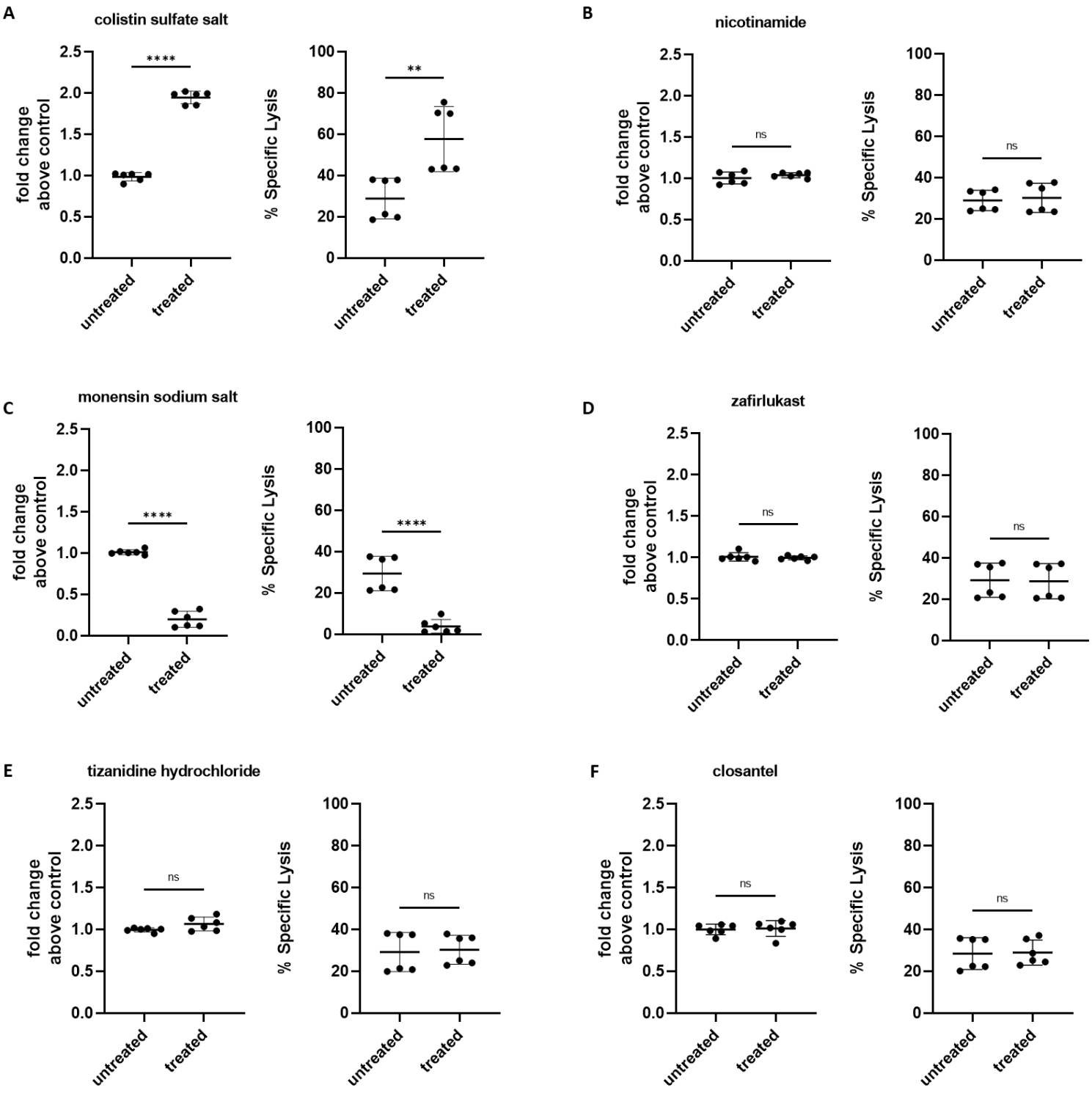
3.3.2. Determining the optimal concentration and E:T ratio for candidate drugs' activity

Next, we wanted to determine the optimal concentration and E:T ratio for candidate drugs' activity. In the previous experiment, only NK92 cells treated with colistin showed an increase in NK92 cytotoxicity. Nevertheless, all 8 candidate drugs were tested to determine if different drug treatment conditions could enhance NK92 cytotoxicity. NK92 and K562-NL cells were either seeded at 1:1 or 3:1 E:T ratio and treated with 0, 1, 5, 10 or 20 µM of drug for 5 hours. Similar to previous experiments, NK92 cells treated with 10 µM colistin showed a 2-fold increase in cytotoxicity at a 1:1 E:T ratio compared to untreated cells (**Figure 4A**). Also, a significant increase in cytotoxicity was also observed when NK92 cells were treated with 5, 10 and 20 µM of colistin at a 1:1 E:T ratio (**Figure 4B**). No difference in fold-change was observed for NK92 cells at a 3:1 E:T ratio treated with all tested concentrations of colistin (**Figure 4A**). None of the other tested candidate drugs were able to increase NK92 cytotoxicity by 2-fold and most showed a significant decrease in NK92 cytotoxicity at the highest tested concentration tested of 20 µM at 1:1 and 3:1 E:T ratio (**Supplemental Figure 2A-G**). We determined that NK92 cells treated with 10 µM of

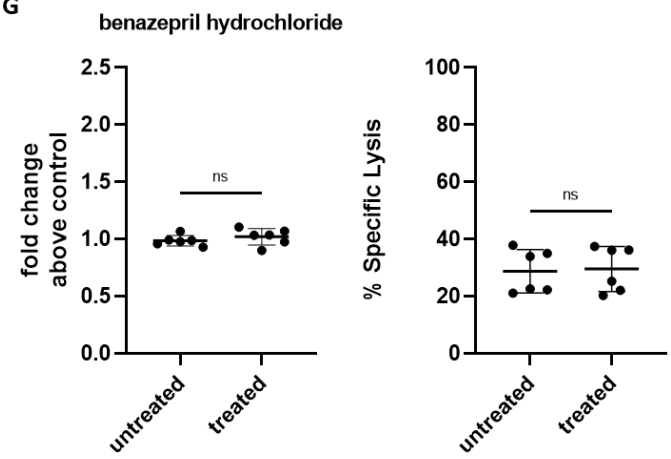
colistin at 1:1 E:T ratio showed the greatest increase in cytotoxicity. Based on these experiments, only colistin was selected for further investigation.

Figure 3. Colistin sulfate salt increases NK92 cytotoxicity against K562-NL.

NK92 and K562-NL cells were seeded into 96-well V bottom plates containing identified drug hits (10 μM) from the Prestwick Chemical Library at a 1:1 E:T ratio, with 10,000 K562-NL cells per well, for 5-hrs at 37˚C. After the incubation, the supernatant was collected and transferred to 96-well black plates. The Biotek Synergy microplate reader was used to dispense CTZ and read luminescence. Left panel: luminescent fold-change over DMSO control. Right panel: Percent specific lysis. **A.** Colistin sulfate salt. **B.** Nicotinamide. **C.** Monensin sodium salt. **D**. Zafirlukast. **E.** Tizanidine hydrochloride. **F.** closantel. **G.** Benazepril hydrochloride. **H.** Diflorasone diacetate. Mean +/- SD of n=2. Unpaired two-tailed Student's t test. ns= not significant, * $p<0.05$, ** $p<0.01$, **** $p<0.0001$.


A
colistin sulfate salt
fold change above control
****
% Specific Lysis
**
untreated
treated
B
nicotinamide
ns
C
monensin sodium salt
****
D
zafirlukast
E
tizanidine hydrochloride
F
closantel

G


benazepril hydrochloride
fold change above control
2.5
2.0
1.5
1.0
0.5
0.0
ns
untreated
treated
% Specific Lysis
100
80
60
40
20
0
ns
untreated
treated

H

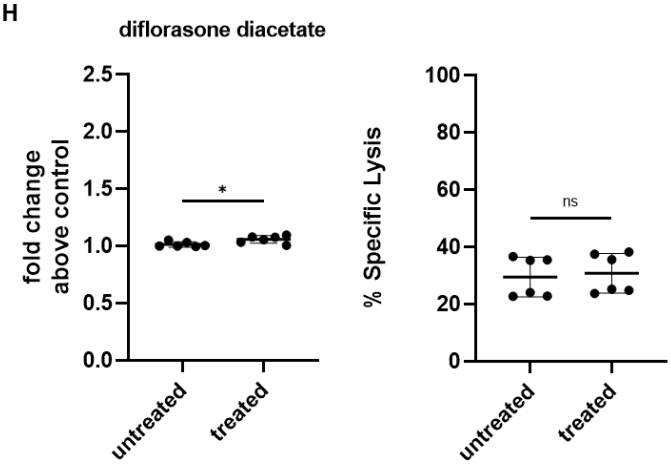
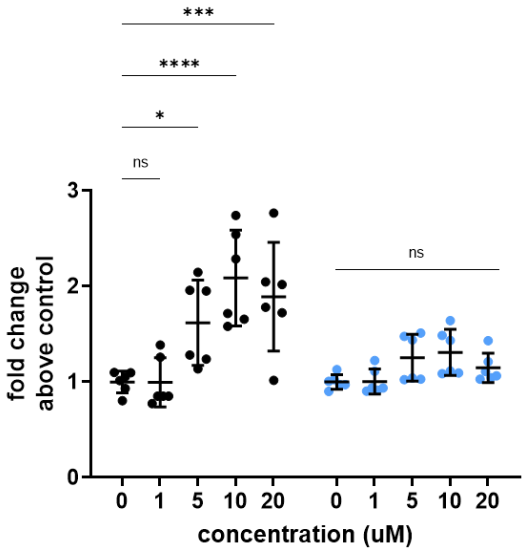
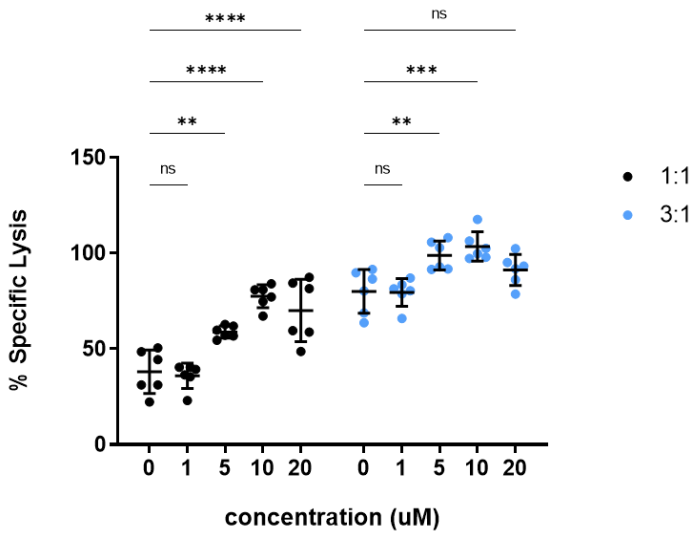

diflorasone diacetate
fold change above control
2.5
2.0
1.5
1.0
0.5
0.0
*
untreated
treated
% Specific Lysis
100
80
60
40
20
0
ns
untreated
treated

Figure 4. NK92 cells show the greatest increase in cytotoxicity at a 1:1 E:T ratio when treated with 10 μM of colistin. NK92 and K562-NL cells were seeded into a 96-well V bottom plate at a 1:1 or 3:1 E:T ratio with 10,000 K562-NL cells per well and treated with 1, 5, 10 and 20 μM of colistin for 5-hrs at 37˚C. After the incubation, the supernatant was collected and transferred to a 96-well black plate. The Biotek Synergy microplate reader was used to dispense CTZ and read luminescence. **A.** Luminescent fold-change over control. **B.** Percent specific lysis. Mean +/- SD of n=2. Black circles represent cells at a 1:1 E:T ratio and blue circles represent cells at a 3:1 E:T ratio. Two-way ANOVA with Tukey's multiple comparison test. ns= not significant, * $p<0.05$, ** $p<0.01$, *** $p<0.001$, **** $p<0.0001$.

A


***
****
*
ns
ns
fold change above control
3
2
1
0
0 1 5 10 20 0 1 5 10 20
concentration (uM)

B


****
****
**
ns
ns
***
**
ns
% Specific Lysis
150
100
50
0
0 1 5 10 20 0 1 5 10 20
concentration (uM)
1:1
3:1

3.3.3. Treating NK92 cells seeded at a low E:T ratio with colistin

Next, we tested if colistin could increase NK92 cytotoxicity at a lower E:T ratio. In previous experiments, the lowest E:T ratios that were tested in this luciferase-release cytotoxicity assay format were 0.1:1 and 0.3:1 E:T ratios (**Figure 1C**). Based on the results from this earlier experiment, we selected the 0.3:1 E:T ratio as a low E:T ratio to test as the 0.1:1 E:T ratio had luminescence values similar to the condition with targets only, indicating that there were too few NK92 cells present to induce killing of target cells. After treating NK92 with 10 μM of colistin, we observed a modest increase in NK92 cytotoxicity at a 0.3:1 E:T ratio, however these results were not significant (**Figure 5**)**.** These results suggest that a certain threshold of killing is necessary for treatment differences to be observed. Here, we showed that colistin slightly increases NK92 cytotoxicity at a low E:T ratio.

3.3.4. Testing if colistin increases NK92 cell cytotoxicity towards other target cell lines

So far, in all experiments testing colistin, K562-NL cells were the only target cells used. We tested if treatment with colistin could increase NK92 cytotoxicity towards different target cell lines. We used a melanoma cell line expressing NL, A375-NL cells. These cells were generated similarly to K562-NL cells (**Supplemental Figure 1C & D**). We treated NK92+K562-NL cells and NK92+A375-NL cells at 1:1 E:T ratio with 10 μM of colistin for 5 hours. As previously shown, we found that colistin increased NK92 cytotoxicity towards K562-NL by 2-fold, however treatment with colistin did not increase NK92 cytotoxicity towards A375-NL cells (**Figure 6**). We also tested a renal adenocarcinoma cell line, 786O-NL cells and similarly found that NK92 cells treated with 10 μM colistin did not show an increase in cytotoxicity towards 786O-NL cells (**Supplemental Figure 3**). From the three cell lines tested, colistin treatment only increased NK92 cytotoxicity when NK92 cells were co-cultured with K562-NL target cells.

Figure 5. Treatment with colistin modestly increases NK92 cytotoxicity at a low E:T ratio.

NK92 cells were mixed with K562-NL cells and seeded into a 96-well V bottom plate at a 0.3:1, 1:1 and 3:1 E:T ratio with 10,000 K562-NL cells per well and treated with 10 μM of colisltin for 5-hrs at 37˚C. After the incubation, the supernatant was collected and transferred to a 96-well black plate. The Biotek Synergy microplate reader was used to dispense CTZ and read luminescence. **A.** Luminescence values. **B.** Percent specific lysis **C.** Luminescent fold-change over 0.3:1 E:T untreated control. Black circles represent untreated cells and red circles represent treated cells. Mean +/- SD of n=2. Two-way ANOVA with Sidak's multiple comparison test. ns= not significant, * $p<0.05$, ** $p<0.01$, *** $p<0.001$, **** $p<0.0001$.

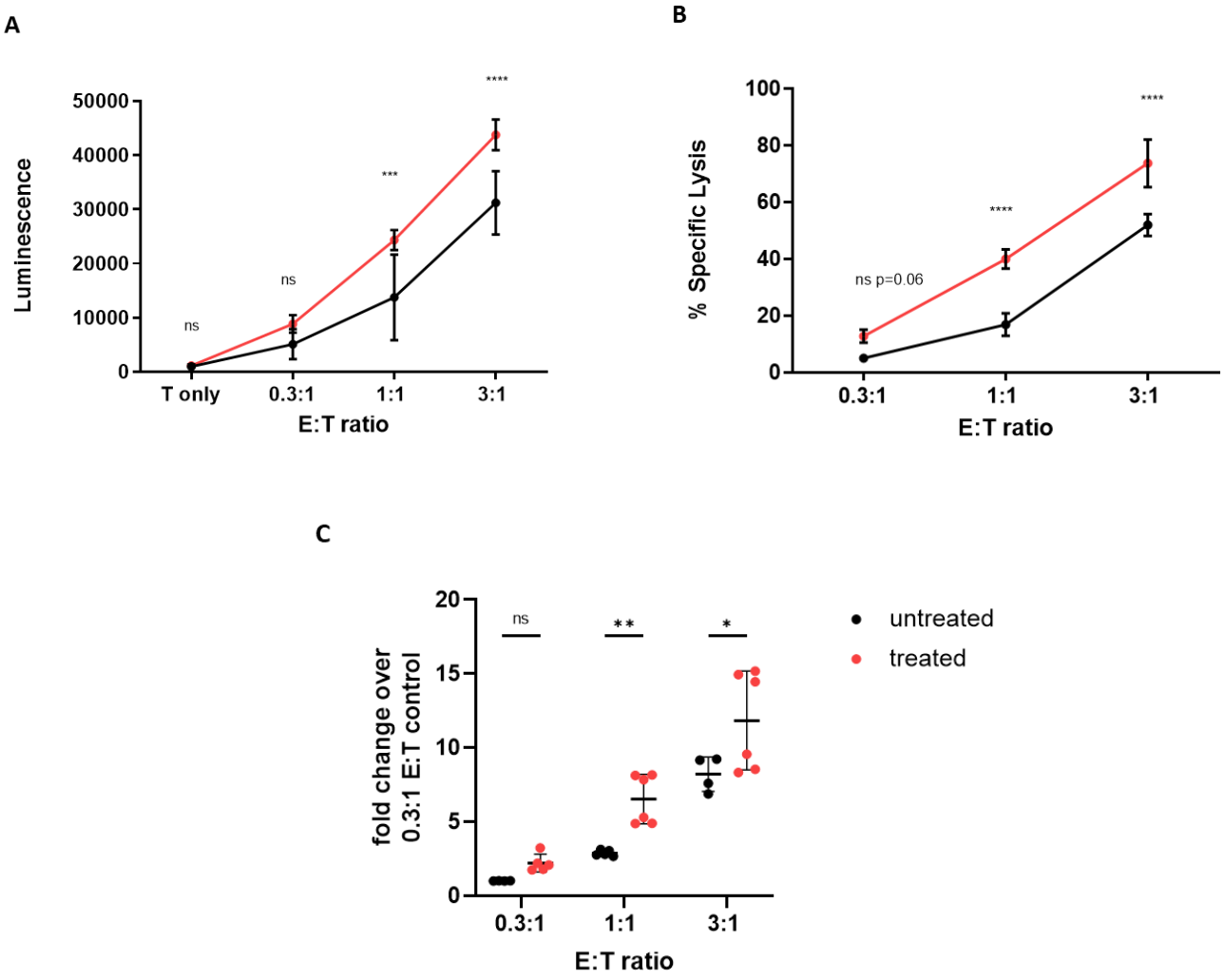
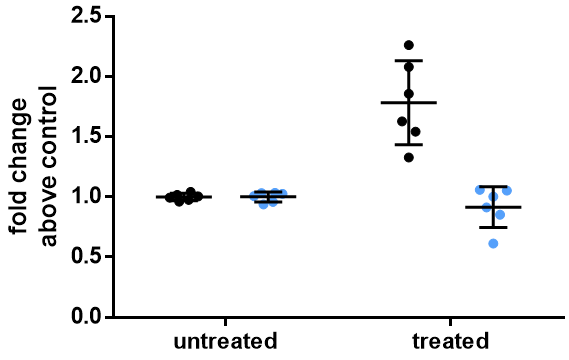

A
Luminescence
50000
40000
30000
20000
10000
0
ns
ns
***
****
T only
0.3:1
1:1
3:1
E:T ratio
B
% Specific Lysis
100
80
60
40
20
0
ns p=0.06
****
****
0.3:1
1:1
3:1
E:T ratio
C
fold change over 0.3:1 E:T control
20
15
10
5
0
ns
**
*
0.3:1
1:1
3:1
E:T ratio
untreated
treated

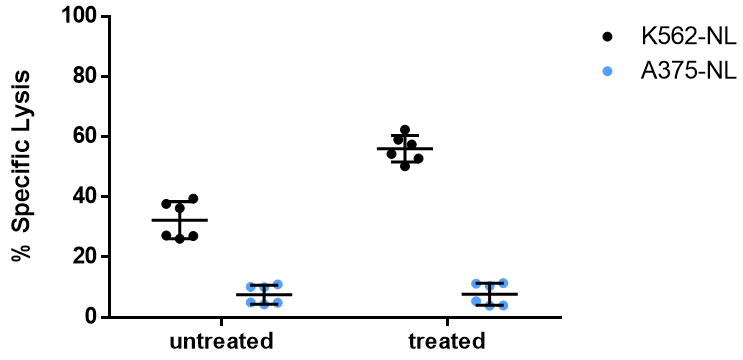
Figure 6. Colistin increases NK92-mediated killing of K562-NL but not A375-NL cells.

NK92 and K562-NL/A375-NL cells were seeded into a 96-well V bottom plate at a 1:1 E:T ratio with 10,000 target cells per well and treated with 10 μM of colistin for 5-hrs at 37˚C. After the incubation, the supernatant was collected and transferred to a 96-well black plate. The Biotek Synergy microplate reader was used to dispense CTZ and read luminescence **A.** Luminescent fold-change over untreated control. **B.** Percent specific lysis. Mean +/- SD of n=2. Black circles represent NK92 cell mixed with K562-NL cells and blue circles represent NK92 cells mixed with A375-NL cells.

A


fold change above control
2.5
2.0
1.5
1.0
0.5
0.0
untreated
treated

B


% Specific Lysis
100
80
60
40
20
0
untreated
treated
K562-NL
A375-NL

3.3.5. Pre-treatment of NK92 cells for 24-hours with colistin

To test if colistin could prime NK92 cells, we compared pre-treating NK92 cells with colistin for 24 hours to cells treated during the 5-hour incubation with target cells. NK92 cells were pre-treated with 0, 1, 5 or 10 μM of colistin. Prior to incubation with K562-NL cells, the drug was washed out. First, we showed that pre-treatment of NK92 cells with colistin at the tested concentrations were not cytotoxic towards NK92 cells (**Figure 7A**). Next, we found that NK92 cells treated with colistin during the 5-hour incubation had a fold-change significantly greater than any of the pre-treatment concentrations tested (**Figure 7B**) and none of the pre-treatment concentrations significantly increased NK92 cytotoxicity towards K562-NL cells (**Figure 7C**). These experiments suggest that colistin needed to be present during the 5-hour incubation with NK92 and K562-NL cells to observe an increased killing of target cells.

3.3.6. Pre-treatment of NK92 and K562-NL cells for 1-hour with colistin

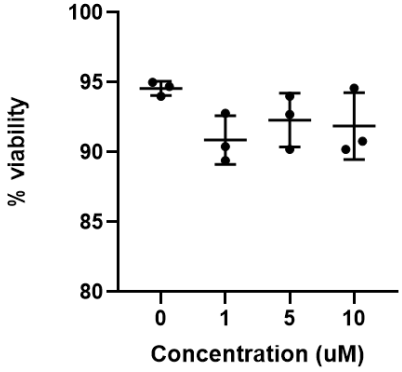
Considering that 24-hour pre-treated NK92 cells with colistin did not increase NK92 cytotoxicity, we decided to test a 1-hour pre-treatment condition. NK92 cells were treated with 10 μM of colistin for 1 hour, and the drug was washed out prior to co-culture with K562-NL cells. In comparison to the untreated condition, 1-hour pre-treatment of NK92 cells with colistin slightly increased NK92 cytotoxicity (**Figure 8**). NK92 cells treated with colistin during the 5-hour incubation showed greater killing of K562-NL cells compared to the pre-treated NK92 cells (**Figure 8B**). To determine if colistin treatment was sensitizing K562-NL cells to NK92-mediated killing, a follow-up experiment was conducted where NK92 and K562-NL cells were separately treated with 10 μM colistin for 1 hour. After washing out the drug, pre-treated NK92 and K562-NL cells were either mixed with each other or mixed with untreated cells for 5 hours. NK92 and K562-NL cells treated with colistin during the 5-hour incubation were also included, as well as an

untreated condition. If colistin was sensitizing K562-NL cells to NK92-mediated killing and likewise having an effect on NK92 cells, we would expect that the condition with both pre-treated cells would recapitulate the 5-hour co-culture treatment condition. However, this was not the case and no significant differences in luminescent fold-change or cytotoxicity were detected in the pre-treatment conditions (**Figure 9**). Only cells treated with colistin during the 5-hour incubation showed a significant increase in luminescent fold-change and cytotoxicity compared to the other tested conditions. All together, these experiments suggest that the effect of colistin is short lived as 1-hour pre-treatments did not significantly increase NK92 cytotoxicity and that colistin is acting on NK92 cells as we see a slight increase in NK92 cytotoxicity in NK92 cell pre-treated for 1-hour.

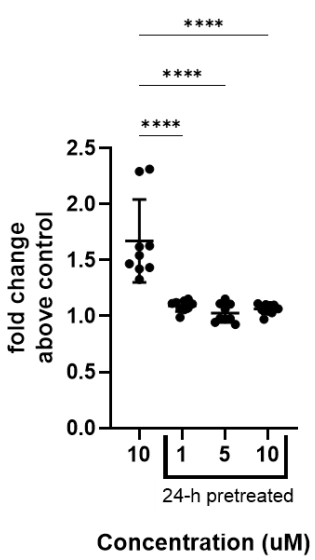
Figure 7. 24-hour pre-treatment with colistin does not increase NK92 cytotoxicity.

A. Percent viability of NK92 cells by trypan-exclusion dye after 24-h treatment with 0, 1, 5, 10 μM of colistin. **B-C** NK92 cells were treated for 24-hrs with 0, 1, 5 and 10 μM of colistin. After 24-hrs, NK92 cells were washed and co-cultured with K562-NL/A375-NL cells in a 96-well V bottom plate at a 1:1 E:T ratio with 10,000 K562-NL cells per well for 5-hrs at 37˚C. NK92 cells co-cultured with targets cells and treated with 10 μM of colistin during the 5-h incubation were also included. After the incubation, the supernatant was collected and transferred to a 96-well black plate. The Biotek Synergy microplate reader was used to dispense CTZ and read luminescence. **B.** Luminescent fold-change over untreated control. **C.** Percent specific lysis. Mean +/- SD of n=3. One-way ANOVA with Dunnett's multiple comparison test. ns= not significant, **** $p<0.0001$.

A


% viability
100
95
90
85
80
0
1
5
10
Concentration (uM)

B


****
****
****
fold change above control
2.5
2.0
1.5
1.0
0.5
0.0
10
1
5
10
24-h pretreated
Concentration (uM)

C

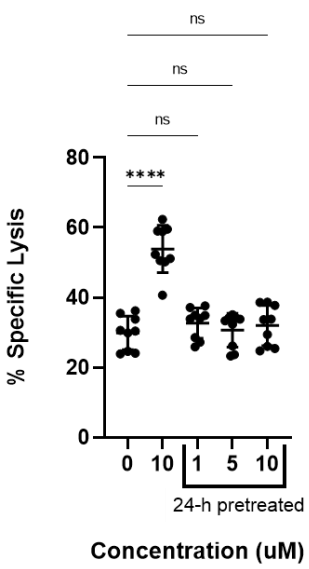
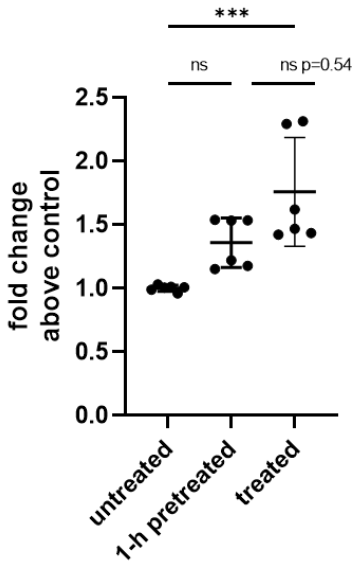

ns
ns
ns
****
% Specific Lysis
80
60
40
20
0
0
10
1
5
10
24-h pretreated
Concentration (uM)

Figure 8. 1-hour pre-treatment with colistin slightly increases NK92 cytotoxicity.

NK92 cells were treated for 1-h with 10 μM of colistin. After 1-h, NK92 cells were washed and co-cultured with K562-NL cells in a 96-well V bottom plate at a 1:1 E:T ratio with 10,000 K562-NL cells per well for 5-hrs at 37˚C. NK92 cells co-cultured with targets cells and treated with 10 μM of colistin during the 5-h incubation were also included. After the incubation, the supernatant was collected and transferred to a 96-well black plate. The Biotek Synergy microplate reader was used to dispense CTZ and read luminescence **A.** Luminescent fold-change over untreated control. **B.** Percent specific lysis. Mean +/- SD of n=2. One-way ANOVA with Tukey's multiple comparison test. ns= not significant, * $p<0.05$, ** $p<0.01$, *** $p<0.001$, **** $p<0.0001$.

A


***
ns
ns p=0.54
fold change above control
2.5
2.0
1.5
1.0
0.5
0.0
untreated
1-h pretreated
treated

B

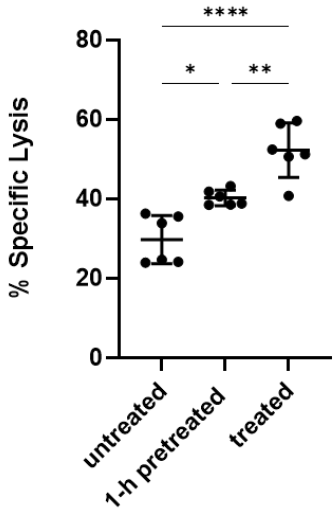
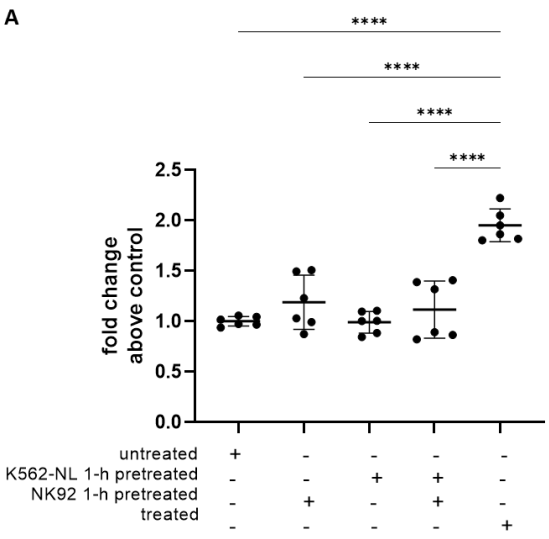

****
*
**
% Specific Lysis
80
60
40
20
0
untreated
1-h pretreated
treated

Figure 9. 1-hour pre-treatment with colistin does not sensitize K562-NL cells to NK92-mediated killing. NK92 and K562-NL cells were each treated separately for 1-h with 10 μM of colistin. After 1-h, cells were washed and co-cultured with either treated or untreated cells. Cells were seeded in a 96-well V bottom plate at a 1:1 E:T ratio with 10,000 K562-NL cells per well for 5-hrs at 37˚C. NK92 cells co-cultured with targets cells and treated with 10 μM of colistin during the 5-h incubation were also included. After the incubation, the supernatant was collected and transferred to a 96-well black plate. The Biotek Synergy microplate reader was used to dispense CTZ and read luminescence. **A.** Luminescent fold-change over untreated control. **B.** Percent specific lysis. Mean +/- SD of n=2. One-way ANOVA with Tukey's multiple comparison test. Only significant differences between treatments are shown. **** $p<0.0001$.


A
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****
fold change above control
2.5
2.0
1.5
1.0
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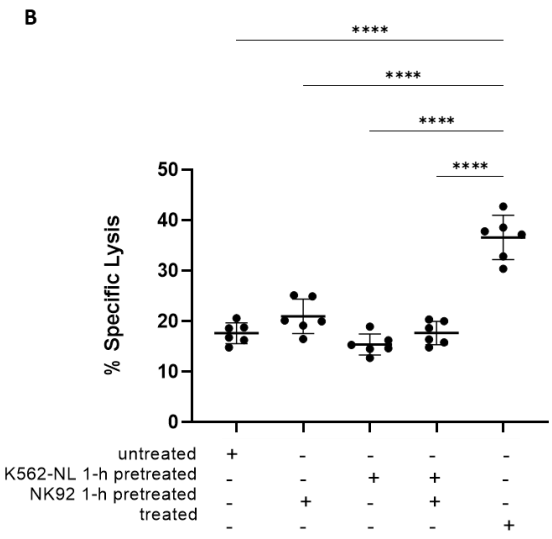
untreated + - - - -
K562-NL 1-h pretreated - - + + -
NK92 1-h pretreated - + - + -
treated - - - - +


B
****
****
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% Specific Lysis
50
40
30
20
10
0
untreated + - - - -
K562-NL 1-h pretreated - - + + -
NK92 1-h pretreated - + - + -
treated - - - - +

3.3.7. Treating primary human NK cells with colistin

Lastly, we tested if colistin treatment could increase cytotoxicity of primary NK cells. We obtained PBMCs from healthy donor blood. From PBMCs, NK cells were isolated by negative selection and NK cell purity was checked by flow cytometry. NK cell purity was ~85% and both $CD56^{+}CD16^{-}$ and $CD56^{+}CD16^{+}$ NK cell populations were present (**Supplemental Figure 4**). After NK cells were isolated from PBMCs, they were immediately co-cultured with K562-NL cells at varying E:T ratios and treated with 10 μM of colistin for 5 hours. Pooled results from all 3 healthy donor are shown in **Figure 10**. Overall, NK cells treated with colistin showed an increase in NK cell cytotoxicity towards K562-NL at all tested E:T ratios, although results were only significant at 1:1 and 3:1 E:T ratio and not significant at 0.3:1 E:T ratio (**Figure 10A&C**). Individual donor results are shown in **Supplemental Figure 5**. From these experiments, we showed that colistin treatment increased NK cytotoxicity towards K562-NL in unstimulated NK cells, with the greatest increase in cytotoxicity observed at the 3:1 E:T ratio.

Overall, the screening of the Prestwick Chemical Library identified colistin as a potential enhancer of NK92 cytotoxicity. In subsequent validation experiments, our results show that treating NK92 cells and primary NK cells with 10 μM of colistin increases NK cytotoxicity towards K562 target cells.

Figure 10. Primary human NK cells treated with colistin show modest increase in cytotoxicity.

Human NK cells isolated from PBMCs from healthy donors were mixed with K562-NL cells and were seeded into a 96-well V bottom plate at a 0.3:1, 1:1 and 3:1 E:T ratio, with 10,000 K562-NL cells per well and treated with 10 μM of colistin for 5-hrs at 37˚C. After the incubation, the supernatant was collected and transferred to 96-well black plates. The Biotek Synergy microplate reader was used to dispense CTZ and read luminescence. **A.** Luminescence values. **B.** Luminescent fold-change over 0.3:1 E:T untreated control. **C.** Percent specific lysis. Mean +/- SD of n=3 healthy donors. Black dots represent untreated cells and red dots represent treated cells. Two-way ANOVA with Bonferroni's multiple comparison test. ns= not significant, * $p<0.05$, ** $p<0.01$, **** $p<0.0001$.

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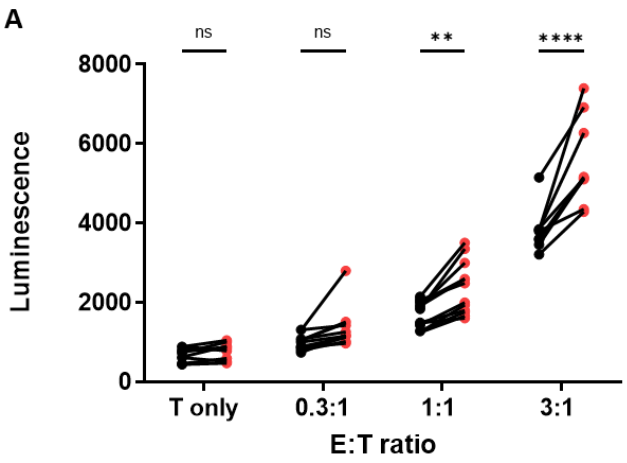
A
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8000
6000
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2000
0
Luminescence
T only
0.3:1
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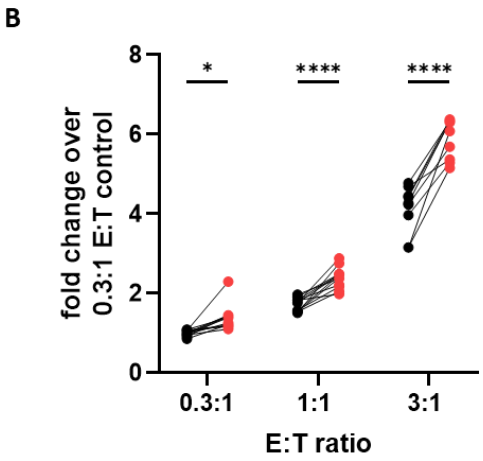
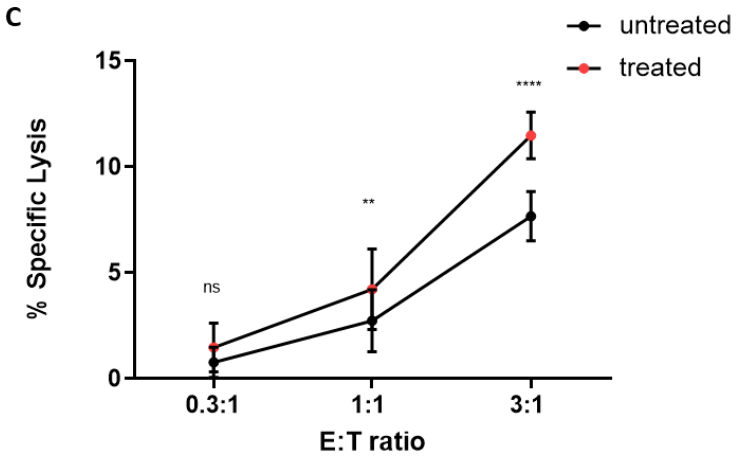
3:1
E:T ratio


B
*
****
****
8
6
4
2
0
fold change over 0.3:1 E:T control
0.3:1
1:1
3:1
E:T ratio


C
untreated
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15
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0.3:1
1:1
3:1
E:T ratio

4. Discussion

Here, we conducted a high-throughput luciferase-release cytotoxicity assay to screen the Prestwick Chemical Library to identify compounds that increased NK cell cytotoxicity. The screening results identified 8 candidate drugs capable of enhancing NK92 cytotoxicity. From the 8 candidate drugs, we show that colistin sulfate salt consistently increased NK92 cytotoxicity towards K562 cells by 2-fold. These results were also confirmed in primary human NK cells.

One of the objectives of this thesis was to optimize a high-throughput method to evaluate compounds capable of modulating NK cell activity. We employed a luciferase-release cytotoxicity assay, where NL released by K562-NL cells was measured and used as a proxy for NK92 cytotoxicity. Luciferase-release assays have been used in previous NK cell drug screenings with success[51]. Overall, the quality of our screening assay was fair, as determined by the Z' factor. The Z' factor measures the signal-to-noise ratio and calculates the variability separation band between the negative and positive controls[60]. When looking at the Z' factor for individual assay plates, we observed that the K562-NL alone condition had better Z' factor scores than the 1:1 E:T plates. An explanation for this observation is that the signal from the negative and positive controls used for the K562-NL alone plates did not overlap, however the signal did overlap for the controls in the 1:1 E:T plates. The dynamic range between the 1:1 E:T DMSO negative control and 9:1 E:T positive control from the 1:1 E:T plates decreased as the screen progressed which is most likely due to decreased cytotoxicity of NK92 cells as time progressed. In preparation for the screen, we showed that cells kept at room temperature for >2-hours prior to co-culture for the cytotoxicity assay, showed decreased cytotoxicity as observed by the reduced difference in luminescence between the K562-NL only and 1:1 E:T condition. Thus, during the drug screening, the 9:1 E:T positive control's signal began to overlap with the 1:1 E:T DMSO control and as a result reduced

the Z' factor. To improve future screenings, we will need to decrease the signal-to-noise ratio to be more confident in the stability of the screening assay. Another limitation of the drug screening was that each compound was only tested in singlet over 2 biological replicates, thus decreasing the robustness of the results. Because of this, volcano plots depicting *p* values versus fold-change for each compound could not be generated which would have improved identification of the most biologically significant drug hits from the screening assay.

Even though the quality of the screening assay could have been improved, our screening workflow was able to identify compounds previously reported to enhance NK cell activity. Our screening results identified amphotericin B as an enhancer of NK92 cytotoxicity, which was previously identified in a study screening the Prestwick Chemical Library for drugs that enhanced NK cell cytotoxicity[52]. We also identified nicotinamide, which is currently under investigation in clinical trials in nicotinamide-expanded NK cells for the treatment of Non-Hodgkin lymphoma and multiple myeloma[47]. Although, in further validation experiments, the tested concentration of nicotinamide did not yield significant results. Due to the decreased robustness of the screening assay, it is likely that there were false-negatives and positive hits. For instance, a previous study screening the Prestwick Chemical Library identified two ergosterol synthesis inhibitors, naftifine and butenafine as enhancers of NK cell activity[53], however we did not identify those compounds in our screening (fold-change 0.84 and 1.14, respectively). Also, we identified monensin, a known inhibitor of NK cell degranulation as an enhancer of NK92 cytotoxicity. As expected, upon further tests, monensin was shown to decrease NK92 cytotoxicity in a dose-dependent manner. Surprisingly, we only identified 12 compounds that were cytotoxic towards K562 cells in absence of NK92 cells. Since we used a short incubation time of 5 hours and a concentration of 10 μM, this treatment condition could be too short and the drug concentration too low for some of the

drugs in the Prestwick Chemical Library to exert their cytotoxic effects (i.e., chemotherapeutic drugs).

From the 8 candidate drugs identified from screening of the Prestwick Chemical Library, we showed that colistin was the sole drug that increased NK cell cytotoxicity. Colistin, also known as polymyxin E, is an antibiotic derived from *Bacillus polymyxa* and is used to treat antibiotic-resistant infections[61]. Colistin is an amphipathic molecule that disrupts the LPS membrane of Gram-negative bacteria by displacing calcium and magnesium ions[61]. This ultimately leads to increased cell permeability and eventually cell death. Few studies have investigated how colistin modulates immune cells, let alone NK cells. One study found that colistin increased cytotoxicity of murine splenic NK cells towards YAC-1 target cells and increased production of IFN-γ[62]. Although no mechanism was provided, it was shown that both polycationic peptide and hydrophobic tail domains were needed for the observed effect[62]. Colistin was also shown to increase NK cytotoxicity in combination with the antibiotics daptomycin or teicoplanin in mouse model of multi-resistant *Acinetobacter baumannii* infection, and this combination showed a greater increase in NK cytotoxicity than either antibiotic on its own[63]. Colistin was previously identified in a Prestwick Chemical Library screen as a compound capable of enhancing p38/MAPK pathway, a key pathway in innate immunity that is induced from TLR signaling[64,65]. Subsequently, this group showed that colistin increased phagocytosis, cytokine secretion and phosphorylation of p38 in rat macrophages and KEGG pathway analysis of treated macrophages showed upregulation of genes involved in signal transduction, immune pathways and calcium signaling[66]. Interestingly, they observed upregulated genes implicated in MAPK and PI3K-Akt pathways after a 3-hour treatment with 20 μg/mL of colistin[66], similar to our treatment conditions of 10 μM (~13μg/mL) of colistin for 5 hours. The MAPK and PI3K-Akt pathways are implicated in downstream signaling

of NK activating receptors[18], suggesting a potential mechanism for colistin increasing NK cytotoxicity. NK cells express various receptors such as TLRs that sense molecules of bacterial origin. Other antimicrobial drugs of bacterial origin such as amphotericin B has been shown to activate TLR pathways[67,68]. Interestingly, colistin enhanced activity of neutrophils towards biofilms which corresponded with an increase in TLR2 expression[69]. Martinez et al showed that TLR2 and NKG2D are both needed in NK cell activation upon vaccinia infection, indicating a synergistic effect among these pathways[70]. Keeping these results in mind, we could predict that colistin activates TLR pathways and this synergizes with activating receptor pathways, thus enhancing NK cell cytotoxicity. Altogether, these highlighted studies illustrate that colistin has potential immunomodulatory properties beyond its bactericidal activity.

We conducted several experiments to determine the optimal conditions for colistin's activity and to gain a better understanding of a potential mechanism of action. First, we showed that NK92 cells treated with colistin showed a dose-dependent increase in cytotoxicity, with the optimal concentration tested of 10 μM at 1:1 E:T ratio. Colistin also increased NK92 cytotoxicity at 0.3:1 E:T ratio, an E:T ratio that shows minimal killing, although these results were not significant. Next, we tested if colistin could increase NK92-mediated cytotoxicity towards different target cells lines. We showed that colistin increased NK92 cytotoxicity towards K562 cells but not towards A375 melanoma cells or 786O renal adenocarcinoma cells. The engagement that occurs between NK activating receptors on NK cells and ligands on target cells can vary depending on the target cell, which will then trigger different signaling pathways. Therefore, we postulated that colistin was enhancing a downstream activating receptor pathway that was not engaged in the interactions with the other target cells. However, NK92-mediated killing of K562 cells is mainly exerted through the NKG2D-ligand interaction[19] and evidence suggests that 786O

cells are also killed principally through the NKG2D pathway. For instance, blocking antibodies for NKG2D or its ligand MICA/B show reduced NK cell-mediated cytotoxicity towards 786O cells[71,72]. On the other hand, A375-NL cells have been reported to shed NKG2D ligands as an immune escape mechanism[73] and killing of A375 cells by NK cells seems to be mediated by the NKp30 activating receptor pathway as blocking NKp30 reduced killing of A375 cells by NK cells[74]. This could indicate that colistin is acting through another pathway independently of these NK activating receptor pathways. Some drugs that disrupt membrane integrity have been shown to increase exocytosis of lytic granules of NK cells[53]. Colistin also disrupts membrane integrity, however if that were occurring here, we would expect that colistin would increase NK cell-mediated killing towards all tested target cell lines, however that was not the case. If lytic granules in NK cells have already polarized to the immunological synapse, colistin's activity at the membrane could potentially aid increasing exocytosis of granules. Interestingly, untreated NK92 cells show similar levels of cytotoxicity towards K562 and 786O target cells but only the treated condition shows increase in killing towards K562 cells. Therefore, it seems unlikely that colistin is increasing lytic granule exocytosis since it would be expected that NK92-mediated cytotoxicity would be increased towards both target cell lines. Since we only observed an increase in target cell death towards K562 cells, it would be of interest to test additional target cell lines of hematological origin to confirm if NK cell-mediated cytotoxicity is enhanced towards other hematological target cells or if this is restricted to K562 cells.

We conducted several pre-treatment experiments to investigate if pre-treating NK92 cells with colistin could prime the cells prior to co-culture with K562 cells. NK92 cells that were pre-treated with colistin for 24 hours did not show increased killing towards K562 cells. Similarly, NK92 cells pre-treated with colistin for 1 hour only slightly showed increased killing of target

cells. Colistin has been shown to induce apoptosis which is linked to its undesirable side effects of neurotoxicity and nephrotoxicity[75–77]. Therefore, we separately pre-treated K562 cells with colistin to test if the drug was sensitizing target cells to NK92-mediated killing. The two conditions that contained the pre-treated K562 cells did not show increased susceptibility to NK92 killing, suggesting that the colistin was not sensitizing the target cells. Here, we used a shorter pre-treatment condition with a much lower concentration of colistin, therefore based on the conditions used in the previously mentioned studies, we do not expect that our conditions induced apoptosis in K562 cells. Although, we did not specifically test for apoptotic markers after target cells were either pre-treated for 1 hour or treated for 5 hours with colistin. To specifically rule out that colistin was not sensitizing target cells to NK92-mediated killing, we would need to further test this. Throughout the study, we have consistently showed that only when colistin was present during the 5-hour incubation with NK92 and K562 cells, an increase target cell death was observed. Altogether, these experiments indicate that the effect of colistin was short-lived, and that the drug needed to be present during the cytotoxicity assay to observe an increase in cytotoxicity.

Our last objective was to test validated drugs identified from the Prestwick Chemical Library screening using primary human NK cells. From our previous experiments, NK92 cells treated with colistin showed increased killing towards K562 cells, therefore we only tested primary NK cells treated with colistin. We observed that treating freshly isolated, unstimulated NK cells from healthy donors with colistin modestly increased killing of K562 targets compared to untreated NK cells. The magnitude was less pronounced in NK cells than NK92 cells however this is not unexpected as freshly isolated, unstimulated NK cells are much less cytotoxic than NK92 cells[78]. In this study, we have not elucidated a mechanism of action for colistin, however based on our results we have several predictions that warrant testing. We showed that K562 cells pre-treated

with colistin were not sensitized to NK92-mediated killing and that increased killing was only detectable when colistin was present during the 5-hour incubation, therefore, we postulate that colistin is enhancing NK cell cytotoxicity by a quick mechanism of action such as increasing calcium availability. We previously mentioned that colistin's known bactericidal mechanism of action is rooted in the molecule's displacement of calcium and magnesium ions from the LPS membrane. Calcium is a key cation needed for NK cell degranulation and perforin-pore formation on target cells[27,28]. Colistin could be promoting calcium availability at an optimal concentration that enhances NK cell activity. This could be tested by monitoring calcium flux in untreated and treated NK cells that are incubated with or without K562 target cells. A previous study showed that NK cells that are more cytotoxic kill their targets in less time and spend less time conjugated to target cells compared to less cytotoxic NK cells[79]. To complement calcium flux experiments, conjugation assays can be conducted either by flow cytometry or time-lapsed fluorescent microscopy to investigate if colistin affects conjugation time between NK cells and target cells. Further investigation such as the suggestions above are needed to determine the mechanism of action of colistin in NK cells. Uncovering this mechanism could contribute to knowledge of fundamental NK cell biology regarding NK cell cytotoxicity which in turn could provide future directions in identifying other small molecule drugs that enhance NK activity.

5. Conclusion

In conclusion, we first optimized a luciferase-release NK cell cytotoxicity assay that can be used in a high-throughput format. Using this assay format, we screened the Prestwick Chemical Library for small molecules that had the ability to increase NK cell cytotoxicity. From our screening results and subsequent validation experiments, we identified colistin sulfate salt as an enhancer of NK cell cytotoxicity. Although no putative mechanism of action was determined here, our results suggest that colistin is acting on NK cells rather than sensitizing target cells to NK-mediated killing and that the effect occurs quickly and is short lived. We suggested several follow-up experiments such as confirming colistin was not sensitizing target cells by investigating apoptosis markers after treatment and testing calcium flux in NK cells and conjugation with target cells following treatment with colistin. Altogether, our main objective was met as we were able to identify compounds from the initial screening. In the future, this screening platform can be improved and used to screen other compound libraries or with some modifications test other functional readouts other than cytotoxicity such as using luciferase reporter gene expression.

6. References

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7. Contribution from collaborators

The work of several collaborators contributed to this research project. Dr. Shaad Hasim helped immensely with the screening workflow over the course of the two drug screening days. The Diallo lab provided valuable reagents and equipment that were crucial for this project. Zaid Taha from the Diallo lab provided 786O-NL cells and the protocol to make the buffer, reconstitute and use coelenterazine. Glib Maznyi from the Diallo lab helped prepare drug library plates that were used for the screening. Fernando Ortiz from the OHRI's Flow Cytometry and Cell Sorting Facility conducted the single clone sorting for K562-NL and A375-NL cells.

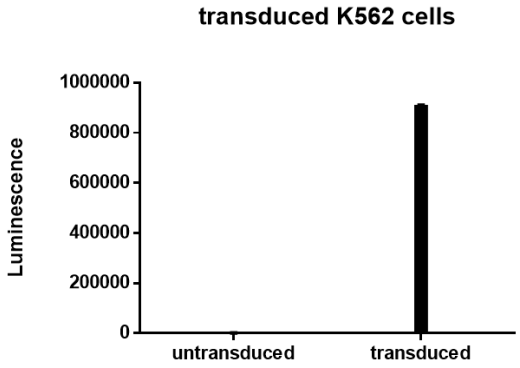
8. Appendix

Supplemental Figures

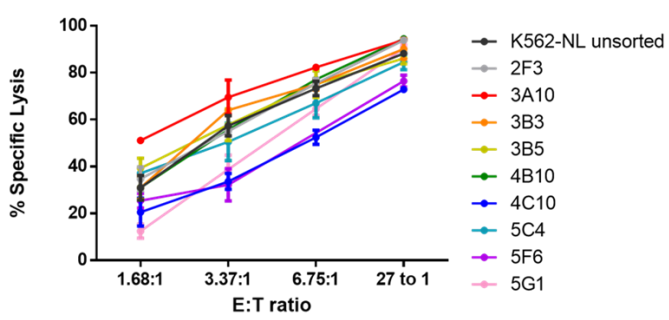
Supplemental Figure 1. Generating nano luciferase (NL) expressing K562 and A375 target cell lines.

A. K562-NL cells were transduced with a lentiviral plasmid expressing NL. Luciferase activity was tested 4-days post-transduction using Promega Nano-glo luciferase assay system and luminescence measured using Biotek Synergy microplate reader. Cells were plated in triplicate with 50,000 cells per well. Bars represent mean +/- SD of three technical replicates. **B.** Flow cytometry-based killing assay where NK92 cells were mixed with bulk unsorted K562-NL population or with sorted single clones expressing NL. Cells were seeded in triplicate at indicated E:T ratios with 10,000 target cells per well and incubated at 37˚C for 5-hrs. Cells were acquired by LSR Fortessa and percent specific lysis calculated by exporting live target cell counts from FlowJo analysis. A polyclonal population of K562-NL cells was made by mixing 50,000 cells from each clone except 5G1, 5F6 and 4C10. Data points represent mean +/- SD of three technical replicates. **C.** A375-NL cells were transduced with a lentiviral plasmid expressing NL. Luciferase activity was tested 5-days post-transduction using Promega Nano-glo luciferase assay system and luminescence measured using Biotek Synergy microplate reader. Cells were plated in triplicate with 50,000 cells per well. Bars represent mean +/- SD of three technical replicates. **D.** Flow cytometry-based killing assay where NK92 cells were mixed with bulk unsorted A375-NL population or with sorted single clones expressing NL. Cells were seeded in triplicate at indicated E:T ratios with 10,000 target cells per well and incubated at 37˚C for 5-hrs. Cells were acquired by LSR Fortessa and percent specific lysis calculated by exporting live target cell counts from FlowJo analysis. A polyclonal population of A375-NL cells was made by mixing 50,000 cells from clones 1E7, 2A2, 2B11, 4E3, 5B1, 5F3. Data points represent mean +/- SD of three technical replicates.

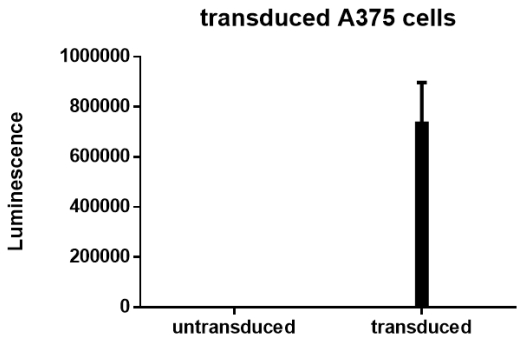
A


transduced K562 cells
Luminescence
1000000
800000
600000
400000
200000
0
untransduced
transduced

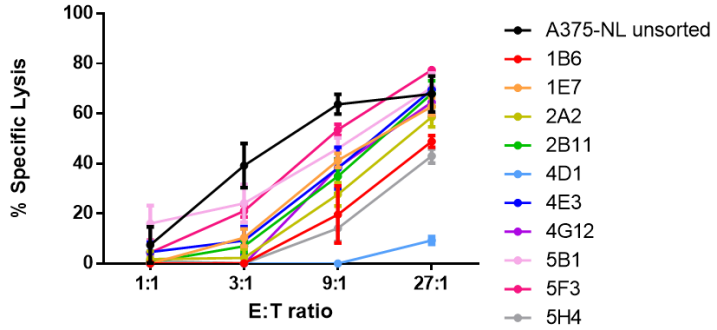
B


% Specific Lysis
100
80
60
40
20
0
1.68:1
3.37:1
6.75:1
27 to 1
E:T ratio
K562-NL unsorted
2F3
3A10
3B3
3B5
4B10
4C10
5C4
5F6
5G1

C

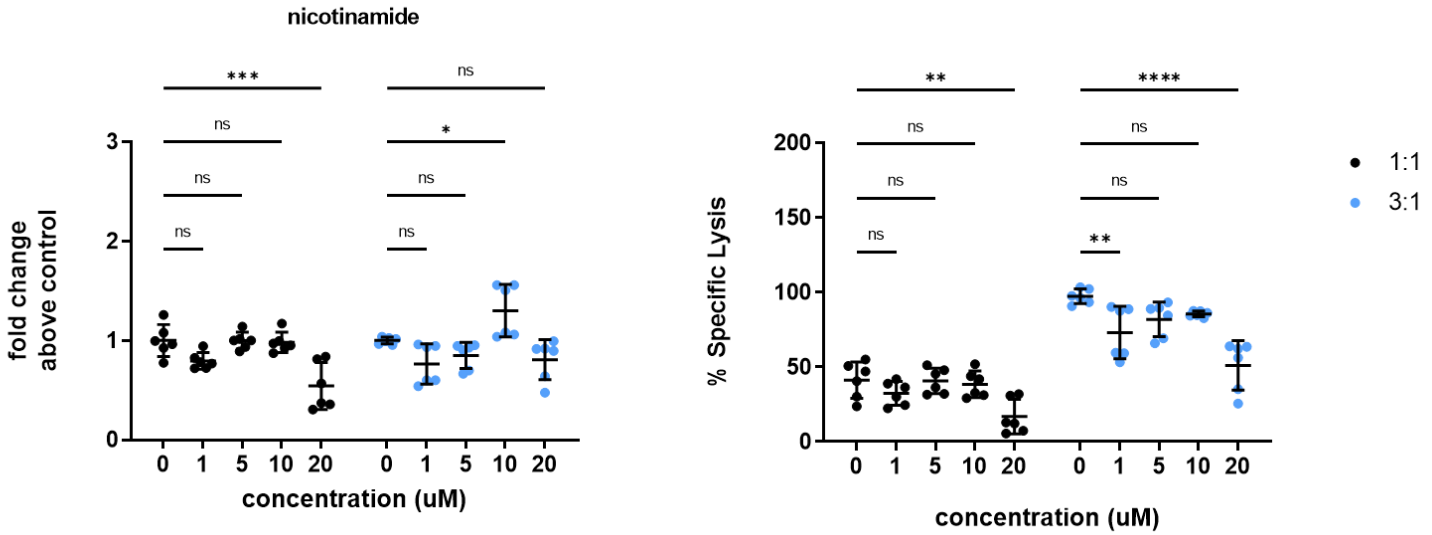

transduced A375 cells
Luminescence
1000000
800000
600000
400000
200000
0
untransduced
transduced

D

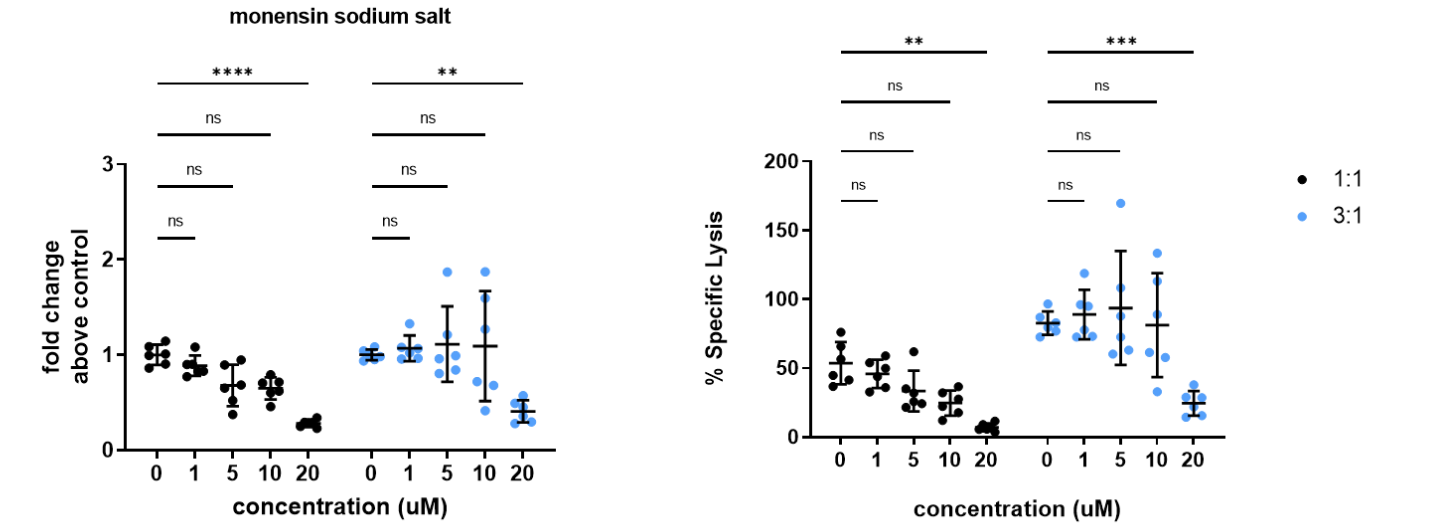

% Specific Lysis
100
80
60
40
20
0
1:1
3:1
9:1
27:1
E:T ratio
A375-NL unsorted
1B6
1E7
2A2
2B11
4D1
4E3
4G12
5B1
5F3
5H4

Supplemental Figure 2. Drug-dose response of drug candidates identified from the Prestwick Chemical Library screening. NK92 and K562-NL cells were seeded into 96-well V bottom plates at a 1:1 or 3:1 E:T ratio, with 10,000 K562-NL cells per well and treated with 1, 5, 10 and 20 μM of drugs for 5-hrs at 37˚C. After the incubation, the supernatant was collected and transferred to 96-well black plates. The Biotek Synergy microplate reader was used to dispense CTZ and read luminescence. Left panel: Luminescent fold-change over control. Right panel: Percent specific lysis. Black circles represent cells at a 1:1 E:T ratio and blue circles represent cells at a 3:1 E:T ratio. **A.** Nicotinamide. **B.** Monensin sodium salt. **C.** Zafirlukast. **D.** Tizanidine hydrochloride. **E.** Closantel. **F.** Benazepril hydrochloride. **G.** Diflorasone diacetate. Mean +/- SD of n=2. Two-way ANOVA with Tukey's multiple comparison test. ns= not significant, * $p<0.05$, ** $p<0.01$, *** $p<0.001$, **** $p<0.0001$.

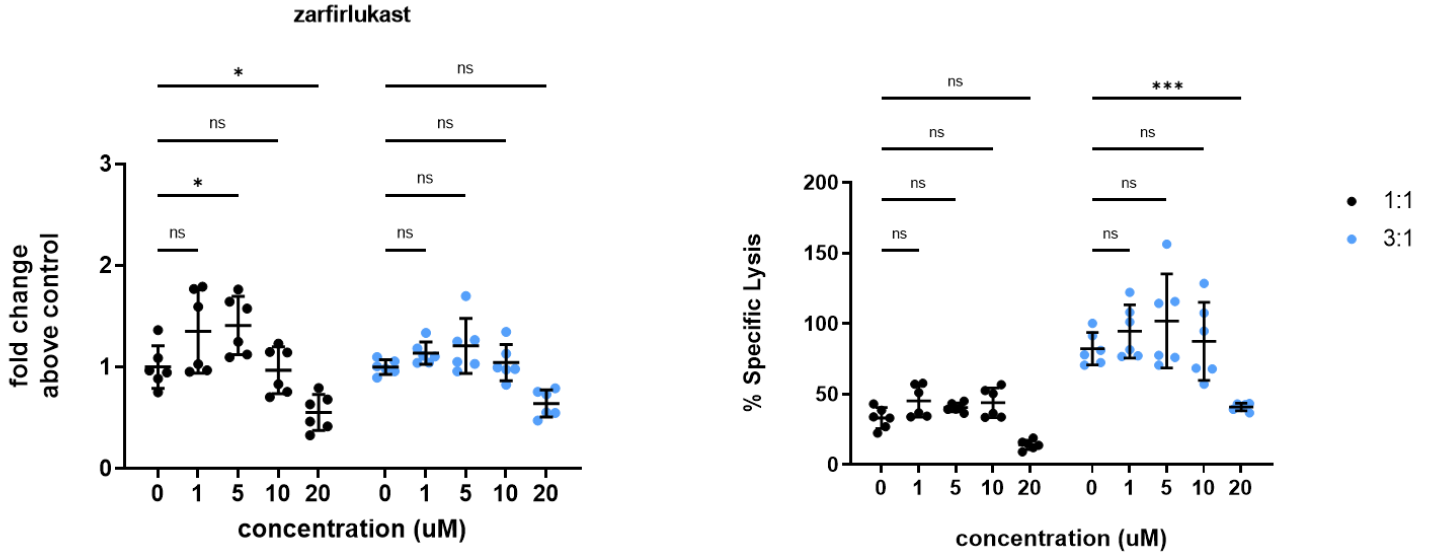
A


nicotinamide
fold change above control
concentration (uM)
% Specific Lysis
1:1
3:1

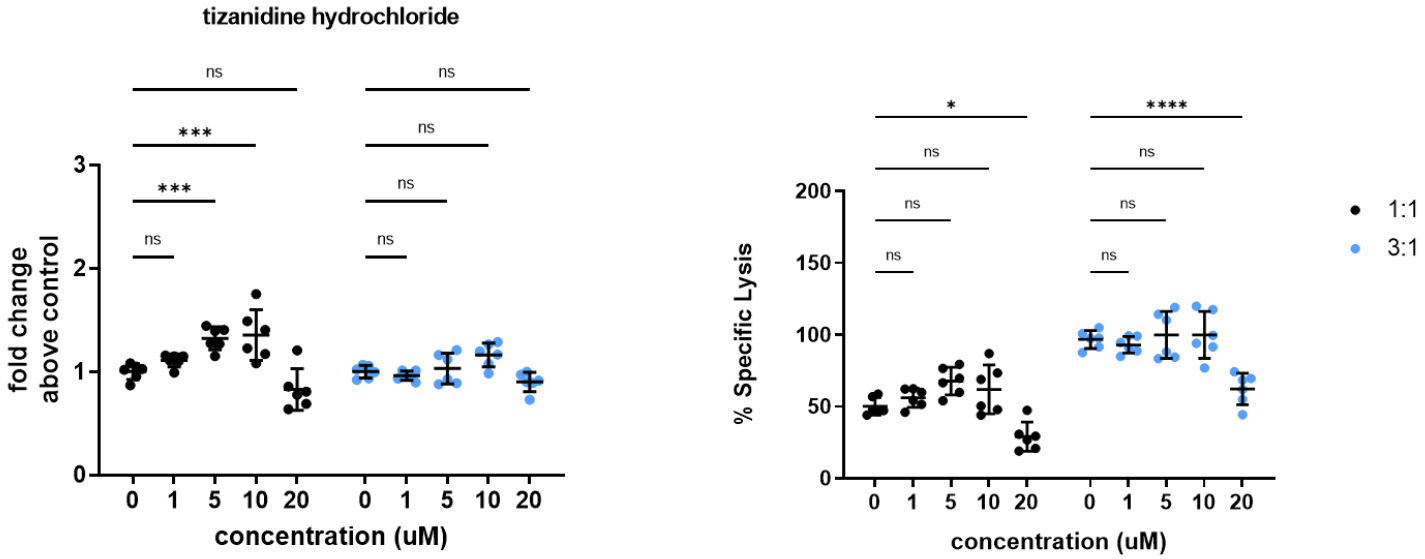
B


monensin sodium salt
fold change above control
concentration (uM)
% Specific Lysis
1:1
3:1

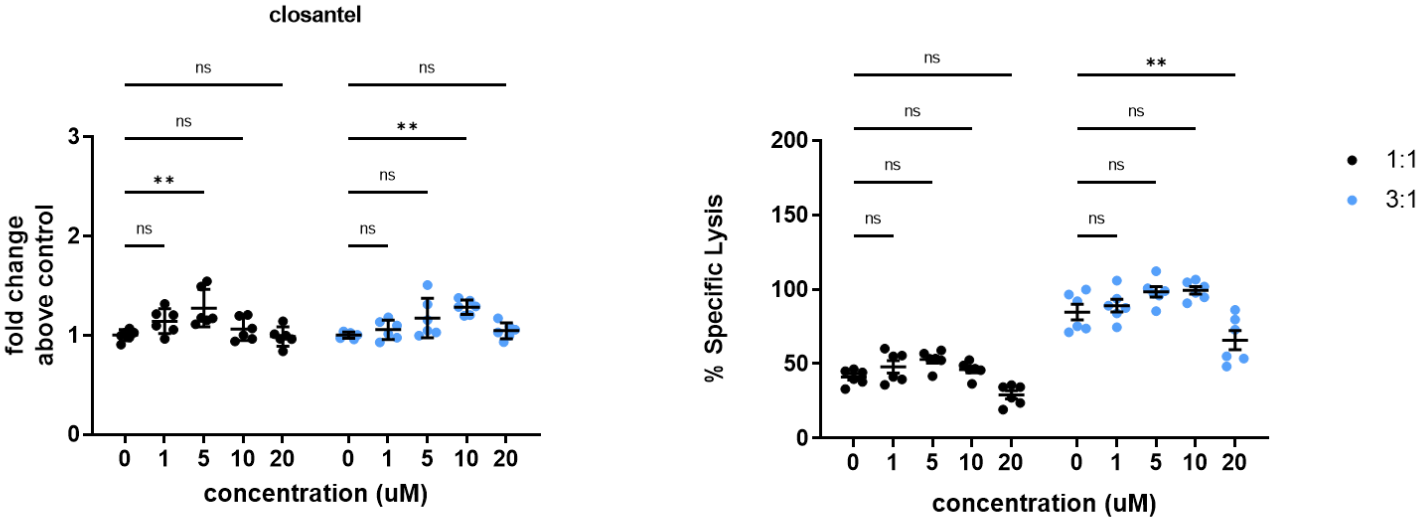
C


zarfirlukast
fold change above control
concentration (uM)
% Specific Lysis
1:1
3:1

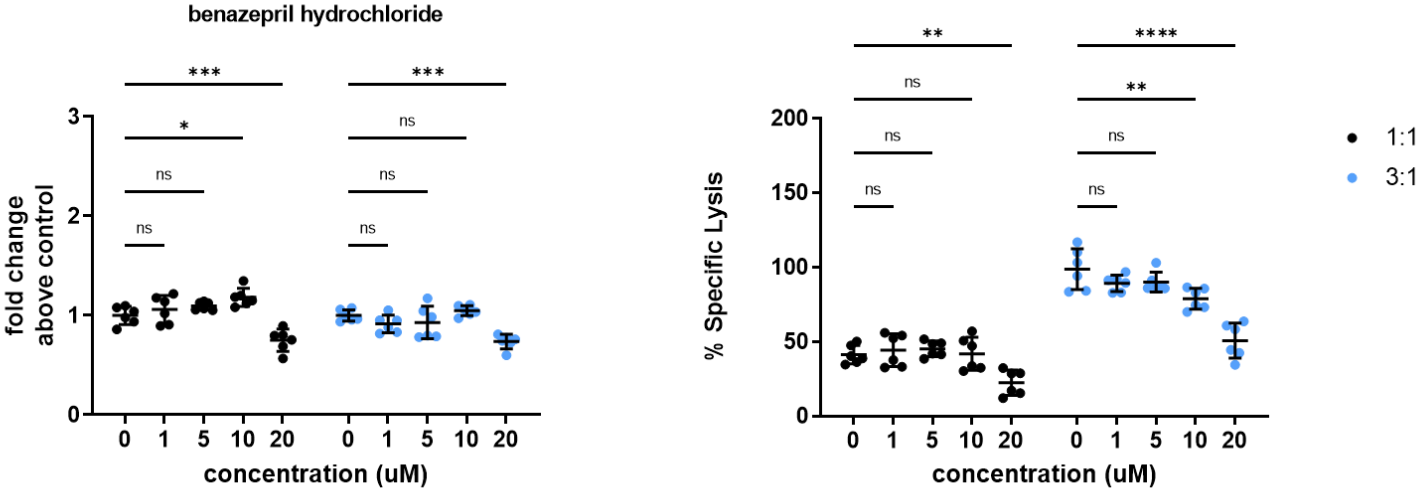
D


tizanidine hydrochloride
fold change above control
concentration (uM)
% Specific Lysis
1:1
3:1

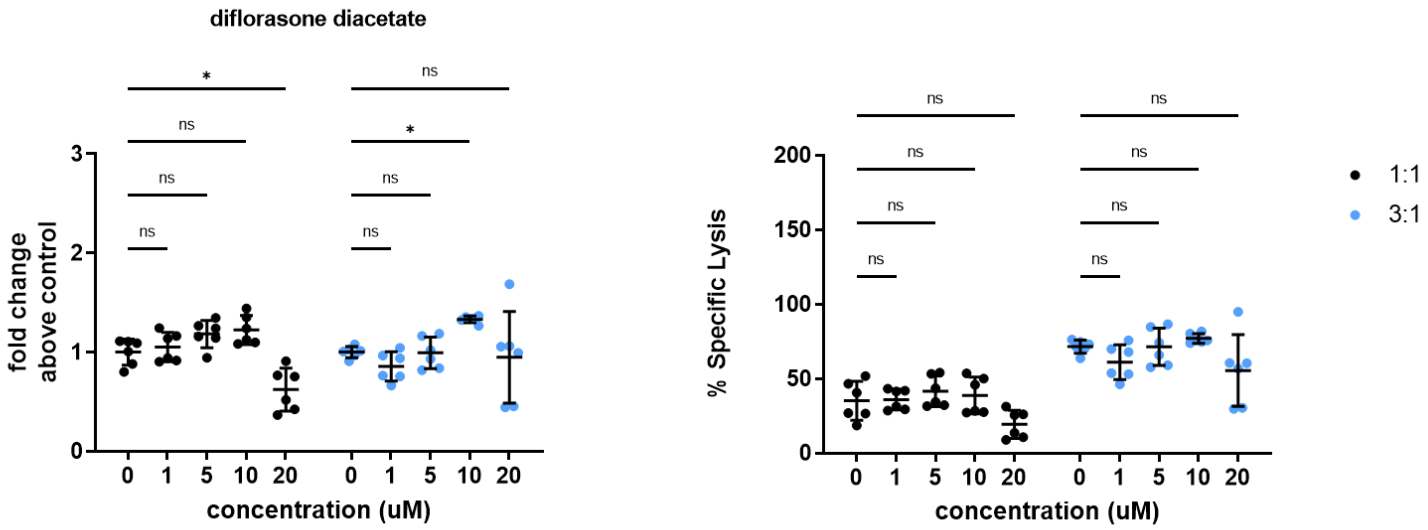
E


closantel
fold change above control
concentration (uM)
% Specific Lysis
1:1
3:1

F

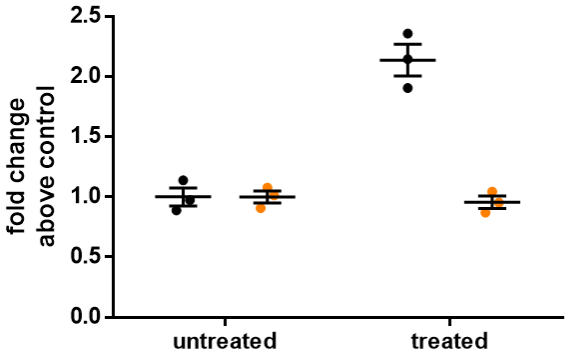

benazepril hydrochloride
fold change above control
concentration (uM)
% Specific Lysis
1:1
3:1

G

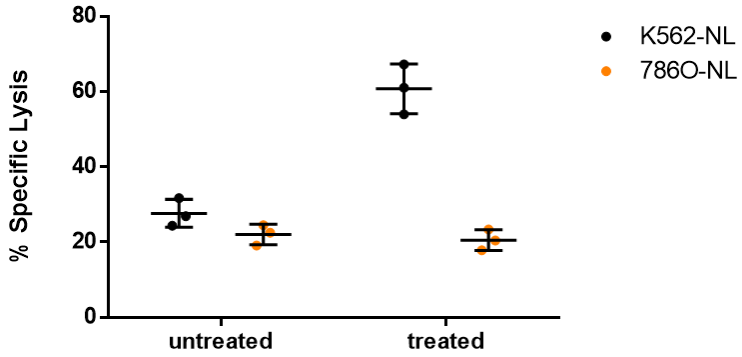

diflorasone diacetate
fold change above control
concentration (uM)
% Specific Lysis
1:1
3:1
ns
*
0
1
5
10
20
0
50
100
150
200
1
2
3

Supplemental Figure 3. Colistin increases NK92-mediated killing of K562-NL but not 786O-NL cells. NK92 and K562-NL/786O-NL cells were seeded into a 96-well V bottom plate at a 1:1 E:T ratio with 10,000 target cells per well and treated with 10 μM of colistin for 5-hrs at 37˚C. After the incubation, the supernatant was collected and transferred to a 96-well black plate. The Biotek Synergy microplate reader was used to dispense CTZ and read luminescence **A.** Luminescent fold-change over untreated control. **B.** Percent specific lysis. Mean +/- SD of 3 technical replicates, representative of 2 independent experiments. Black circles represent NK92 cell mixed with K562-NL cells and orange circles represent NK92 cells mixed with 786O-NL cells.

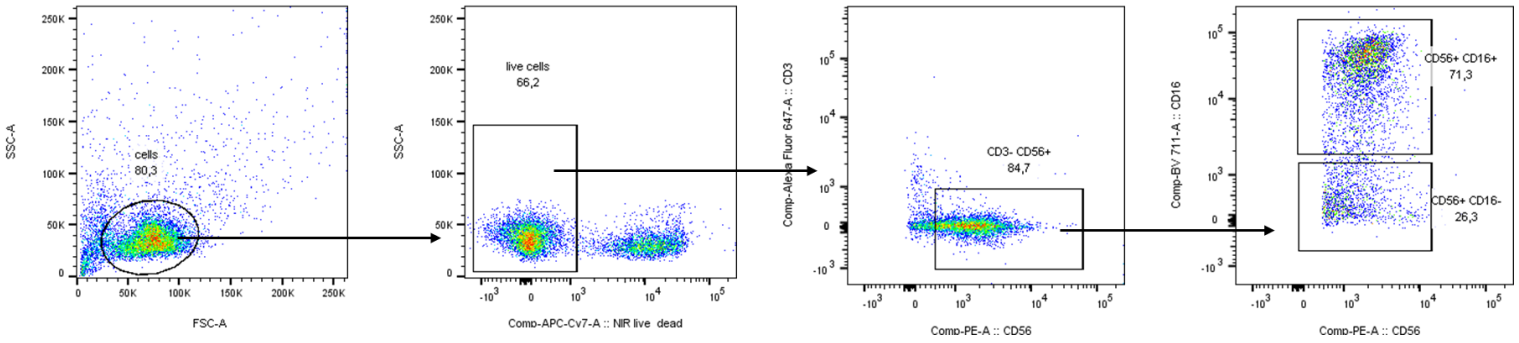
A


fold change above control
2.5
2.0
1.5
1.0
0.5
0.0
untreated
treated

B

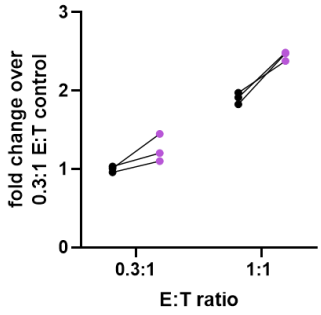

% Specific Lysis
80
60
40
20
0
untreated
treated
K562-NL
786O-NL

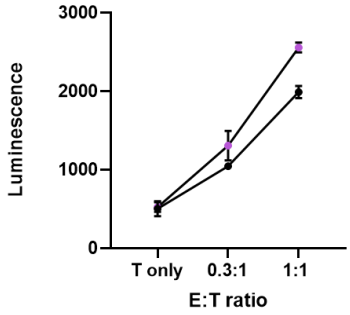
Supplemental Figure 4. Verifying the purity of NK cells isolated from thawed PBMCs. Human NK cells were isolated from previously frozen PBMCs by negative selection using EasySep™ Human NK Cell Isolation Kit. After isolation, NK cell purity was checked by flow cytometry. Prior to acquisition, isolated NK cells were stained with AF647-CD3, APC R700-CD4, BV786-CD8, PE-CD56, BV711-CD16, BV650-CD19 and PerCP Cy5.5-CD14 fluorochrome-conjugated antibodies. Flow plots illustrate the gating strategy used to identify NK cells and check NK cell purity. Samples were acquired by LSR Fortessa. Flow plots are representative of two independent experiments.

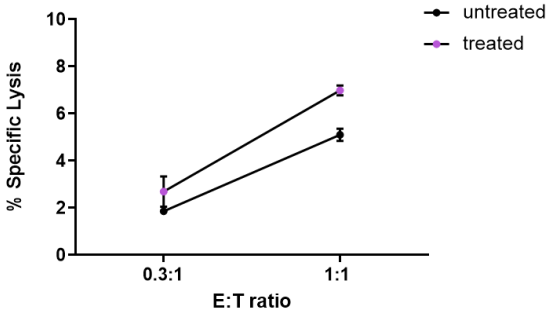

SSC-A
FSC-A
cells
80,3
live cells
66,2
Comp-APC-Cv7-A :: NIR live dead
Comp-Alexa Fluor 647-A :: CD3
Comp-PE-A :: CD56
CD3- CD56+
84,7
Comp-BV 711-A :: CD16
CD56+ CD16+
71,3
CD56+ CD16-
26,3

Supplemental Figure 5. Primary human NK cells treated with colistin show modest increase in cytotoxicity. Human NK cells isolated from PBMCs from healthy donors were co-cultured with K562-NL cells in a 96-well V bottom plate at a 0.3:1, 1:1 and 3:1 E:T ratios with 10,000 K562-NL cells per well and treated with 10 μM of colistin for 5-hrs at 37˚C. After the incubation, the supernatant was collected and transferred to a 96-well black plate. The Biotek Synergy microplate reader was used to dispense CTZ and read luminescence. Left panel: Luminescent fold-change over 0.3:1 E:T untreated control. Middle panel: luminescence values. Right panel: Percent specific lysis. **A.** Donor 1: mean +/- SD of 3 technical replicates. **B.** Donor 2: mean +/- SD of 3 technical replicates. **C.** Donor 3: mean +/- SD of 6 technical replicates. Black circles represent untreated cells and colored circles represent treated cells.

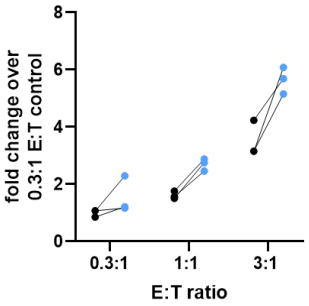
A

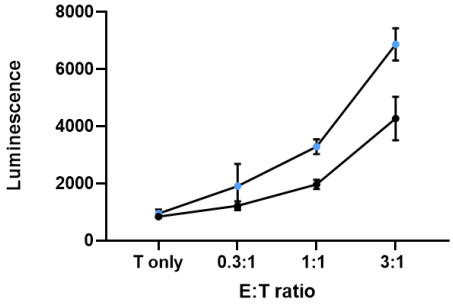

fold change over 0.3:1 E:T control
0
1
2
3
0.3:1
1:1
E:T ratio

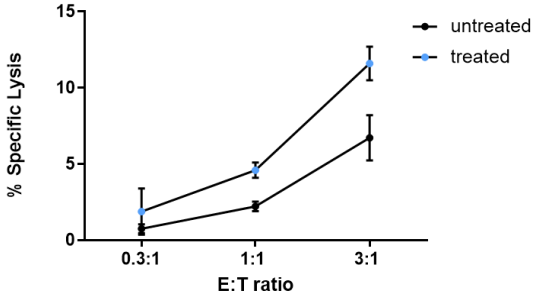

Luminescence
0
1000
2000
3000
T only
0.3:1
1:1
E:T ratio


% Specific Lysis
0
2
4
6
8
10
0.3:1
1:1
E:T ratio
untreated
treated

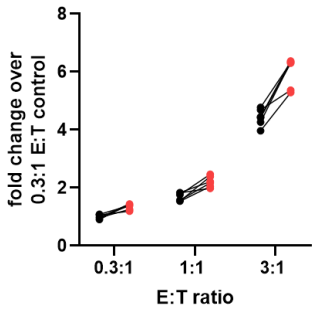
B

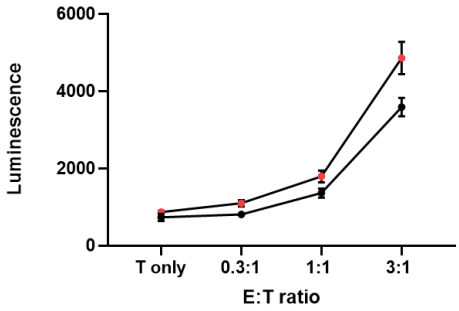

fold change over 0.3:1 E:T control
0
2
4
6
8
0.3:1
1:1
3:1
E:T ratio

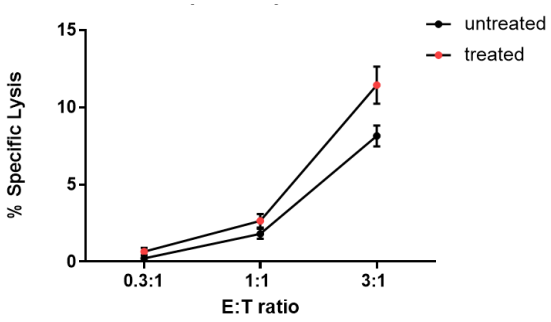

Luminescence
0
2000
4000
6000
8000
T only
0.3:1
1:1
3:1
E:T ratio


% Specific Lysis
0
5
10
15
0.3:1
1:1
3:1
E:T ratio
untreated
treated

C


fold change over 0.3:1 E:T control
0
2
4
6
8
0.3:1
1:1
3:1
E:T ratio


Luminescence
0
2000
4000
6000
T only
0.3:1
1:1
3:1
E:T ratio


% Specific Lysis
0
5
10
15
0.3:1
1:1
3:1
E:T ratio
untreated
treated

Supplemental Tables

Supplemental Table 1. Luminescent fold-change from NK92+K562-NL cells treated with compounds from the Prestwick Chemical Library drug screening. Average luminescent fold-change of all compounds from the 1:1 E:T condition compared to DMSO control wells in the same plate. Each compound was evaluated in singlet over 2 biological replicates. [a]Plates 5 & 7: fold-change of one replicate.

Prestw number	Plate # / Well position	Chemical name	Fold-change
Plate 1			
Prestw-1	01A02	Azaguanine-8	1.16
Prestw-2	01A03	Allantoin	1.15
Prestw-3	01A04	Acetazolamide	1.13
Prestw-4	01A05	Metformin hydrochloride	1.16
Prestw-5	01A06	Atracurium besylate	1.15
Prestw-6	01A07	Isoflupredone acetate	1.19
Prestw-7	01A08	Amiloride hydrochloride dihydrate	1.20
Prestw-8	01A09	Amprolium hydrochloride	1.19
Prestw-9	01A10	Hydrochlorothiazide	1.20
Prestw-10	01A11	Sulfaguanidine	1.16
Prestw-11	01B02	Meticrane	1.05
Prestw-12	01B03	Benzonatate	1.16
Prestw-13	01B04	Hydroflumethiazide	1.16
Prestw-14	01B05	Sulfacetamide sodic hydrate	1.09
Prestw-15	01B06	Heptaminol hydrochloride	1.06
Prestw-16	01B07	Sulfathiazole	1.17
Prestw-17	01B08	Levodopa	1.12
Prestw-18	01B09	Idoxuridine	1.17
Prestw-19	01B10	Captopril	1.11
Prestw-20	01B11	Minoxidil	1.10
Prestw-21	01C02	Sulfaphenazole	1.10
Prestw-22	01C03	Panthenol (D)	1.15
Prestw-23	01C04	Sulfadiazine	1.06
Prestw-24	01C05	Norethynodrel	1.08
Prestw-25	01C06	Thiamphenicol	1.11
Prestw-26	01C07	Cimetidine	1.10
Prestw-27	01C08	Doxylamine succinate	1.08
Prestw-28	01C09	Ethambutol dihydrochloride	1.12
Prestw-29	01C10	Antipyrine	1.00

Prestw-30	01C11	Antipyrine, 4-hydroxy	1.10
Prestw-31	01D02	Chloramphenicol	1.04
Prestw-32	01D03	Epirizole	1.03
Prestw-33	01D04	Diprophylline	1.04
Prestw-34	01D05	Triamterene	1.08
Prestw-35	01D06	Dapsone	1.08
Prestw-36	01D07	Troleandomycin	1.15
Prestw-37	01D08	Pyrimethamine	1.06
Prestw-38	01D09	Hexamethonium dibromide dihydrate	1.13
Prestw-39	01D10	Diflunisal	1.06
Prestw-40	01D11	Niclosamide	1.18
Prestw-41	01E02	Procaine hydrochloride	1.07
Prestw-42	01E03	Moxisylyte hydrochoride	1.10
Prestw-43	01E04	Betazole hydrochloride	1.06
Prestw-44	01E05	Isoxicam	1.00
Prestw-45	01E06	Naproxen	1.05
Prestw-46	01E07	Naphazoline hydrochloride	1.08
Prestw-47	01E08	Ticlopidine hydrochloride	1.12
Prestw-48	01E09	Dicyclomine hydrochloride	1.05
Prestw-49	01E10	Amyleine hydrochloride	1.04
Prestw-50	01E11	Lidocaïne hydrochloride	1.04
Prestw-51	01F02	Trichlorfon	0.99
Prestw-52	01F03	Carbamazepine	1.02
Prestw-53	01F04	Triflupromazine hydrochloride	0.96
Prestw-54	01F05	Mefenamic acid	1.05
Prestw-55	01F06	Acetohexamide	1.06
Prestw-56	01F07	Sulpiride	1.02
Prestw-57	01F08	Benoxinate hydrochloride	1.00
Prestw-58	01F09	Oxethazaine	1.01
Prestw-59	01F10	Pheniramine maleate	1.13
Prestw-60	01F11	Tolazoline hydrochloride	1.02
Prestw-61	01G02	Morantel tartrate	1.00
Prestw-62	01G03	Homatropine hydrobromide (R,S)	0.99
Prestw-63	01G04	Nifedipine	1.03
Prestw-64	01G05	Chlorpromazine hydrochloride	1.01
Prestw-65	01G06	Diphenhydramine hydrochloride	0.96
Prestw-66	01G07	Minaprine dihydrochloride	1.03
Prestw-67	01G08	Miconazole	1.06
Prestw-68	01G09	Isoxsuprine hydrochloride	1.00
Prestw-69	01G10	Acebutolol hydrochloride	1.02
Prestw-70	01G11	Tolnaftate	1.06
Prestw-71	01H02	Todralazine hydrochloride	1.02
Prestw-72	01H03	Imipramine hydrochloride	0.91

Prestw-73	01H04	Sulindac	0.99
Prestw-74	01H05	Amitryptiline hydrochloride	0.91
Prestw-75	01H06	Adiphenine hydrochloride	1.01
Prestw-76	01H07	Dibucaine	0.99
Prestw-77	01H08	Prednisone	1.02
Prestw-78	01H09	Thioridazine hydrochloride	0.98
Prestw-79	01H10	Diphemanil methylsulfate	0.99
Prestw-80	01H11	Trimethobenzamide hydrochloride	1.06
Plate 2			
Prestw-81	02A02	Metronidazole	1.16
Prestw-1424	02A03	Fulvestrant	1.16
Prestw-83	02A04	Edrophonium chloride	1.24
Prestw-84	02A05	Moroxidine hydrochloride	1.13
Prestw-85	02A06	Baclofen (R,S)	1.13
Prestw-86	02A07	Acyclovir	1.17
Prestw-87	02A08	Diazoxide	1.19
Prestw-88	02A09	Amidopyrine	1.12
Prestw-1179	02A10	Busulfan	1.20
Prestw-90	02A11	Pindolol	1.19
Prestw-91	02B02	Khellin	1.03
Prestw-92	02B03	Zimelidine dihydrochloride monohydrate	1.08
Prestw-93	02B04	Azacyclonol	1.03
Prestw-94	02B05	Azathioprine	1.07
Prestw-95	02B06	Lynestrenol	1.10
Prestw-96	02B07	Guanabenz acetate	1.19
Prestw-97	02B08	Disulfiram	0.87
Prestw-98	02B09	Acetylsalicylsalicylic acid	1.23
Prestw-99	02B10	Mianserine hydrochloride	1.08
Prestw-100	02B11	Nocodazole	1.25
Prestw-101	02C02	R(-) Apomorphine hydrochloride hemihydrate	1.10
Prestw-102	02C03	Amoxapine	0.86
Prestw-103	02C04	Cyproheptadine hydrochloride	1.09
Prestw-104	02C05	Famotidine	1.16
Prestw-105	02C06	Danazol	1.07
Prestw-106	02C07	Nicorandil	1.14
Prestw-1314	02C08	Pioglitazone	1.16
Prestw-108	02C09	Nomifensine maleate	1.04
Prestw-109	02C10	Dizocilpine maleate	1.04

Prestw-1192	02C11	Oxandrolone	1.16
Prestw-111	02D02	Naloxone hydrochloride	1.08
Prestw-112	02D03	Metolazone	1.01
Prestw-113	02D04	Ciprofloxacin hydrochloride	1.02
Prestw-114	02D05	Ampicillin trihydrate	1.06
Prestw-115	02D06	Haloperidol	1.06
Prestw-116	02D07	Naltrexone hydrochloride dihydrate	1.06
Prestw-117	02D08	Chlorpheniramine maleate	1.00
Prestw-118	02D09	Nalbuphine hydrochloride	1.05
Prestw-119	02D10	Picotamide monohydrate	1.13
Prestw-120	02D11	Triamcinolone	1.14
Prestw-121	02E02	Bromocryptine mesylate	1.24
Prestw-1471	02E03	Amfepramone hydrochloride	1.08
Prestw-123	02E04	Dehydrocholic acid	1.15
Prestw-1184	02E05	Tioconazole	0.98
Prestw-125	02E06	Perphenazine	0.45
Prestw-126	02E07	Mefloquine hydrochloride	1.03
Prestw-127	02E08	Isoconazole	1.04
Prestw-128	02E09	Spironolactone	1.11
Prestw-129	02E10	Pirenzepine dihydrochloride	1.09
Prestw-130	02E11	Dexamethasone acetate	1.13
Prestw-131	02F02	Glipizide	1.07
Prestw-132	02F03	Loxapine succinate	0.90
Prestw-133	02F04	Hydroxyzine dihydrochloride	0.80
Prestw-134	02F05	Diltiazem hydrochloride	1.03
Prestw-135	02F06	Methotrexate	1.10
Prestw-136	02F07	Astemizole	0.77
Prestw-137	02F08	Clindamycin hydrochloride	1.08
Prestw-138	02F09	Terfenadine	0.86
Prestw-139	02F10	Cefotaxime sodium salt	1.11
Prestw-140	02F11	Tetracycline hydrochloride	1.14
Prestw-141	02G02	Verapamil hydrochloride	0.99
Prestw-142	02G03	Dipyridamole	1.03
Prestw-143	02G04	Chlorhexidine	0.41
Prestw-144	02G05	Loperamide hydrochloride	0.83
Prestw-145	02G06	Chlortetracycline hydrochloride	1.03
Prestw-146	02G07	Tamoxifen citrate	1.00
Prestw-147	02G08	Nicergoline	1.03
Prestw-148	02G09	Canrenoic acid potassium salt	1.01
Prestw-149	02G10	Thioproperazine dimesylate	0.77

Prestw-150	02G11	Dihydroergotamine tartrate	0.82
Prestw-151	02H02	Erythromycin	0.95
Prestw-1474	02H03	Chloroxine	0.97
Prestw-153	02H04	Didanosine	0.97
Prestw-154	02H05	Josamycin	0.97
Prestw-155	02H06	Paclitaxel	0.94
Prestw-156	02H07	Ivermectin	1.05
Prestw-157	02H08	Gallamine triethiodide	0.95
Prestw-158	02H09	Neomycin sulfate	1.02
Prestw-159	02H10	Dihydrostreptomycin sulfate	1.01
Prestw-160	02H11	Gentamicine sulfate	1.06
Plate 3			
Prestw-161	03A02	Isoniazid	1.10
Prestw-162	03A03	Pentylenetetrazole	1.14
Prestw-163	03A04	Chlorzoxazone	1.09
Prestw-164	03A05	Ornidazole	1.17
Prestw-165	03A06	Ethosuximide	1.08
Prestw-166	03A07	Mafenide hydrochloride	1.22
Prestw-167	03A08	Riluzole hydrochloride	0.94
Prestw-168	03A09	Nitrofurantoin	1.11
Prestw-169	03A10	Hydralazine hydrochloride	1.14
Prestw-170	03A11	Phenelzine sulfate	1.26
Prestw-171	03B02	Tranexamic acid	1.04
Prestw-172	03B03	Etofylline	1.18
Prestw-173	03B04	Tranylcypromine hydrochloride	1.07
Prestw-174	03B05	Alverine citrate salt	1.10
Prestw-175	03B06	Aceclofenac	1.07
Prestw-176	03B07	Iproniazide phosphate	1.14
Prestw-177	03B08	Sulfamethoxazole	1.02
Prestw-178	03B09	Mephenesin	1.07
Prestw-179	03B10	Phenformin hydrochloride	1.12
Prestw-180	03B11	Flutamide	0.96
Prestw-181	03C02	Ampyrone	1.05
Prestw-182	03C03	Levamisole hydrochloride	0.94
Prestw-183	03C04	Pargyline hydrochloride	1.03
Prestw-184	03C05	Methocarbamol	1.08
Prestw-185	03C06	Aztreonam	1.06
Prestw-186	03C07	Cloxacillin sodium salt	1.02
Prestw-187	03C08	Catharanthine	1.06
Prestw-188	03C09	Pentolinium bitartrate	1.02
Prestw-189	03C10	Aminopurine, 6-benzyl	0.85
Prestw-190	03C11	Tolbutamide	0.84

Prestw-191	03D02	Midodrine hydrochloride	0.96
Prestw-192	03D03	Thalidomide	0.94
Prestw-193	03D04	Oxolinic acid	0.98
Prestw-194	03D05	Nimesulide	1.06
Prestw-195	03D06	Hydrastinine hydrochloride	0.98
Prestw-196	03D07	Pentoxifylline	0.97
Prestw-197	03D08	Metaraminol bitartrate	0.99
Prestw-198	03D09	Salbutamol	1.11
Prestw-199	03D10	Prilocaine hydrochloride	0.99
Prestw-200	03D11	Camptothecine (S,+)	0.87
Prestw-201	03E02	Ranitidine hydrochloride	1.11
Prestw-202	03E03	Tiratricol, 3,3',5-triiodothyroacetic acid	1.06
Prestw-203	03E04	Flufenamic acid	1.05
Prestw-204	03E05	Flumequine	1.09
Prestw-205	03E06	Tolfenamic acid	1.10
Prestw-206	03E07	Meclofenamic acid sodium salt monohydrate	1.06
Prestw-1181	03E08	Tibolone	1.02
Prestw-208	03E09	Trimethoprim	1.03
Prestw-209	03E10	Metoclopramide monohydrochloride	1.03
Prestw-210	03E11	Fenbendazole	0.90
Prestw-211	03F02	Piroxicam	0.94
Prestw-212	03F03	Pyrantel tartrate	0.93
Prestw-213	03F04	Fenspiride hydrochloride	0.97
Prestw-214	03F05	Gemfibrozil	0.95
Prestw-215	03F06	Mefexamide hydrochloride	0.97
Prestw-216	03F07	Tiapride hydrochloride	1.05
Prestw-217	03F08	Mebendazole	1.03
Prestw-218	03F09	Fenbufen	1.03
Prestw-219	03F10	Ketoprofen	0.96
Prestw-220	03F11	Indapamide	1.01
Prestw-221	03G02	Norfloxacin	1.01
Prestw-222	03G03	Antimycin A	1.15
Prestw-223	03G04	Xylometazoline hydrochloride	1.00
Prestw-224	03G05	Oxymetazoline hydrochloride	1.02
Prestw-225	03G06	Nifenazone	0.95
Prestw-226	03G07	Griseofulvin	0.95
Prestw-227	03G08	Clemizole hydrochloride	1.02
Prestw-228	03G09	Tropicamide	0.83
Prestw-229	03G10	Nefopam hydrochloride	0.70
Prestw-230	03G11	Phentolamine hydrochloride	0.75

Prestw-231	03H02	Etodolac	1.07
Prestw-232	03H03	Scopolamin-N-oxide hydrobromide	0.97
Prestw-233	03H04	Hyoscyamine (L)	1.01
Prestw-234	03H05	Chlorphensin carbamate	0.99
Prestw-235	03H06	Metampicillin sodium salt	0.94
Prestw-236	03H07	Dilazep dihydrochloride	1.01
Prestw-237	03H08	Ofloxacin	1.05
Prestw-238	03H09	Lomefloxacin hydrochloride	1.03
Prestw-239	03H10	Orphenadrine hydrochloride	0.91
Prestw-240	03H11	Proglumide	1.08
Plate 4			
Prestw-241	04A02	Mexiletine hydrochloride	1.20
Prestw-242	04A03	Flavoxate hydrochloride	1.16
Prestw-243	04A04	Bufexamac	1.09
Prestw-244	04A05	Glutethimide, para-amino	1.22
Prestw-245	04A06	Dropropizine (R,S)	1.21
Prestw-246	04A07	Pinacidil	1.03
Prestw-247	04A08	Albendazole	1.02
Prestw-248	04A09	Clonidine hydrochloride	1.20
Prestw-249	04A10	Bupropion hydrochloride	1.29
Prestw-250	04A11	Alprenolol hydrochloride	1.18
Prestw-251	04B02	Chlorothiazide	0.95
Prestw-252	04B03	Diphenidol hydrochloride	1.10
Prestw-253	04B04	Norethindrone	1.13
Prestw-254	04B05	Nortriptyline hydrochloride	0.99
Prestw-255	04B06	Niflumic acid	1.17
Prestw-256	04B07	Isotretinoin	1.23
Prestw-257	04B08	Retinoic acid	1.24
Prestw-258	04B09	Antazoline hydrochloride	1.11
Prestw-259	04B10	Ethacrynic acid	1.20
Prestw-260	04B11	Praziquantel	1.10
Prestw-261	04C02	Ethisterone	1.04
Prestw-262	04C03	Triprolidine hydrochloride	1.12
Prestw-263	04C04	Doxepin hydrochloride	0.86
Prestw-264	04C05	Dyclonine hydrochloride	1.01
Prestw-265	04C06	Dimenhydrinate	1.09
Prestw-266	04C07	Disopyramide	1.14
Prestw-267	04C08	Clotrimazole	1.06
Prestw-268	04C09	Vinpocetine	1.25
Prestw-269	04C10	Clomipramine hydrochloride	0.97
Prestw-270	04C11	Fendiline hydrochloride	0.91
Prestw-271	04D02	Vincamine	1.12
Prestw-272	04D03	Indomethacin	1.02

Prestw-273	04D04	Cortisone	1.11
Prestw-274	04D05	Prednisolone	1.16
Prestw-275	04D06	Fenofibrate	1.12
Prestw-276	04D07	Bumetanide	1.25
Prestw-277	04D08	Labetalol hydrochloride	1.09
Prestw-278	04D09	Cinnarizine	1.18
Prestw-279	04D10	Methylprednisolone, 6-alpha	1.26
Prestw-280	04D11	Quinidine hydrochloride monohydrate	1.14
Prestw-281	04E02	Fludrocortisone acetate	1.11
Prestw-282	04E03	Fenoterol hydrobromide	1.15
Prestw-283	04E04	Homochlorcyclizine dihydrochloride	0.81
Prestw-284	04E05	Diethylcarbamazine citrate	1.19
Prestw-285	04E06	Chenodiol	1.13
Prestw-286	04E07	Perhexiline maleate	0.80
Prestw-287	04E08	Oxybutynin chloride	1.06
Prestw-288	04E09	Spiperone	1.14
Prestw-289	04E10	Pyrilamine maleate	1.13
Prestw-290	04E11	Sulfinpyrazone	1.09
Prestw-291	04F02	Dantrolene sodium salt	0.97
Prestw-292	04F03	Trazodone hydrochloride	0.96
Prestw-293	04F04	Glafenine hydrochloride	1.09
Prestw-294	04F05	Pimethixene maleate	0.81
Prestw-295	04F06	Pergolide mesylate	1.26
Prestw-296	04F07	Acemetacin	1.05
Prestw-297	04F08	Benzydamine hydrochloride	0.99
Prestw-298	04F09	Fipexide hydrochloride	1.17
Prestw-299	04F10	Mifepristone	1.17
Prestw-300	04F11	Diperodon hydrochloride	1.01
Prestw-301	04G02	Lisinopril	0.96
Prestw-302	04G03	Lincomycin hydrochloride	1.04
Prestw-303	04G04	Telenzepine dihydrochloride	1.06
Prestw-304	04G05	Econazole nitrate	1.21
Prestw-305	04G06	Bupivacaine hydrochloride	1.26
Prestw-306	04G07	Clemastine fumarate	0.86
Prestw-307	04G08	Oxytetracycline dihydrate	1.29
Prestw-308	04G09	Pimozide	1.16
Prestw-309	04G10	Amodiaquin dihydrochloride dihydrate	0.72
Prestw-310	04G11	Mebeverine hydrochloride	1.19
Prestw-311	04H02	Ifenprodil tartrate	0.98
Prestw-312	04H03	Flunarizine dihydrochloride	1.17
Prestw-313	04H04	Trifluoperazine dihydrochloride	0.78
Prestw-314	04H05	Enalapril maleate	1.05
Prestw-315	04H06	Minocycline hydrochloride	1.04

Prestw-316	04H07	Glibenclamide	1.19
Prestw-317	04H08	Guanethidine sulfate	1.07
Prestw-318	04H09	Quinacrine dihydrochloride dihydrate	0.47
Prestw-319	04H10	Clofilium tosylate	1.08
Prestw-320	04H11	Fluphenazine dihydrochloride	0.76
Plate 5[a]			
Prestw-321	05A02	Streptomycin sulfate	1.09
Prestw-322	05A03	Alfuzosin hydrochloride	1.14
Prestw-323	05A04	Chlorpropamide[a]	1.09
Prestw-324	05A05	Phenylpropanolamine hydrochloride	1.08
Prestw-325	05A06	Ascorbic acid	1.10
Prestw-326	05A07	Methyldopa (L,-)	1.12
Prestw-327	05A08	Cefoperazone dihydrate	1.09
Prestw-328	05A09	Zoxazolamine	1.17
Prestw-329	05A10	Tacrine hydrochloride hydrate	1.07
Prestw-330	05A11	Bisoprolol fumarate	1.27
Prestw-331	05B02	Tremorine dihydrochloride	0.79
Prestw-332	05B03	Practolol	0.93
Prestw-333	05B04	Zidovudine, AZT	0.93
Prestw-334	05B05	Sulfisoxazole	0.97
Prestw-335	05B06	Zaprinast	1.02
Prestw-336	05B07	Chlormezanone	0.91
Prestw-337	05B08	Procainamide hydrochloride	0.98
Prestw-338	05B09	N6-methyladenosine	1.00
Prestw-339	05B10	Guanfacine hydrochloride	1.05
Prestw-340	05B11	Domperidone	0.62
Prestw-341	05C02	Furosemide	0.93
Prestw-342	05C03	Methapyrilene hydrochloride	0.96
Prestw-343	05C04	Desipramine hydrochloride	0.65
Prestw-344	05C05	Clorgyline hydrochloride	0.98
Prestw-345	05C06	Clenbuterol hydrochloride	0.94
Prestw-346	05C07	Maprotiline hydrochloride	0.78
Prestw-347	05C08	Thioguanosine	1.04
Prestw-348	05C09	Chlorprothixene hydrochloride	0.88
Prestw-349	05C10	Ritodrine hydrochloride	1.03
Prestw-350	05C11	Clozapine	0.73
Prestw-351	05D02	Chlorthalidone	0.88
Prestw-352	05D03	Dobutamine hydrochloride	0.91
Prestw-353	05D04	Moclobemide	1.00
Prestw-354	05D05	Clopamide	0.94
Prestw-355	05D06	Hycanthone	0.74
Prestw-356	05D07	Adenosine 5'-monophosphate monohydrate	1.12

Prestw-357	05D08	Amoxicillin	1.22
Prestw-358	05D09	Cephalexin monohydrate	1.17
Prestw-359	05D10	Dextromethorphan hydrobromide monohydrate	1.01
Prestw-360	05D11	Droperidol	0.95
Prestw-361	05E02	Bambuterol hydrochloride	0.88
Prestw-362	05E03	Betamethasone	1.09
Prestw-363	05E04	Colchicine	0.38
Prestw-364	05E05	Metergoline	0.94
Prestw-365	05E06	Brinzolamide	0.98
Prestw-366	05E07	Ambroxol hydrochloride	1.13
Prestw-367	05E08	Benfluorex hydrochloride	1.09
Prestw-368	05E09	Bepridil hydrochloride	0.99
Prestw-369	05E10	Meloxicam	0.98
Prestw-370	05E11	Benzbromarone	0.94
Prestw-371	05F02	Ketotifen fumarate	0.78
Prestw-372	05F03	Debrisoquin sulfate	0.99
Prestw-373	05F04	Amethopterin (R,S)	1.07
Prestw-374	05F05	Methylergometrine maleate	0.99
Prestw-375	05F06	Methiothepin maleate	0.63
Prestw-376	05F07	Clofazimine	0.98
Prestw-377	05F08	Nafronyl oxalate	1.14
Prestw-378	05F09	Bezafibrate	1.12
Prestw-1152	05F10	Nefazodone HCl	1.04
Prestw-380	05F11	Clebopride maleate	0.80
Prestw-381	05G02	Lidoflazine	0.53
Prestw-382	05G03	Betaxolol hydrochloride	0.96
Prestw-383	05G04	Nicardipine hydrochloride	0.45
Prestw-384	05G05	Probucol	1.02
Prestw-385	05G06	Mitoxantrone dihydrochloride	0.87
Prestw-386	05G07	GBR 12909 dihydrochloride	0.96
Prestw-387	05G08	Carbetapentane citrate	1.05
Prestw-388	05G09	Dequalinium dichloride	0.69
Prestw-389	05G10	Ketoconazole	0.85
Prestw-390	05G11	Fusidic acid sodium salt	0.76
Prestw-391	05H02	Terbutaline hemisulfate	1.01
Prestw-392	05H03	Ketanserin tartrate hydrate	1.02
Prestw-393	05H04	Hemicholinium bromide	0.99
Prestw-394	05H05	Kanamycin A sulfate	1.05
Prestw-395	05H06	Amikacin hydrate	0.98
Prestw-396	05H07	Etoposide	1.04
Prestw-397	05H08	Clomiphene citrate (Z,E)	0.88

Prestw-398	05H09	Oxantel pamoate	1.03
Prestw-399	05H10	Prochlorperazine dimaleate	0.81
Prestw-400	05H11	Hesperidin	1.22
Plate 6			
Prestw-401	06A02	Testosterone propionate	1.14
Prestw-402	06A03	Arecoline hydrobromide	1.12
Prestw-403	06A04	Thyroxine (L)	0.87
Prestw-1288	06A05	Idebenone	0.88
Prestw-405	06A06	Pepstatin A	1.01
Prestw-406	06A07	SR-95639A	1.06
Prestw-407	06A08	Adamantamine fumarate	1.20
Prestw-408	06A09	Butoconazole nitrate	1.38
Prestw-409	06A10	Amiodarone hydrochloride	1.34
Prestw-410	06A11	Amphotericin B	1.50
Prestw-411	06B02	Androsterone	1.03
Prestw-1489	06B03	Amifostine	1.09
Prestw-413	06B04	Carbarsone	0.95
Prestw-1219	06B05	Amlodipine	0.72
Prestw-1147	06B06	Modafinil	0.99
Prestw-416	06B07	Bacampicillin hydrochloride	1.12
Prestw-1298	06B08	Lamivudine	1.00
Prestw-418	06B09	Biotin	1.27
Prestw-419	06B10	Bisacodyl	1.28
Prestw-1242	06B11	Erlotinib	1.25
Prestw-421	06C02	Suloctidil	1.03
Prestw-1368	06C03	Zotepine	0.82
Prestw-423	06C04	Carisoprodol	1.02
Prestw-424	06C05	Cephalosporanic acid, 7-amino	1.07
Prestw-425	06C06	Chicago sky blue 6B	1.01
Prestw-426	06C07	Buflomedil hydrochloride	1.13
Prestw-1393	06C08	Dibenzepine hydrochloride	1.09
Prestw-428	06C09	Roxatidine Acetate HCl	1.26
Prestw-429	06C10	Cholecalciferol	1.29
Prestw-430	06C11	Cisapride	1.13
Prestw-1303	06D02	Pefloxacine	1.05

Prestw-432	06D03	Corticosterone	1.18
Prestw-433	06D04	Cyanocobalamin	1.10
Prestw-434	06D05	Cefadroxil	1.11
Prestw-435	06D06	Cyclosporin A	0.45
Prestw-436	06D07	Digitoxigenin	0.78
Prestw-437	06D08	Digoxin	0.85
Prestw-438	06D09	Doxorubicin hydrochloride	1.06
Prestw-439	06D10	Carbimazole	1.22
Prestw-440	06D11	Epiandrosterone	1.23
Prestw-441	06E02	Estradiol-17 beta	1.04
Prestw-1380	06E03	Clobutinol hydrochloride	1.22
Prestw-443	06E04	Gabazine	1.15
Prestw-1156	06E05	Oxcarbazepine	1.14
Prestw-445	06E06	Cyclobenzaprine hydrochloride	0.87
Prestw-446	06E07	Carteolol hydrochloride	1.11
Prestw-447	06E08	Hydrocortisone base	1.22
Prestw-448	06E09	Hydroxytacrine maleate (R,S)	1.31
Prestw-449	06E10	Pilocarpine nitrate	1.33
Prestw-450	06E11	Dicloxacillin sodium salt	1.18
Prestw-451	06F02	Alizapride HCl	1.20
Prestw-1161	06F03	Stanozolol	1.16
Prestw-1257	06F04	Calcipotriene	1.31
Prestw-1429	06F05	Linezolid	1.11
Prestw-455	06F06	Mebhydroline 1,5-naphtalenedisulfonate	1.12
Prestw-456	06F07	Meclocycline sulfosalicylate	1.06
Prestw-457	06F08	Meclozine dihydrochloride	1.19
Prestw-458	06F09	Melatonin	1.25
Prestw-1251	06F10	Butalbital	1.43
Prestw-460	06F11	Dinoprost trometamol	1.12
Prestw-461	06G02	Tropisetron HCl	1.11
Prestw-462	06G03	Cefixime	1.13
Prestw-463	06G04	Metrizamide	1.27
Prestw-1323	06G05	Quetiapine	1.04
Prestw-1464	06G06	Tosufloxacin hydrochloride	1.13

Prestw-1400	06G07	Efavirenz	1.01
Prestw-1157	06G08	Rifapentine	1.13
Prestw-468	06G09	Neostigmine bromide	1.33
Prestw-469	06G10	Niridazole	1.19
Prestw-470	06G11	Ceforanide	1.12
Prestw-1358	06H02	Vatalanib	0.99
Prestw-1295	06H03	Itopride	1.03
Prestw-473	06H04	Cefotetan	1.01
Prestw-1254	06H05	Fentiazac	1.08
Prestw-475	06H06	Brompheniramine maleate	0.94
Prestw-476	06H07	Primaquine diphosphate	0.95
Prestw-477	06H08	Progesterone	1.02
Prestw-478	06H09	Felodipine	1.27
Prestw-1325	06H10	Raclopride	1.23
Prestw-1385	06H11	Closantel	1.41
Plate 7[a]			
Prestw-481	07A02	Serotonin hydrochloride	1.33
Prestw-482	07A03	Cefotiam hydrochloride	1.05
Prestw-1336	07A04	Rofecoxib	1.17
Prestw-484	07A05	Benperidol	1.37
Prestw-485	07A06	Cefaclor	1.20
Prestw-486	07A07	Colistin sulfate salt	2.02
Prestw-487	07A08	Daunorubicin hydrochloride	1.02
Prestw-488	07A09	Dosulepin hydrochloride	1.09
Prestw-489	07A10	Ceftazidime pentahydrate	1.44
Prestw-490	07A11	Iobenguane sulfate	1.76
Prestw-491	07B02	Metixene hydrochloride	0.62
Prestw-492	07B03	Nitrofural	1.29
Prestw-493	07B04	Omeprazole	1.19
Prestw-494	07B05	Propylthiouracil	1.08
Prestw-495	07B06	Terconazole	0.63
Prestw-496	07B07	Tiaprofenic acid	0.98
Prestw-497	07B08	Vancomycin hydrochloride	1.18
Prestw-498	07B09	Artemisinin	1.32
Prestw-499	07B10	Propafenone hydrochloride	1.51
Prestw-500	07B11	Ethamivan	1.81

Prestw-501	07C02	Vigabatrin	1.46
Prestw-502	07C03	Biperiden hydrochloride	1.42
Prestw-503	07C04	Cetirizine dihydrochloride	1.45
Prestw-504	07C05	Etifenin	1.18
Prestw-505	07C06	Metaproterenol sulfate, orciprenaline sulfate	1.35
Prestw-506	07C07	Sisomicin sulfate	1.09
Prestw-1159	07C08	Sibutramine HCl	1.09
Prestw-508	07C09	Resveratrol	0.91
Prestw-509	07C10	Bromperidol	1.10
Prestw-510	07C11	Cyclizine hydrochloride	1.17
Prestw-511	07D02	Fluoxetine hydrochloride	1.27
Prestw-512	07D03	Iohexol	1.45
Prestw-513	07D04	Norcyclobenzaprine	1.02
Prestw-514	07D05	Pyrazinamide	1.13
Prestw-515	07D06	Trimethadione	1.24
Prestw-516	07D07	Lovastatin	1.21
Prestw-517	07D08	Nystatine	1.08
Prestw-518	07D09	Budesonide	1.56
Prestw-519	07D10	Imipenem	1.37
Prestw-520	07D11	Sulfasalazine	0.90
Prestw-1430	07E02	Lofexidine	1.31
Prestw-522	07E03	Thiostrepton	1.40
Prestw-1169	07E04	Miglitol	1.61
Prestw-524	07E05	Tiabendazole	1.08
Prestw-525	07E06	Rifampicin	1.19
Prestw-526	07E07	Ethionamide	0.86
Prestw-527	07E08	Tenoxicam	1.17
Prestw-528	07E09	Triflusal	1.54
Prestw-529	07E10	Mesoridazine besylate	1.23
Prestw-530	07E11	Trolox	1.32
Prestw-531	07F02	Pirenperone	1.54
Prestw-532	07F03	Isoquinoline, 6,7-dimethoxy-1-methyl-1,2,3,4-tetrahydro, hydrochloride	1.34
Prestw-533	07F04	Phenacetin	1.45
Prestw-534	07F05	Atovaquone	1.53
Prestw-535	07F06	Methoxamine hydrochloride	1.29
Prestw-953	07F07	(S)-(-)-Atenolol	1.34
Prestw-537	07F08	Piracetam	1.41
Prestw-538	07F09	Phenindione	1.50

Prestw-539	07F10	Thiocolchicoside	1.42
Prestw-540	07F11	Clorsulon	1.44
Prestw-541	07G02	Ciclopirox ethanolamine	1.23
Prestw-542	07G03	Probenecid	1.28
Prestw-543	07G04	Betahistine mesylate	1.37
Prestw-544	07G05	Tobramycin	1.25
Prestw-545	07G06	Tetramisole hydrochloride	1.16
Prestw-546	07G07	Pregnenolone	1.06
Prestw-547	07G08	Molsidomine	1.32
Prestw-548	07G09	Chloroquine diphosphate	1.20
Prestw-549	07G10	Trimetazidine dihydrochloride	1.49
Prestw-550	07G11	Parthenolide	0.93
Prestw-551	07H02	Hexetidine	1.27
Prestw-552	07H03	Selegiline hydrochloride	1.22
Prestw-553	07H04	Pentamidine isethionate	1.28
Prestw-554	07H05	Tolazamide	1.19
Prestw-555	07H06	Nifuroxazide	1.11
Prestw-1144	07H07	Mirtazapine	1.00
Prestw-557	07H08	Dirithromycin	1.03
Prestw-558	07H09	Gliclazide	1.30
Prestw-559	07H10	DO 897/99	1.28
Prestw-560	07H11	Prenylamine lactate	1.13
Plate 8			
Prestw-1188	08A02	Ziprasidone Hydrochloride	0.98
Prestw-1441	08A03	Mevastatin	0.92
Prestw-1322	08A04	Pyridostigmine iodid	1.06
Prestw-1491	08A05	Pentobarbital	1.23
Prestw-565	08A06	Atropine sulfate monohydrate	1.32
Prestw-566	08A07	Eserine sulfate, physostigmine sulfate	1.02
Prestw-1139	08A08	Itraconazole	0.99
Prestw-1174	08A09	Acarbose	1.48
Prestw-1403	08A10	Entacapone	1.44
Prestw-1449	08A11	Nicotinamide	1.85
Prestw-571	08B02	Tetracaïne hydrochloride	1.22

Prestw-572	08B03	Mometasone furoate	1.17
Prestw-1467	08B04	Troglitazone	1.13
Prestw-574	08B05	Dacarbazine	1.12
Prestw-1351	08B06	Tenatoprazole	1.15
Prestw-576	08B07	Acetopromazine maleate salt	0.84
Prestw-1271	08B08	Escitalopram	0.89
Prestw-1158	08B09	Ropinirole HCl	1.28
Prestw-1297	08B10	Lacidipine	1.22
Prestw-1228	08B11	Argatroban	1.46
Prestw-1328	08C02	Reboxetine mesylate	1.07
Prestw-582	08C03	Lobelanidine hydrochloride	1.26
Prestw-583	08C04	Papaverine hydrochloride	1.11
Prestw-584	08C05	Yohimbine hydrochloride	1.14
Prestw-585	08C06	Lobeline alpha (-) hydrochoride	1.02
Prestw-1211	08C07	Alfacalcidol	1.09
Prestw-587	08C08	Cilostazol	0.99
Prestw-588	08C09	Galanthamine hydrobromide	1.13
Prestw-1130	08C10	Azelastine HCl	1.04
Prestw-1409	08C11	Etretinate	1.34
Prestw-1274	08D02	Emedastine	1.28
Prestw-1407	08D03	Etofenamate	1.28
Prestw-1369	08D04	Zaleplon	1.24
Prestw-594	08D05	Diclofenac sodium	1.17
Prestw-1410	08D06	Exemestane	1.09
Prestw-596	08D07	Convolamine hydrochloride	0.97
Prestw-1183	08D08	Temozolomide	1.10
Prestw-598	08D09	Xylazine	1.22
Prestw-1132	08D10	Celiprolol HCl	1.11

Prestw-1367	08D11	Zopiclone	1.18
Prestw-1198	08E02	Tranilast	1.16
Prestw-1182	08E03	Tizanidine HCl	1.42
Prestw-1364	08E04	Zafirlukast	1.54
Prestw-1252	08E05	Butenafine	1.14
Prestw-1121	08E06	Carbadox	1.09
Prestw-1331	08E07	Rimantadine	0.98
Prestw-607	08E08	Eburnamonine (-)	1.22
Prestw-1460	08E09	Oxibendazol	1.23
Prestw-1292	08E10	Ipsapirone	1.29
Prestw-610	08E11	Harmaline hydrochloride dihydrate	1.11
Prestw-611	08F02	Harmalol hydrochloride dihydrate	1.23
Prestw-612	08F03	Harmol hydrochloride monohydrate	1.30
Prestw-613	08F04	Harmine hydrochloride	1.10
Prestw-1177	08F05	Carbidopa	1.08
Prestw-615	08F06	Chrysene-1,4-quinone	1.06
Prestw-616	08F07	Demecarium bromide	1.07
Prestw-617	08F08	Quipazine dimaleate salt	1.14
Prestw-1127	08F09	Acipimox	1.17
Prestw-619	08F10	Diflorasone Diacetate	1.40
Prestw-620	08F11	Harmane hydrochloride	1.22
Prestw-621	08G02	Methoxy-6-harmalan	1.05
Prestw-1217	08G03	Amisulpride	1.19
Prestw-623	08G04	Pyridoxine hydrochloride	1.23
Prestw-1469	08G05	Mercaptopurine	1.03
Prestw-1134	08G06	Cytarabine	0.90
Prestw-626	08G07	Racecadotril	1.08
Prestw-627	08G08	Folic acid	1.01
Prestw-1129	08G09	Benazepril HCl	1.40

Prestw-1178	08G10	Aniracetam	1.27
Prestw-630	08G11	Dimethisoquin hydrochloride	1.45
Prestw-1210	08H02	Alendronate sodium	1.03
Prestw-632	08H03	Dipivefrin hydrochloride	1.00
Prestw-633	08H04	Thiorphan	1.07
Prestw-1463	08H05	Tomoxetine hydrochloride	0.83
Prestw-1299	08H06	Lapatinib ditosylate	1.08
Prestw-1488	08H07	Penciclovir	1.12
Prestw-1427	08H08	Levetiracetam	1.02
Prestw-1392	08H09	Dexfenfluramine hydrochloride	1.27
Prestw-1408	08H10	Etoricoxib	1.19
Prestw-1341	08H11	Sertindole	0.67
Plate 9			
Prestw-641	09A02	Sulmazole	1.07
Prestw-1270	09A03	Gefitinib	0.96
Prestw-643	09A04	Flunisolide	0.99
Prestw-644	09A05	N-Acetyl-DL-homocysteine Thiolactone	1.00
Prestw-645	09A06	Flurandrenolide	1.14
Prestw-1125	09A07	Oxiconazole Nitrate	0.87
Prestw-1166	09A08	Rebamipide	1.02
Prestw-1154	09A09	Nilvadipine	1.21
Prestw-649	09A10	Etanidazole	1.24
Prestw-650	09A11	Butirosin disulfate salt	1.60
Prestw-651	09B02	Glimepiride	0.94
Prestw-652	09B03	Picrotoxinin	0.99
Prestw-653	09B04	Mepenzolate bromide	1.09
Prestw-654	09B05	Benfotiamine	1.00
Prestw-655	09B06	Halcinonide	1.05
Prestw-656	09B07	Lanatoside C	0.71
Prestw-657	09B08	Benzamil hydrochloride	0.78
Prestw-658	09B09	Suxibuzone	1.20

Prestw-659	09B10	6-Furfurylaminopurine	1.10
Prestw-660	09B11	Avermectin B1a	1.16
Prestw-1317	09C02	Pranlukast	0.97
Prestw-1477	09C03	Penicillamine	1.12
Prestw-1365	09C04	Zileuton	0.98
Prestw-1432	09C05	Loratadine	0.96
Prestw-1201	09C06	Clindamycin Phosphate	1.06
Prestw-666	09C07	Nisoldipine	0.84
Prestw-667	09C08	Foliosidine	0.83
Prestw-1165	09C09	Acitretin	1.08
Prestw-1162	09C10	Zonisamide	1.27
Prestw-1173	09C11	Irsogladine Maleate	1.06
Prestw-671	09D02	Dydrogesterone	1.19
Prestw-1346	09D03	Sumatriptan succinate	1.21
Prestw-1456	09D04	Opipramol dihydrochloride	0.86
Prestw-1447	09D05	Nalidixic acid sodium salt	1.05
Prestw-1475	09D06	Oxacillin Na	1.05
Prestw-676	09D07	Beta-Escin	0.97
Prestw-1496	09D08	Tiludronate disodium	0.90
Prestw-1349	09D09	Tazobactam	1.15
Prestw-1285	09D10	Ibandronate	1.02
Prestw-1363	09D11	Warfarin	1.16
Prestw-1318	09E02	Pranoprofen	1.14
Prestw-1340	09E03	Secnidazole	1.21
Prestw-683	09E04	Pempidine tartrate	1.33
Prestw-1381	09E05	Clodronate	1.14

Prestw-685	09E06	Nitrarine dihydrochloride	0.83
Prestw-1194	09E07	Thimerosal	0.25
Prestw-1465	09E08	Tramadol hydrochloride	0.97
Prestw-688	09E09	Estropipate	1.04
Prestw-1253	09E10	Butylscopolammonium (n-) bromide	1.08
Prestw-1494	09E11	Irinotecan Hydrochloride	1.02
Prestw-1353	09F02	Tylosin	1.09
Prestw-692	09F03	Citalopram Hydrobromide	1.12
Prestw-693	09F04	Promazine hydrochloride	0.83
Prestw-694	09F05	Sulfamerazine	1.05
Prestw-1170	09F06	Venlafaxine	0.99
Prestw-696	09F07	Ethotoin	1.03
Prestw-697	09F08	3-alpha-Hydroxy-5-beta-androstan-17-one	1.15
Prestw-698	09F09	Tetrahydrozoline hydrochloride	1.21
Prestw-699	09F10	Hexestrol	1.32
Prestw-700	09F11	Cefmetazole sodium salt	1.07
Prestw-701	09G02	Trihexyphenidyl-D,L Hydrochloride	1.06
Prestw-702	09G03	Succinylsulfathiazole	0.98
Prestw-703	09G04	Famprofazone	1.00
Prestw-704	09G05	Bromopride	0.99
Prestw-705	09G06	Methyl benzethonium chloride	1.07
Prestw-706	09G07	Chlorcyclizine hydrochloride	0.84
Prestw-707	09G08	Diphenylpyraline hydrochloride	0.90
Prestw-708	09G09	Benzethonium chloride	1.14
Prestw-709	09G10	Trioxsalen	1.14
Prestw-1136	09G11	Doxofylline	1.18
Prestw-711	09H02	Sulfabenzamide	0.91
Prestw-712	09H03	Benzocaine	0.94
Prestw-713	09H04	Dipyrone	1.00
Prestw-714	09H05	Isosorbide dinitrate	0.81
Prestw-715	09H06	Sulfachloropyridazine	0.88
Prestw-716	09H07	Pramoxine hydrochloride	1.01
Prestw-717	09H08	Finasteride	0.97
Prestw-718	09H09	Fluorometholone	1.08
Prestw-719	09H10	Cephalothin sodium salt	1.08
Prestw-720	09H11	Cefuroxime sodium salt	1.11

Plate 10			
Prestw-721	10A02	Althiazide	0.97
Prestw-722	10A03	Isopyrin hydrochloride	0.99
Prestw-723	10A04	Phenethicillin potassium salt	0.97
Prestw-724	10A05	Sulfamethoxypyridazine	0.87
Prestw-725	10A06	Deferoxamine mesylate	0.91
Prestw-726	10A07	Mephentermine hemisulfate	0.96
Prestw-1140	10A08	Liranaftate	0.99
Prestw-728	10A09	Sulfadimethoxine	0.88
Prestw-729	10A10	Sulfanilamide	0.94
Prestw-730	10A11	Balsalazide Sodium	0.95
Prestw-731	10B02	Sulfaquinoxaline sodium salt	1.00
Prestw-732	10B03	Streptozotocin	1.09
Prestw-733	10B04	Metoprolol-(+,-) (+)-tartrate salt	1.04
Prestw-734	10B05	Flumethasone	1.08
Prestw-735	10B06	Flecainide acetate	1.02
Prestw-736	10B07	Cefazolin sodium salt	1.04
Prestw-737	10B08	Atractyloside potassium salt	1.11
Prestw-738	10B09	Folinic acid calcium salt	0.99
Prestw-739	10B10	Levonordefrin	1.02
Prestw-740	10B11	Ebselen	1.15
Prestw-741	10C02	Nadide	1.11
Prestw-742	10C03	Sulfamethizole	1.09
Prestw-743	10C04	Medrysone	1.03
Prestw-744	10C05	Flunixin meglumine	1.02
Prestw-745	10C06	Spiramycin	1.08
Prestw-746	10C07	Glycopyrrolate	1.09
Prestw-747	10C08	Cefamandole sodium salt	1.02
Prestw-748	10C09	Monensin sodium salt	1.62
Prestw-749	10C10	Isoetharine mesylate salt	1.03
Prestw-750	10C11	Mevalonic-D, L acid lactone	1.08
Prestw-751	10D02	Terazosin hydrochloride	1.10
Prestw-752	10D03	Phenazopyridine hydrochloride	1.05
Prestw-753	10D04	Demeclocycline hydrochloride	1.00
Prestw-754	10D05	Fenoprofen calcium salt dihydrate	1.05
Prestw-755	10D06	Piperacillin sodium salt	1.11
Prestw-756	10D07	Diethylstilbestrol	1.01
Prestw-757	10D08	Chlorotrianisene	1.04
Prestw-758	10D09	Ribostamycin sulfate salt	0.95
Prestw-759	10D10	Methacholine chloride	0.94
Prestw-760	10D11	Pipenzolate bromide	0.96
Prestw-761	10E02	Butamben	1.08

Prestw-762	10E03	Sulfapyridine	0.98
Prestw-763	10E04	Meclofenoxate hydrochloride	1.14
Prestw-764	10E05	Furaltadone hydrochloride	0.96
Prestw-765	10E06	Ethoxyquin	0.92
Prestw-766	10E07	Tinidazole	1.06
Prestw-767	10E08	Guanadrel sulfate	0.96
Prestw-768	10E09	Vidarabine	1.01
Prestw-769	10E10	Sulfameter	0.88
Prestw-770	10E11	Isopropamide iodide	0.96
Prestw-771	10F02	Alclometasone dipropionate	1.15
Prestw-772	10F03	Leflunomide	0.94
Prestw-773	10F04	Norgestrel-(-)-D	0.96
Prestw-774	10F05	Fluocinonide	1.14
Prestw-775	10F06	Sulfamethazine sodium salt	1.06
Prestw-776	10F07	Guaifenesin	1.04
Prestw-777	10F08	Alexidine dihydrochloride	6.74
Prestw-778	10F09	Proadifen hydrochloride	0.95
Prestw-779	10F10	Zomepirac sodium salt	0.95
Prestw-780	10F11	Cinoxacin	1.02
Prestw-781	10G02	Clobetasol propionate	1.02
Prestw-782	10G03	Podophyllotoxin	0.68
Prestw-783	10G04	Clofibric acid	1.03
Prestw-784	10G05	Bendroflumethiazide	1.04
Prestw-785	10G06	Dicumarol	1.11
Prestw-786	10G07	Methimazole	0.93
Prestw-787	10G08	Merbromin	0.89
Prestw-788	10G09	Hexylcaine hydrochloride	1.00
Prestw-789	10G10	Drofenine hydrochloride	0.97
Prestw-790	10G11	Cycloheximide	0.99
Prestw-791	10H02	(R) -Naproxen sodium salt	0.93
Prestw-792	10H03	Propidium iodide	0.85
Prestw-793	10H04	Cloperastine hydrochloride	0.80
Prestw-794	10H05	Eucatropine hydrochloride	0.82
Prestw-795	10H06	Isocarboxazid	0.79
Prestw-796	10H07	Lithocholic acid	0.78
Prestw-797	10H08	Methotrimeprazine maleat salt	0.81
Prestw-798	10H09	Dienestrol	0.86
Prestw-799	10H10	Pridinol methanesulfonate salt	0.95
Prestw-800	10H11	Amrinone	0.96
Plate 11			
Prestw-801	11A02	Carbinoxamine maleate salt	1.04
Prestw-802	11A03	Methazolamide	1.00
Prestw-803	11A04	Pyrithyldione	1.12

Prestw-804	11A05	Spectinomycin dihydrochloride	0.99
Prestw-805	11A06	Piromidic acid	1.09
Prestw-806	11A07	Trimipramine maleate salt	0.95
Prestw-807	11A08	Chloropyramine hydrochloride	1.04
Prestw-808	11A09	Furazolidone	1.12
Prestw-809	11A10	Dichlorphenamide	1.26
Prestw-810	11A11	Sulconazole nitrate	1.18
Prestw-1233	11B02	Auranofin	0.49
Prestw-812	11B03	Cromolyn disodium salt	0.87
Prestw-813	11B04	Bucladesine sodium salt	0.88
Prestw-814	11B05	Cefsulodin sodium salt	0.84
Prestw-815	11B06	Fosfosal	1.10
Prestw-816	11B07	Suprofen	1.03
Prestw-817	11B08	Catechin-(+,-) hydrate	1.08
Prestw-818	11B09	Nadolol	1.19
Prestw-819	11B10	Moxalactam disodium salt	1.16
Prestw-820	11B11	Aminophylline	0.99
Prestw-821	11C02	Azlocillin sodium salt	1.07
Prestw-822	11C03	Clidinium bromide	0.96
Prestw-823	11C04	Sulfamonomethoxine	0.99
Prestw-824	11C05	Benzthiazide	1.03
Prestw-825	11C06	Trichlormethiazide	1.23
Prestw-826	11C07	Oxalamine citrate salt	1.18
Prestw-827	11C08	Propantheline bromide	1.19
Prestw-1361	11C09	Viloxazine hydrochloride	0.99
Prestw-829	11C10	Dimethadione	1.01
Prestw-830	11C11	Ethaverine hydrochloride	0.93
Prestw-831	11D02	Butacaine	0.97
Prestw-832	11D03	Cefoxitin sodium salt	0.99
Prestw-833	11D04	Ifosfamide	1.11
Prestw-834	11D05	Novobiocin sodium salt	1.09
Prestw-835	11D06	Tetrahydroxy-1,4-quinone monohydrate	1.19
Prestw-836	11D07	Indoprofen	1.26
Prestw-837	11D08	Carbenoxolone disodium salt	1.01
Prestw-838	11D09	Iocetamic acid	1.13
Prestw-839	11D10	Ganciclovir	1.20
Prestw-840	11D11	Ethopropazine hydrochloride	0.78
Prestw-1455	11E02	Olanzapine	0.88
Prestw-842	11E03	Trimeprazine tartrate	0.63

Prestw-843	11E04	Nafcillin sodium salt monohydrate	1.07
Prestw-844	11E05	Procyclidine hydrochloride	0.95
Prestw-845	11E06	Amiprilose hydrochloride	1.10
Prestw-846	11E07	Ethynylestradiol 3-methyl ether	1.05
Prestw-847	11E08	(-) -Levobunolol hydrochloride	1.06
Prestw-848	11E09	Iodixanol	1.10
Prestw-849	11E10	Rolitetracycline	0.97
Prestw-850	11E11	Equilin	0.87
Prestw-851	11F02	Paroxetine Hydrochloride	0.78
Prestw-1454	11F03	Nylidrin	0.91
Prestw-853	11F04	Liothyronine	1.07
Prestw-854	11F05	Roxithromycin	1.01
Prestw-855	11F06	Beclomethasone dipropionate	1.16
Prestw-856	11F07	Tolmetin sodium salt dihydrate	1.11
Prestw-857	11F08	(+) -Levobunolol hydrochloride	1.10
Prestw-858	11F09	Doxazosin mesylate	0.92
Prestw-859	11F10	Fluvastatin sodium salt	0.98
Prestw-860	11F11	Methylhydantoin-5-(L)	0.87
Prestw-861	11G02	Gabapentin	0.94
Prestw-862	11G03	Raloxifene hydrochloride	0.82
Prestw-863	11G04	Etidronic acid, disodium salt	0.91
Prestw-864	11G05	Methylhydantoin-5-(D)	1.04
Prestw-865	11G06	Simvastatin	0.94
Prestw-866	11G07	Azacytidine-5	0.91
Prestw-867	11G08	Paromomycin sulfate	1.10
Prestw-868	11G09	Acetaminophen	1.04
Prestw-869	11G10	Phthalylsulfathiazole	0.97
Prestw-870	11G11	Luteolin	0.96
Prestw-871	11H02	Iopamidol	1.11
Prestw-872	11H03	Iopromide	1.10
Prestw-873	11H04	Theophylline monohydrate	0.94
Prestw-874	11H05	Theobromine	0.97
Prestw-875	11H06	Reserpine	0.76
Prestw-1239	11H07	Bicalutamide	0.90
Prestw-877	11H08	Scopolamine hydrochloride	0.89
Prestw-878	11H09	Ioversol	0.96
Prestw-1495	11H10	Rabeprazole	0.93
Prestw-880	11H11	Carbachol	0.97
Plate 12			
Prestw-881	12A02	Niacin	1.17

Prestw-882	12A03	Bemegride	1.14
Prestw-883	12A04	Digoxigenin	0.86
Prestw-884	12A05	Meglumine	1.11
Prestw-885	12A06	Cantharidin	1.03
Prestw-886	12A07	Clioquinol	1.18
Prestw-887	12A08	Oxybenzone	1.14
Prestw-888	12A09	Promethazine hydrochloride	1.03
Prestw-1167	12A10	Diacerein	1.06
Prestw-1137	12A11	Esmolol hydrochloride	1.13
Prestw-1486	12B02	Cortisol acetate	0.93
Prestw-1416	12B03	Flubendazol	0.95
Prestw-893	12B04	Felbinac	0.88
Prestw-894	12B05	Butylparaben	0.86
Prestw-895	12B06	Aminohippuric acid	0.90
Prestw-896	12B07	N-Acetyl-L-leucine	0.92
Prestw-897	12B08	Pipemidic acid	0.95
Prestw-898	12B09	Dioxybenzone	0.79
Prestw-899	12B10	Adrenosterone	0.75
Prestw-900	12B11	Methylatropine nitrate	0.98
Prestw-901	12C02	Hymecromone	0.97
Prestw-902	12C03	Caffeic acid	0.94
Prestw-903	12C04	Diloxanide furoate	0.94
Prestw-904	12C05	Metyrapone	0.91
Prestw-905	12C06	Urapidil hydrochloride	0.89
Prestw-906	12C07	Fluspirilen	0.78
Prestw-907	12C08	S-(+)-ibuprofen	0.86
Prestw-908	12C09	Ethynodiol diacetate	0.82
Prestw-909	12C10	Nabumetone	0.74
Prestw-910	12C11	Nisoxetine hydrochloride	0.83
Prestw-911	12D02	(+)-Isoproterenol (+)-bitartrate salt	0.88
Prestw-912	12D03	Monobenzone	0.82
Prestw-913	12D04	2-Aminobenzenesulfonamide	1.12
Prestw-914	12D05	Estrone	1.20
Prestw-915	12D06	Lorglumide sodium salt	1.16
Prestw-916	12D07	Nitrendipine	0.67
Prestw-917	12D08	Flurbiprofen	0.87
Prestw-918	12D09	Nimodipine	0.81
Prestw-919	12D10	Bacitracin	0.93
Prestw-920	12D11	L(-)-vesamicol hydrochloride	0.86

Prestw-921	12E02	Nizatidine	0.96
Prestw-922	12E03	Thioperamide maleate	0.89
Prestw-923	12E04	Xamoterol hemifumarate	0.91
Prestw-924	12E05	Rolipram	0.97
Prestw-925	12E06	Thonzonium bromide	0.89
Prestw-926	12E07	Idazoxan hydrochloride	0.84
Prestw-927	12E08	Quinapril HCl	0.83
Prestw-928	12E09	Nilutamide	0.90
Prestw-929	12E10	Ketorolac tromethamine	0.85
Prestw-930	12E11	Protriptyline hydrochloride	0.76
Prestw-931	12F02	Propofol	0.94
Prestw-932	12F03	S(-)Eticlopride hydrochloride	0.89
Prestw-933	12F04	Primidone	0.99
Prestw-934	12F05	Flucytosine	1.04
Prestw-935	12F06	(-)-MK 801 hydrogen maleate	1.02
Prestw-936	12F07	Bephenium hydroxynaphthoate	0.86
Prestw-937	12F08	Dehydroisoandosterone 3-acetate	0.90
Prestw-938	12F09	Benserazide hydrochloride	0.84
Prestw-939	12F10	Iodipamide	0.84
Prestw-1213	12F11	Allopurinol	0.81
Prestw-941	12G02	Pentetic acid	1.00
Prestw-942	12G03	Bretylium tosylate	0.95
Prestw-943	12G04	Pralidoxime chloride	0.93
Prestw-944	12G05	Phenoxybenzamine hydrochloride	0.93
Prestw-945	12G06	Salmeterol	0.80
Prestw-946	12G07	Altretamine	0.83
Prestw-947	12G08	Prazosin hydrochloride	0.78
Prestw-948	12G09	Timolol maleate salt	0.84
Prestw-949	12G10	(+,-)-Octopamine hydrochloride	0.80
Prestw-1279	12G11	Stavudine	0.89
Prestw-951	12H02	Crotamiton	0.99
Prestw-1197	12H03	Toremifene	0.87
Prestw-536	12H04	(R)-(+)-Atenolol	1.03
Prestw-954	12H05	Tyloxapol	1.03
Prestw-955	12H06	Florfenicol	0.95
Prestw-956	12H07	Megestrol acetate	1.00
Prestw-957	12H08	Deoxycorticosterone	0.93
Prestw-958	12H09	Urosiol	0.98
Prestw-959	12H10	Proparacaine hydrochloride	1.03
Prestw-960	12H11	Aminocaproic acid	0.84

Plate 13			
Prestw-961	13A02	Denatonium benzoate	1.02
Prestw-1259	13A03	Canrenone	1.03
Prestw-963	13A04	Enilconazole	1.08
Prestw-964	13A05	Methacycline hydrochloride	1.03
Prestw-1415	13A06	Floxuridine	1.26
Prestw-966	13A07	Sotalol hydrochloride	1.26
Prestw-1267	13A08	Gestrinone	1.18
Prestw-968	13A09	Decamethonium bromide	1.26
Prestw-969	13A10	3-Acetamidocoumarin	1.26
Prestw-970	13A11	Roxarsone	1.21
Prestw-971	13B02	Remoxipride Hydrochloride	0.95
Prestw-972	13B03	THIP Hydrochloride	0.98
Prestw-973	13B04	Pirlindole mesylate	0.97
Prestw-974	13B05	Pronethalol hydrochloride	1.05
Prestw-975	13B06	Naftopidil dihydrochloride	1.06
Prestw-976	13B07	Tracazolate hydrochloride	1.04
Prestw-977	13B08	Zardaverine	1.19
Prestw-978	13B09	Memantine Hydrochloride	1.29
Prestw-979	13B10	Ozagrel hydrochloride	1.10
Prestw-980	13B11	Piribedil hydrochloride	1.20
Prestw-981	13C02	Nitrocaramiphen hydrochloride	0.97
Prestw-982	13C03	Nandrolone	1.00
Prestw-983	13C04	Dimaprit dihydrochloride	1.08
Prestw-1459	13C05	Oxfendazol	1.05
Prestw-1268	13C06	Guaiacol	1.19
Prestw-986	13C07	Proscillaridin A	0.76
Prestw-1316	13C08	Pramipexole	1.21
Prestw-1452	13C09	Norgestimate	1.09
Prestw-1374	13C10	Chlormadinone acetate	1.21
Prestw-1310	13C11	Phenylbutazone	1.25
Prestw-991	13D02	Gliquidone	1.04
Prestw-992	13D03	Pizotifen malate	0.82
Prestw-993	13D04	Ribavirin	1.10
Prestw-994	13D05	Cyclopenthiazide	1.10

Prestw-995	13D06	Fluvoxamine maleate	1.21
Prestw-1321	13D07	Prothionamide	1.06
Prestw-997	13D08	Fluticasone propionate	1.20
Prestw-998	13D09	Zuclopenthixol hydrochloride	0.60
Prestw-999	13D10	Proguanil hydrochloride	1.14
Prestw-1000	13D11	Lymecycline	1.16
Prestw-1001	13E02	Alfadolone acetate	1.36
Prestw-1002	13E03	Alfaxalone	1.11
Prestw-1003	13E04	Azapropazone	1.21
Prestw-1004	13E05	Meptazinol hydrochloride	1.17
Prestw-1005	13E06	Apramycin	1.25
Prestw-1006	13E07	Epitiostanol	1.18
Prestw-1007	13E08	Fursultiamine Hydrochloride	1.22
Prestw-1008	13E09	Gabexate mesilate	1.08
Prestw-1009	13E10	Pivampicillin	1.17
Prestw-1010	13E11	Talampicillin hydrochloride	1.26
Prestw-1011	13F02	Flucloxacillin sodium	1.16
Prestw-1012	13F03	Trapidil	1.13
Prestw-1013	13F04	Deptropine citrate	0.95
Prestw-1014	13F05	Sertraline	0.64
Prestw-1015	13F06	Ethamsylate	1.28
Prestw-1016	13F07	Moxonidine	1.28
Prestw-1017	13F08	Etilefrine hydrochloride	1.21
Prestw-1018	13F09	Alprostadil	0.86

Prestw-1019	13F10	Tribenoside	1.27
Prestw-1020	13F11	Rimexolone	1.43
Prestw-1021	13G02	Isradipine	0.56
Prestw-1022	13G03	Tiletamine hydrochloride	1.06
Prestw-1023	13G04	Isometheptene mucate	1.20
Prestw-1024	13G05	Nifurtimox	1.16
Prestw-1025	13G06	Letrozole	1.20
Prestw-1026	13G07	Arbutin	1.21
Prestw-1027	13G08	Tocainide hydrochloride	1.37
Prestw-1028	13G09	Benzathine benzylpenicillin	1.28
Prestw-1029	13G10	Risperidone	1.05
Prestw-1030	13G11	Torsemide	1.24
Prestw-1031	13H02	Halofantrine hydrochloride	0.87
Prestw-1032	13H03	Articaine hydrochloride	0.82
Prestw-1033	13H04	Nomegestrol acetate	0.87
Prestw-1034	13H05	Pancuronium bromide	0.91
Prestw-1035	13H06	Molindone hydrochloride	1.04
Prestw-1036	13H07	Alcuronium chloride	1.10
Prestw-1037	13H08	Zalcitabine	1.24
Prestw-1038	13H09	Methyldopate hydrochloride	1.27
Prestw-1039	13H10	Levocabastine hydrochloride	1.25
Prestw-1040	13H11	Pyrvinium pamoate	1.39
Plate 14			

Prestw-1041	14A02	Etomidate	0.90
Prestw-1042	14A03	Tridihexethyl chloride	0.86
Prestw-1043	14A04	Penbutolol sulfate	0.83
Prestw-1044	14A05	Prednicarbate	0.81
Prestw-1045	14A06	Sertaconazole nitrate	0.82
Prestw-1046	14A07	Repaglinide	0.95
Prestw-1047	14A08	Piretanide	0.94
Prestw-1048	14A09	Piperacetazine	0.84
Prestw-1049	14A10	Oxyphenbutazone	1.00
Prestw-1050	14A11	Quinethazone	1.24
Prestw-1051	14B02	Moricizine hydrochloride	0.93
Prestw-1052	14B03	Iopanoic acid	0.76
Prestw-1053	14B04	Pivmecillinam hydrochloride	0.87
Prestw-1054	14B05	Levopropoxyphene napsylate	0.90
Prestw-1055	14B06	Piperidolate hydrochloride	0.87
Prestw-1056	14B07	Trifluridine	0.92
Prestw-1057	14B08	Oxprenolol hydrochloride	0.92
Prestw-1058	14B09	Ondansetron Hydrochloride	0.91
Prestw-1059	14B10	Propoxycaine hydrochloride	0.90
Prestw-1060	14B11	Oxaprozin	0.94
Prestw-1061	14C02	Phensuximide	0.84
Prestw-1062	14C03	Ioxaglic acid	1.10
Prestw-1063	14C04	Naftifine hydrochloride	0.84

Prestw-1064	14C05	Meprylcaine hydrochloride	0.94
Prestw-1065	14C06	Milrinone	0.99
Prestw-1066	14C07	Methantheline bromide	0.91
Prestw-1067	14C08	Ticarcillin sodium	1.02
Prestw-1068	14C09	Thiethylperazine malate	0.57
Prestw-1069	14C10	Mesalamine	1.00
Prestw-1362	14C11	Vorinostat	1.00
Prestw-1071	14D02	Imidurea	0.96
Prestw-1072	14D03	Lansoprazole	0.90
Prestw-1073	14D04	Bethanechol chloride	0.86
Prestw-1074	14D05	Cyproterone acetate	0.95
Prestw-1075	14D06	(R)-Propranolol hydrochloride	1.08
Prestw-1076	14D07	Ciprofibrate	1.05
Prestw-1420	14D08	Formestane	0.97
Prestw-1078	14D09	Benzylpenicillin sodium	0.97
Prestw-1079	14D10	Chlorambucil	1.14
Prestw-1080	14D11	Methiazole	1.06
Prestw-1081	14E02	(S)-propranolol hydrochloride	1.06
Prestw-1082	14E03	(-)-Eseroline fumarate salt	1.02
Prestw-1294	14E04	Isosorbide mononitrate	1.03
Prestw-1084	14E05	Leucomisine	1.07
Prestw-1493	14E06	Topiramate	1.05
Prestw-1086	14E07	D-cycloserine	1.06

Prestw-1087	14E08	2-Chloropyrazine	1.07
Prestw-1088	14E09	(+,-)-Synephrine	1.11
Prestw-1089	14E10	(S)-(-)-Cycloserine	1.03
Prestw-1090	14E11	Homosalate	1.13
Prestw-1091	14F02	Spaglumic acid	1.10
Prestw-1092	14F03	Ranolazine	1.06
Prestw-1443	14F04	Misoprostol	1.18
Prestw-1094	14F05	Sulfadoxine	1.01
Prestw-1095	14F06	Cyclopentolate hydrochloride	1.10
Prestw-1096	14F07	Estriol	1.10
Prestw-1097	14F08	(-)-Isoproterenol hydrochloride	1.13
Prestw-1339	14F09	Sarafloxacin	1.13
Prestw-1099	14F10	Nialamide	1.09
Prestw-1195	14F11	Toltrazuril	1.02
Prestw-1101	14G02	Perindopril	1.08
Prestw-1102	14G03	Fexofenadine HCl	0.99
Prestw-1202	14G04	4-aminosalicylic acid	1.15
Prestw-1104	14G05	Clonixin Lysinate	1.04
Prestw-1105	14G06	Verteporfin	1.12
Prestw-1106	14G07	Meropenem	0.92
Prestw-1107	14G08	Ramipril	1.03
Prestw-1108	14G09	Mephenytoin	0.96
Prestw-1109	14G10	Rifabutin	0.84

Prestw-1110	14G11	Parbendazole	1.09
Prestw-1111	14H02	Mecamylamine hydrochloride	0.81
Prestw-1112	14H03	Procarbazine hydrochloride	0.81
Prestw-1113	14H04	Viomycin sulfate	0.85
Prestw-1114	14H05	Saquinavir mesylate	0.78
Prestw-1115	14H06	Ronidazole	0.99
Prestw-1116	14H07	Dorzolamide hydrochloride	1.14
Prestw-1117	14H08	Azaperone	1.22
Prestw-1118	14H09	Cefepime hydrochloride	1.23
Prestw-1119	14H10	Clocortolone pivalate	1.23
Prestw-1120	14H11	Nadifloxacin	1.20
Plate 15			
Prestw-1283	15A02	Buspirone hydrochloride	0.90
Prestw-1222	15A03	Anastrozole	1.09
Prestw-1399	15A04	Doxycycline hydrochloride	0.78
Prestw-1345	15A05	Sulbactam	0.85
Prestw-1414	15A06	Fleroxacin	0.87
Prestw-1315	15A07	Potassium clavulanate	1.08
Prestw-1482	15A08	Valproic acid	1.16
Prestw-1280	15A09	Mepivacaine hydrochloride	1.06
Prestw-1478	15A10	Rifaximin	1.06
Prestw-1473	15A11	Estradiol Valerate	1.16
Prestw-1206	15B02	Acetylcysteine	0.86

Prestw-1435	15B03	Melengestrol acetate	0.80
Prestw-1246	15B04	Bromhexine hydrochloride	0.73
Prestw-1223	15B05	Anethole-trithione	0.80
Prestw-1476	15B06	Amcinonide	0.72
Prestw-1256	15B07	Caffeine	0.76
Prestw-1262	15B08	Carvedilol	0.73
Prestw-1282	15B09	Methenamine	0.99
Prestw-1308	15B10	Phentermine hydrochloride	0.98
Prestw-1394	15B11	Diclazuril	0.92
Prestw-1249	15C02	Famciclovir	0.84
Prestw-1398	15C03	Dopamine hydrochloride	1.05
Prestw-1263	15C04	Cefdinir	0.78
Prestw-1261	15C05	Carprofen	0.91
Prestw-1371	15C06	Celecoxib	0.87
Prestw-1258	15C07	Candesartan	0.83
Prestw-1483	15C08	Fludarabine	0.90
Prestw-1484	15C09	Cladribine	1.12
Prestw-1356	15C10	Vardenafil	1.00
Prestw-1417	15C11	Fluconazole	0.84
Prestw-1203	15D02	5-fluorouracil	0.95
Prestw-1487	15D03	Mesna	1.06
Prestw-1444	15D04	Mitotane	0.83
Prestw-1497	15D05	Ambrisentan	0.95

Prestw-1479	15D06	Triclosan	0.91
Prestw-1401	15D07	Enoxacin	0.89
Prestw-1307	15D08	Olopatadine hydrochloride	0.85
Prestw-1187	15D09	Granisetron	1.00
Prestw-1224	15D10	Anthralin	1.07
Prestw-1492	15D11	Lamotrigine	0.76
Prestw-1383	15E02	Clofibrate	1.09
Prestw-1481	15E03	Cyclophosphamide	1.05
Prestw-1229	15E04	Aripiprazole	1.01
Prestw-1405	15E05	Ethinylestradiol	0.97
Prestw-1419	15E06	Fluocinolone acetonide	0.90
Prestw-1343	15E07	Sparfloxacin	0.90
Prestw-1390	15E08	Desloratadine	0.51
Prestw-1378	15E09	Clarithromycin	0.94
Prestw-1199	15E10	Tripelennamine hydrochloride	0.92
Prestw-1352	15E11	Tulobuterol	1.00
Prestw-1196	15F02	Topotecan	1.09
Prestw-1232	15F03	Atorvastatin	1.03
Prestw-1234	15F04	Azithromycin	0.98
Prestw-1286	15F05	Ibudilast	0.94
Prestw-1433	15F06	Losartan	0.93
Prestw-1236	15F07	Benztropine mesylate	0.61
Prestw-1359	15F08	Vecuronium bromide	0.88

Prestw-1350	15F09	Telmisartan	1.02
Prestw-1490	15F10	Nalmefene hydrochloride	0.85
Prestw-1241	15F11	Bifonazole	0.87
Prestw-1265	15G02	Gatifloxacin	0.99
Prestw-1244	15G03	Bosentan	0.93
Prestw-1266	15G04	Gemcitabine	0.84
Prestw-1190	15G05	Olmesartan	0.59
Prestw-1480	15G06	Racepinephrine HCl	0.94
Prestw-1189	15G07	Montelukast	1.02
Prestw-1180	15G08	Docetaxel	0.91
Prestw-1376	15G09	Cilnidipine	0.97
Prestw-1291	15G10	Imiquimod	1.00
Prestw-1423	15G11	Fosinopril	0.97
Prestw-1290	15H02	Imatinib	0.72
Prestw-1446	15H03	Moxifloxacin	0.70
Prestw-1421	15H04	Formoterol fumarate	0.65
Prestw-1338	15H05	Rufloxacin	0.77
Prestw-1319	15H06	Pravastatin	0.82
Prestw-1337	15H07	Rosiglitazone	0.98
Prestw-1334	15H08	Rivastigmine	0.98
Prestw-1342	15H09	Sildenafil	1.03
Prestw-1207	15H10	Acetylsalicylic acid	0.99
Prestw-1472	15H11	Hexachlorophene	0.99

Supplemental Table 2. Compounds from the Prestwick Chemical Library screening excluded from analysis. Excluded compounds with a luminescent fold-change ≥ 1.3 in the K562-NL alone condition over K562 cells treated with DMSO.

Prestw number	Plate # / Well position	Chemical name	average fold-change
Prestw-349	05C10	Ritodrine hydrochloride	1.69
Prestw-369	05E10	Meloxicam	1.50
Prestw-339	05B10	Guanfacine hydrochloride	1.44
Prestw-925	12E06	Thonzonium bromide	1.36
Prestw-143	02G04	Chlorhexidine	1.36
Prestw-1152	05F10	Nefazodone HCl	1.34
Prestw-1435	15B03	Melengestrol acetate	1.43
Prestw-705	09G06	Methyl benzethonium chloride	1.32
Prestw-1050	14A11	Quinethazone	1.32
Prestw-1399	15A04	Doxycycline hydrochloride	1.30
Prestw-777	10F08	Alexidine dihydrochloride	16.01
Prestw-1222	15A03	Anastrozole	1.36

Supplemental Table 3. Z' factor for individual assay plates from the Prestwick Chemical Library screening. Z' factor was calculated using the positive and negative control luminescent values from each plate. Z' factor for each plate represents the average Z' factor from both screening days (n=2), except for plate 5 and 7 which represent Z' factor from a single screening.

Plate #	K562-NL alone	1:1 E:T
1	0.84	0.64
2	0.67	0.52
3	0.63	0.20
4	0.75	0.43
5	0.66	0.50
6	0.64	0.56
7	0.74	0.80
8	0.73	0.28
9	0.75	0.54
10	0.81	0.55
11	0.80	0.56
12	0.79	0.68
13	0.77	0.51
14	0.74	-0.06
15	0.50	0.06
Average	0.72	0.44